BC

B1877

GUARDIAN

Glass • Automotive • Building Products

November 2, 2021

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

RECEIVED
MDEQ - JACKSON

NOV 09 2021

AIR QUALITY DIVISION

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

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

CleanAir.

CleanAir Engineering
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Pittsburgh, PA 15275
800-632-1619
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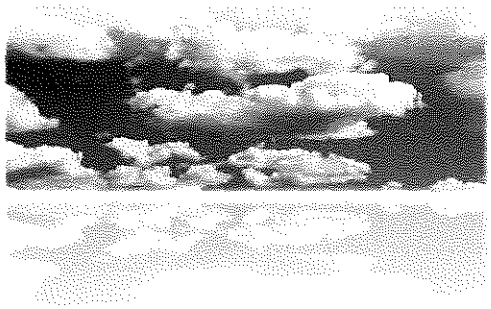

REPORT ON COMPLIANCE TESTING

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 Submitted:

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

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)
acfm (actual cubic feet per minute)
ACI (activated carbon injection)
ADL (above detection limit)
AIG (ammonia injection grid)
APC (air pollution control)
AQCS (air quality control system(s))
ASME (American Society of Mechanical Engineers)
ASTM (American Society for Testing and Materials)
BDL (below detection limit)
Btu (British thermal units)
CAM (compliance assurance monitoring)
CARB (California Air Resources Board)
CCM (Controlled Condensation Method)
CE (capture efficiency)
°C (degrees Celsius)
CEMS (continuous emissions monitoring system(s))
CFB (circulating fluidized bed)
CFR (Code of Federal Regulations)
cm (centimeter(s))
COMS (continuous opacity monitoring system(s))
CT (combustion turbine)
CTI (Cooling Technology Institute)
CTM (Conditional Test Method)
CVAAS (cold vapor atomic absorption spectroscopy)
CVAFS (cold vapor atomic fluorescence spectrometry)
DI H_2O (de-ionized water)
%dv (percent, dry volume)
DLL (detection level limited)
DE (destruction efficiency)
DCI (dry carbon injection)
DGM (dry gas meter)
dscf (dry standard cubic feet)
dscfm (dry standard cubic feet per minute)
dscm (dry standard cubic meter)
ESP (electrostatic precipitator)
FAMS (flue gas adsorbent mercury speciation)
°F (degrees Fahrenheit)
FB (field blank)
FCC (fluidized catalytic cracking)
FCCU (fluidized catalytic cracking unit)
FEGT (furnace exit gas temperatures)
FF (fabric filter)
FGD (flue gas desulfurization)
FIA (flame ionization analyzer)
FID (flame ionization detector)
FPD (flame photometric detection)
FRB (field reagent blank)
FSTM (flue gas sorbent total mercury)
ft (feet or foot)
ft^2 (square feet)
ft^3 (cubic feet)
ft/sec (feet per second)
FTIR (Fourier Transform Infrared Spectroscopy)
FTRB (field train reagent blank)
g (gram(s))
GC (gas chromatography)
GFAAS (graphite furnace atomic absorption spectroscopy)
GFC (gas filter correlation)
gr/dscf (grains per dry standard cubic feet)
> (greater than)/ ≥ (greater than or equal to)
g/s (grams per second)
H_2O (water)
HAP(s) (hazardous air pollutant(s))
HI (heat input)
hr (hour(s))
HR GC/MS (high-resolution gas chromatography and mass spectrometry)
HRVOC (highly reactive volatile organic compounds)
HSRG(s) (heat recovery steam generator(s))
HVT (high velocity thermocouple)
IC (ion chromatography)
IC/PCR (ion chromatography with post column reactor)
ICP/MS (inductively coupled argon plasma mass spectroscopy)
ID (induced draft)
in. (inch(es))
in. H_2O (inches water)
in. Hg (inches mercury)
IPA (isopropyl alcohol)
ISE (ion-specific electrode)
kg (kilogram(s))
kg/hr (kilogram(s) per hour)
< (less than)/ ≤ (less than or equal to)
L (liter(s))
lb (pound(s))
lb/hr (pound per hour)
lb/MMBtu (pound per million British thermal units)
lb/TBtu (pound per trillion British thermal units)
lb/lb-mole (pound per pound mole)
LR GC/MS (low-resolution gas chromatography and mass spectrometry)
m (meter)
m^3 (cubic meter)
MACT (maximum achievable control technology)
MASS® (Multi-Point Automated Sampling System)
MATS (Mercury and Air Toxics Standards)
MDL (method detection limit)
µg (microgram(s))
min. (minute(s))
mg (milligram(s))
ml (milliliter(s))
MMBtu (million British thermal units)
MW (megawatt(s))
NCASI (National Council for Air and Stream Improvement)
ND (non-detect)
NDIR (non-dispersive infrared)
NDO (natural draft opening)
NESHAP (National Emission Standards for Hazardous Air Pollutants)
ng (nanogram(s))
Nm^3 (Normal cubic meter)
% (percent)
PEMS (predictive emissions monitoring systems)
PFGC (pneumatic focusing gas chromatography)
pg (picogram(s))
PJFF (pulse jet fabric filter)
ppb (parts per billion)
PPE (personal protective equipment)
ppm (parts per million)
ppmdv (parts per million, dry volume)
ppmwv (parts per million, wet volume)
PSD (particle size distribution)
psi (pound(s) per square inch)
PTE (permanent total enclosure)
PTFE (polytetrafluoroethylene)
QA/QC (quality assurance/quality control)
QI (qualified individual)
QSTI (qualified source testing individual)
QSTO (qualified source testing observer)
RA (relative accuracy)
RATA (relative accuracy test audit)
RB (reagent blank)
RE (removal or reduction efficiency)
RM (reference method)
scf (standard cubic feet)
scfm (standard cubic feet per minute)
SCR (selective catalytic reduction)
SDA (spray dryer absorber)
SNCR (selective non-catalytic reduction)
STD (standard)
STMS (sorbent trap monitoring system)
TBtu (trillion British thermal units)
TEOM (Tapered Element Oscillating Microbalance)
TEQ (toxic equivalency quotient)
ton/hr (ton per hour)
ton/yr (ton per year)
TSS (third stage separator)
USEPA or EPA (United States Environmental Protection Agency)
UVA (ultraviolet absorption)
WFGD (wet flue gas desulfurization)
%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 Constituent	Sampling Method	Average Emission	Permit Limit[1]
EU(00079) Stack			
H_2SO_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 (H_2SO_4)
- flue gas composition (e.g., O_2, CO_2, H_2O)
- 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_2SO_4	10/05/21	08:40	09:40
2	EU00079 Stack	CTM-013	H_2SO_4	10/05/21	10:35	11:35
3	EU00079 Stack	CTM-013	H_2SO_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 (SO_4^{2-}).

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.

End of Section

2. RESULTS

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

Table 2-1:
Stack (EU00079) – H_2SO_4

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_{mstd}	Volume metered, standard (dscf)	21.99	21.94	21.92	**21.95**
Laboratory Data (Ion Chromatography)					
m_n	Total H2SO4 collected (mg)	1.9093	1.1935	2.1788	
Sulfuric Acid (H2SO4) Results (Ion Chromatography)					
C_{sd}	H2SO4 Concentration (ppmdv)	0.752	0.471	0.861	**0.695**
$E_{lb/hr}$	H2SO4 Rate (lb/hr)	0.418	0.255	0.477	**0.383**
Laboratory Data (Titration)					
m_n	Total H2SO4 collected (mg)	1.83888	1.34851	2.02276	
Sulfuric Acid (H2SO4) Results (Titration)					
C_{sd}	H2SO4 Concentration (ppmdv)	0.725	0.533	0.800	**0.686**
$E_{lb/hr}$	H2SO4 Rate (lb/hr)	0.402	0.288	0.442	**0.377**

End of Section

3. DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

Guardian's flat gas 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

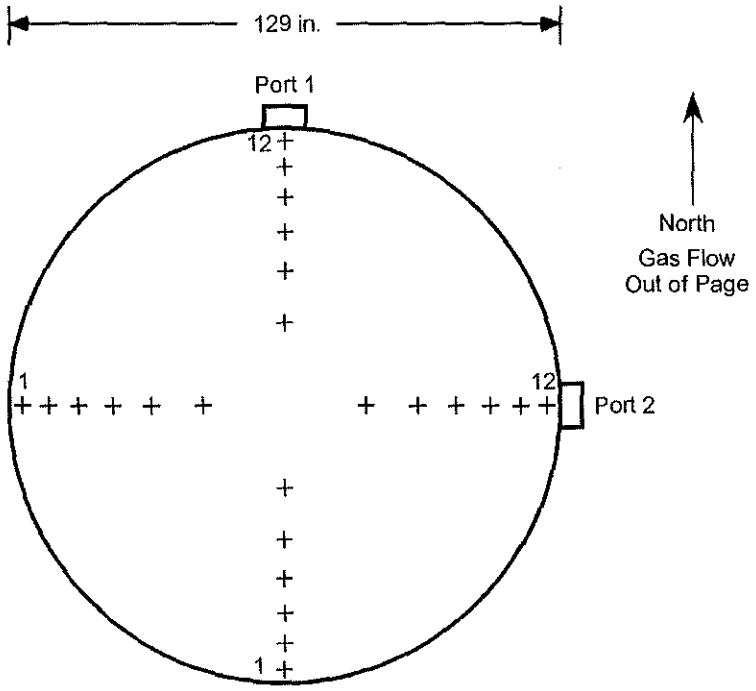
The sample point placement was determined by EPA Method 1 specifications. Table 3-1 presents the sampling information for the test location. The figure represents the layout of the test location.

Table 3-1:
Sampling Information

Source Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
Stack							
Flow Rate	EPA M2	1-3	4	6	Varied	Varied	3-1
H_2SO_4	CTM-013	1-3	1	1	60	60	NA[1]

[1] H_2SO_4 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 Limit: 0.5
Duct diameters downstream from flow disturbance (B):7.0 Limit: 2.0

End of Section

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 (O_2) and carbon dioxide (CO_2).

SULFURIC ACID MIST – CTM-013

CleanAir followed EPA Conditional Test Method 013 (CTM-013). This method is applicable for the determination of sulfur trioxide (SO_3) and sulfuric acid vapor/mist (H_2SO_4) 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.
- H_2SO_4 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 SO_2.

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

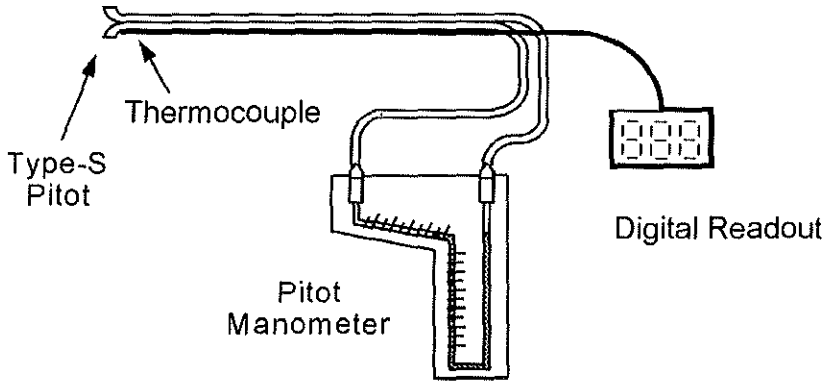
APPENDIX A: TEST METHOD SPECIFICATIONS

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

	Standard Method Specification	Actual Specification Used
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 (H_2SO_4)
Other Parameters to be Determined from Train	Gas Density, Moisture

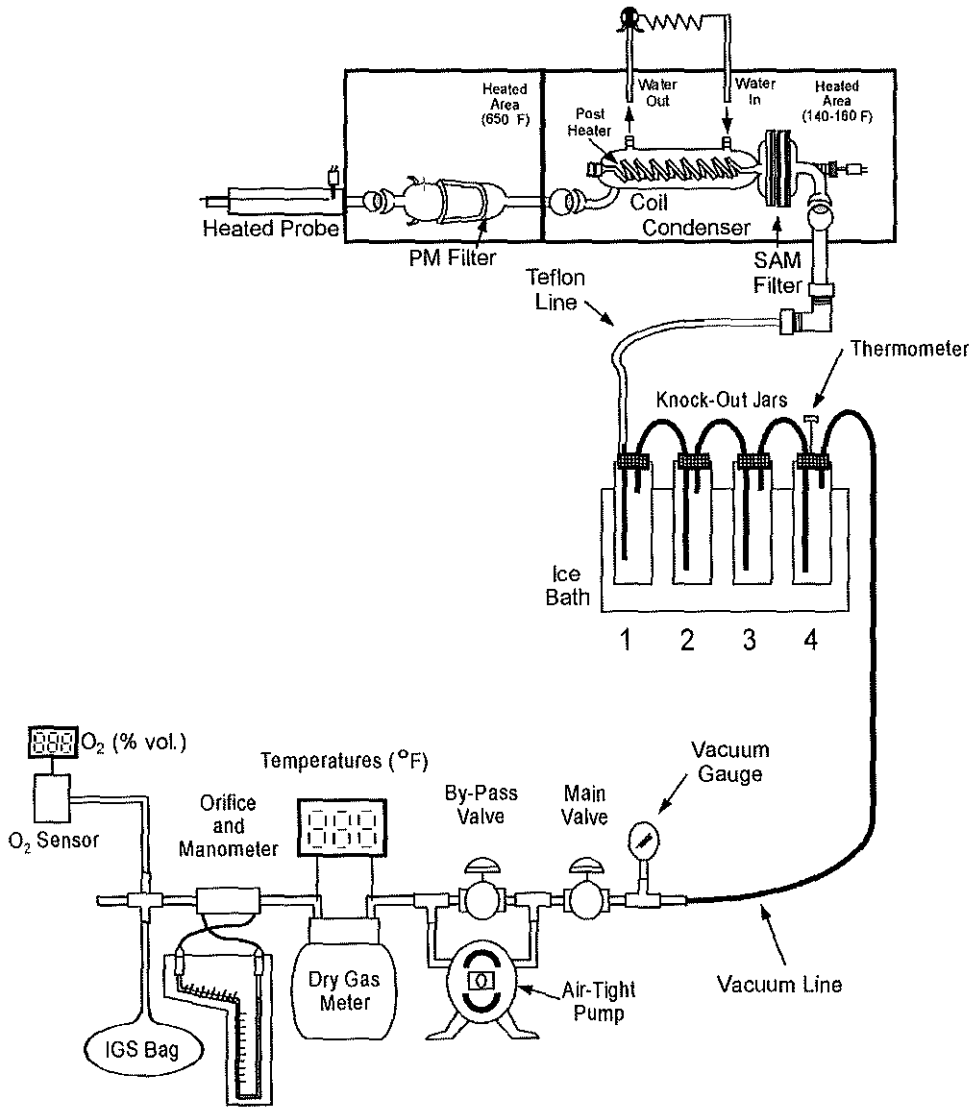
	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	60 minutes (minimum)	60 minutes
No. of Sample Traverse Points	1	1
Sample Time per Point	60 minutes (minimum)	60 minutes
Sampling Rate	Constant rate of at least 10.0 Lpm	Constant rate of at least 10.0 Lpm
Sampling Probe		
Nozzle Material	N/A	None
Nozzle Design	N/A	N/A
Probe Liner Material	Borosilcate 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
SO_3 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 (H_2SO_4)
Other Parameters to be Determined from Train	Gas Density, Moisture

	Standard Method Specification	Actual Specification Used
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 H2O)	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 H2O)	N/A
Impinger Wash Bottle	Polyethylene	N/A
Impinger Storage Container	Polyethylene	N/A
Analytical Information		
Method 4 H_2O 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

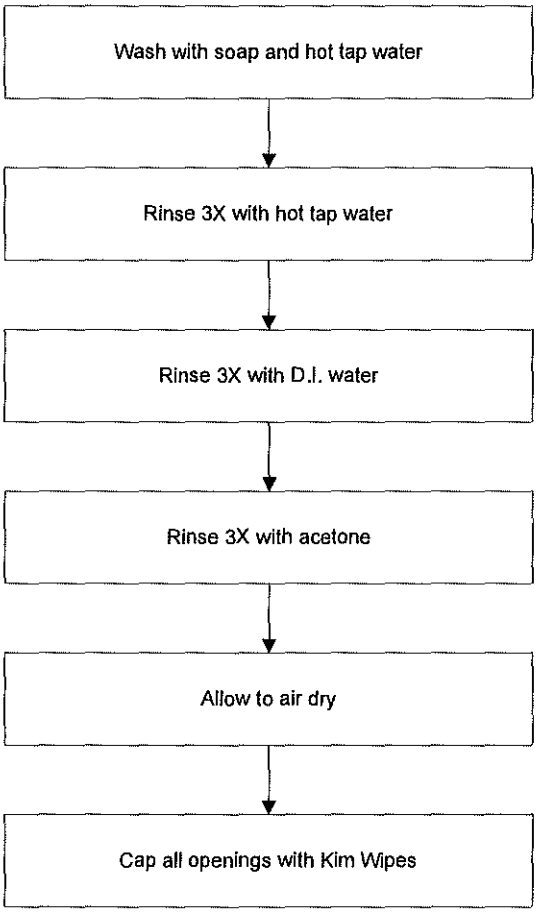
CTM-013 CCM
Sampling Train Configuration



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)

Container 0
Condenser Rinse
Pre-Test Proof
125ml HDPE

Prior to Run 1, rinse condenser with approximately 75ml of DI water and collect in sample container

Label, seal and mark liquid level of container

Condition condenser with 50ml of 100% IPA

Container 2A
Particulate Catch
(Optional Ash Analysis)
Quartz Filter
125ml HDPE

Place PM filter in sample container and brush any loose particulate into sample container

Rinse filter holder with 75ml of DI water and collect in the container with the filter. Add water if necessary to cover the filter

Label, seal and mark liquid level of container

Note: If the ash analysis is not to be done, then the filter and particulate catch may be discarded.

Container 1
Condenser Rinse
125ml HDPE

Rinse condenser a minimum of 3X with approximately 75ml DI water and collect rinse in sample container

Label, seal and mark liquid level of container

Container 2B
Probe Rinse
(Optional Ash Analysis)
125 ml HDPE

Rinse 3x with DI water and collect in sample container

Label, seal and mark liquid level of container

Container 3
Impingers Contents
(Optional Sulfur Dioxide Analysis)
500ml HDPE

Impingers 1, 2 and 3, teflon jumper and connecting glassware

Rinse teflon jumper into Impinger 1 with measured amount of DI water

Weigh all impingers to plus or minus 1ml or 0.5g

Quantitatively transfer impinger contents into sample container

Rinse impingers and connecting glassware with DI water and add to container

Label, seal and mark liquid level of container

Container 4
Silica Gel

Measure volume by weight to nearest 0.5g and note any color change

Recycle silica gel

Container 5
Final Condenser Rinse
Post-Test Proof
125ml HDPE

Rinse condenser a minimum of 3X with approximately 75ml DI water and collect rinse in sample container

Label, seal and mark liquid level of container

Condition condenser with 50ml of 100% IPA

Blanks

Container 6
DI Water Blank
250ml Plastic

200ml of DI water

Container 7
3% Hydrogen Peroxide Blank (Optional Sulfur Dioxide Analysis)
250ml HDPE

200ml of 3% H_2O_2

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

Containers 0, 1 and 5

Quantitatively transfer each sample to a volumetric flask or graduated cylinder and bring to standard volume with D.I. water

Sample Blanks, Audits, Standards

Analyze by ion chromatography for sulfate

OPTIONAL

Container 2A PM Filter

Container 2B Probe Rinse

Combine contents and agitate vigorously

Filter solution through Whatman filter paper

Bring filtrate to standard volume with DI water

Analyze by ion chromatography for sulfate

Container 3 (Optional SO2 Analysis)

Quantitatively transfer each sample to a volumetric flask or graduated cylinder and bring to standard volume with D.I. water

Analyze by ion chromatography for sulfate

**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)

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

Where:

V_{lc}	= 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_2O)	=	0.50	in. H_2O
17.64	= standard temperature to pressure ratio (°R/in. Hg)	=	17.64	°R/in. Hg
13.6	= conversion factor (in. H_2O/in. Hg)	=	13.6	in.H_2O/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_2O)	=	-0.85	in. H_2O
13.6	= conversion factor (in. H_2O/in. Hg)	=	13.6	in. H_2O/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)

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

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)

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

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_{wo}	= 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)

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

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)

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

Where:

M_{CO2}	= molecular weight of carbon dioxide (lb/lb·mole)	=	44.00	lb/lb·mole
M_{O2}	= molecular weight of oxygen (lb/lb·mole)	=	32.00	lb/lb·mole
M_{N2+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_{H2O}	= 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)

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

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_2O)	=	0.000	$\sqrt{}$in. H_2O
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%O_2 (dscfm)

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

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

$Q_{std\text{-}min}$	= volumetric flow rate, english units (ft^3/min)	=	37,409	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$Q_{std\text{-}hr}$	= 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:

$Q_{std\text{-}english}$	= 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
$Q_{std\text{-}metric}$	= 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:

$Q_{std\text{-}metric}$	= 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

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

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
$\Delta H_@$	= 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_2O)	=	0.500	in. H_2O
M_d	= dry molecular weight of stack gas (lb/lb·mole)	=	29.71	lb/lb·mole
$\sqrt{\Delta H_{avg}}$	= average of square root of pressure drop across meter orifice	=	0.707	$\sqrt{}$in. H_2O
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_2O/in. Hg)	=	13.6	in.H_2O/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)

$$m_b = K_a \times B_i \times \frac{(v_1 + v_2)}{1000}$$

$$m_b = 0 \quad \text{if } B_i < MDL$$

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)

$$m_n = MAXIMUM \left[m_{nb} \quad or \quad < m_{MDL} \right]$$

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

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

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_2O)	-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**
$\sqrt{\Delta P}$	Velocity head ($\sqrt{in.}$ H_2O)	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_2O)	-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_2O)	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_s	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_{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**
$\sqrt{\Delta P}$	Velocity head ($\sqrt{}$in. H_2O)	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				
	Final Leak Check			
	(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
	Sample Volume			
	Minimum Volume Required (dscf)	21.00	21.00	21.00
V_{mstd}	Actual Sample Volume (dscf)	21.994	21.939	21.921

102521 f12013
NKK@

Certificate #: C51091-010521AF

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	Temperature:	23.0 °C
		Humidity:	45 %RH
Serial Number:	T-276617	Data Type:	AS-FOUND
Asset Number:	C51091		

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/NCSL 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.*

Corey Mullen
Calibration Performed By

Jacob Ortman
Calibration Reviewed By

Standards Used

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

Test Results

Test Description	System Actual	UUT Value	Tolerance	Deviation	Condition	Exp Uncert	TUR
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 *****

CRITICAL ORIFICE K' CALIBRATION

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

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_2O	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°R/in.Hg

All test runs must be of the same time length.

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

CleanAir ENGINEERING

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?
α1=	α2=	<=10 °	
β1=	β2=	<=5°	
γ=	θ=	None	
A=		None	
Dt= 0.250		0.1875"<=Dt<=0.375"	Yes

Calculations	Specifications	Within Spec?
A/2=Pa=Pb=	None	
Pa/Dt=Pb/Dt=	1.05<P/Dt<1.5	
z = A sin γ =	<=0.125"	
w = A sin θ =	<=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		>=6*O.D.		
Static to Bend		>=8*O.D.		

Pitot Cp=

Calibrated by: Bill Dimitroff Date: 1/11/2021

CleanAir ENGINEERING

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?
α1=	1	α2=	1	<=10 °	Yes
β1=	0	β2=	1	<=5°	Yes
γ=	0	θ=	1	None	N/A
A=	0.687			None	N/A
Dt=	0.250			0.1875"<=Dt<=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 γ =	0.000 inches	<=0.125"	Yes
w = A sin θ =	0.012 inches	<=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		>=6*O.D.		
Static to Bend		>=8*O.D.		

Pitot Cp=

Calibrated by: Bill Dimitroff Date: 1/11/2021

CleanAir ENGINEERING

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 ΔH@: 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	ΔH@
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

- P_b Barometric Pressure (in. Hg)
- Q Flow Rate (cfm)
- ΔH Orifice Pressure differential (in. H_2O)
- ΔP Inlet Pressure Differential (in. H_2O)
- V_d Gas Meter Volume - Dry (ft^3)
- V_{ds} Standard Meter Volume - Dry (ft^3)
- T_d Average Meter Box Temperature (°F)
- T_o Outlet Meter Box Temperature (°F)
- T_{ds} Average Standard Meter Temperature (°F)
- Y_d Meter Correction Factor (unitless), $Y_i \leq Y_{avg} \pm 0.02$
- Y_{ds} Standard Meter Correction Factor (unitless)
- ΔH@ Orifice Pressure Differential giving 0.75 cfm of air at 68°F and 29.92 in. Hg (in. H_2O) $\Delta H@_i \leq \Delta H@_{avg} \pm 0.2$
- Θ Duration of Run (minutes)

Equations

$$Y_d = (Y_{ds})\left[\frac{V_{ds}}{V_d}\right]\left[\frac{T_d + 460}{T_{ds} + 460}\right]\left[\frac{P_b + \Delta P/13.6}{P_b + \Delta H/13.6}\right]$$

$$\Delta H@ = \frac{(0.0319)(\Delta H)}{P_b(T_o + 460)}\left[\frac{(T_{ds} + 460)\Theta}{(V_{ds})(Y_{ds})}\right]^2$$

$$Q = \frac{17.64(V_{ds})(P_b)}{(T_{ds} + 460)(\Theta)}$$

Vacuum Gauge

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

CleanAir ENGINEERING

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: Digimite C51091 Serial No: C51091

Calibrated By: Clean Air Knoxville Date Calibrated: 1/7/2020

Calibration Report No: C51091-01072020A

CDS005C-Meter Full, April 2004a

CleanAir ENGINEERING

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 — *No movement of manometer in one-minute* ☑ Pass

Positive Pressure — *No movement of manometer in one-minute* ☑ Pass

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

Barom. Press. (P_b) 29.21 in. Hg

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

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

$$\Delta Y_i = \frac{Y_i - \overline{Y_i}}{\overline{Y_i}} \times 100 \qquad \text{Spec.: } \Delta Y_i \le \pm 2\%$$

$$Cal.Error = \frac{\overline{Y_i} - Y_d}{Y_d} \times 100 \qquad \text{Spec.: } Cal.Error \le \pm 5\%$$

CleanAir ENGINEERING

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. 4000011852, 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)

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/cm³	As Left Apparent Mass vs 8.0 g/cm³	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/cm³
When tantalum	50 mg-500 mg	16.6 g/cm³
When aluminum:	10-50 mg	2.7 g/cm³
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.

CHEMRX Service, INC. for TotalSP, LLC.
Samuel M. Prepelka, President

Service, Calibration, Repair & Sales of Balances & Scales from New York to California for Over Forty Five Years
Thank you for choosing TotalSP, LLC, a Women-Owned Business!
◊ NIST TRACEABLE WEIGHTS CERTIFICATION ◊ ANTISTATIC PRODUCTS ◊ MEMBER, AMERICAN SOCIETY FOR QUALITY

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
11711 S. Alameda Street
Los Angeles, CA 90059
Airgas.com

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

Airgas
an Air Liquide company

Airgas Great Lakes region
Airgas USA, LLC
1290 Combermere Dr.
Troy, MI 48083
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

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

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 O_2 / CO_2 Data

TEST LOCATION: LINE #1 STACK **PAGE** 1 **OF** 1

Client	GUARDIAN INDUSTRIES	Project Number	14485	$Fo = \frac{20.9 - \%O_2}{\%CO_2}$
Plant	CARLETON, MI	Unit	LINE #1	
Asset No.	68 A	Fuel Type	NAT. GAS	Leak Check Passed ☑

Gas	Cylinder ID No.	Gas Concentration (%dv)	Expiration Date
Zero	HIS 365	0.0% / 0.0%	
O_2 / CO_2	CC 13945	9.772% / 4.934%	3/26/26
O_2 / CO_2	CC 316220	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	Fo	Analyst	Analysis Date	Analysis 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 Fo 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

CleanAir. ENGINEERING

Impinger Weight Sheet

Client	Guardian		Unit Name / Location Stack 79
Plant	Carleton, MI	Job No. 14485	Method CTM013

Balance Calibration Check			
Balance ID	68-S	Reference Weight Mass	1000.0 g
Reference Weight ID	05-JD6467-1	Reference Weight Reading	1000.1 g

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

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

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

Run No.	1	Filter Type	N/A	N/A	Sample Box No. 68-S
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

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

Run No.	Run 2	Filter Type	N/A	N/A	Sample Box No. 87-R5
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

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1	DI	672.4	612.0	60.4	
Impinger 2	DI	650.9	647.5	3.4	QA/QC JL
Impinger 3	None	441.9	439.9	2.0	Date 10/5/21
Impinger 4	Silica Gel	745.5	740.2	5.3	
Impinger 5					Total Weight (gm)
Impinger 6					65.8
Impinger 7					71.1

QA/QC_____

Date_____

CleanAir

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	OS-J06467-C	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

AR 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 AR
Impinger 3	None	449.6	447.4	2.2	Date 10/5/21
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
Impinger 3					Date
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
Impinger 3					Date
Impinger 4					
Impinger 5					Total Weight (gm)
Impinger 6					
Impinger 7					

QA/QC_____
Date_____

CleanAir

TEST LOCATION: Stack

UNIT: Furnace RUN: 1

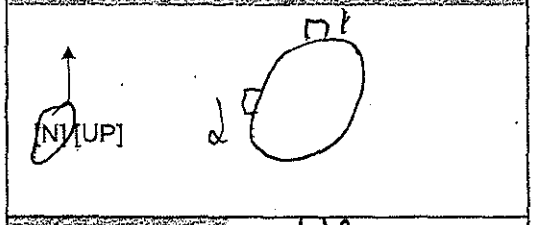
Sulfuric Acid Mist Testing

FIELD DATA SHEET

METHOD: CTM-013 Mod. PAGE 1 OF 1

Client	Guardian	Project No.	14485
Plant	Colleton, SC	Date	10/4/21
Meter Operator		J. Collins	
Probe Operator		AT Parkins	

Cross Section of Test Location



Amb. Temp. (°F)	86	Bar. Press.	29.10 [in. Hg] [mbar]
Probe I.D. No.	68-LL-9-4		
Liner Material	Glass		

Meter Box No.	68-4	Sample Box No.	LL-NO
Meter Y	1.0084	Meter ΔH@	1.8754
K Factor		Pitot C	0.84
Leak Rate Before	0.001 [cfm] [Lpm] @	15	(in. Hg)
Leak Rate After	0.00 [cfm] [Lpm] @	15	(in. Hg)
Pitot Leak Check Before	☐ After: Good ☑ Bad ☐		

Filter No.			
Thimble No.			
Nozzle Diameter		Nozzle I.D.	
Post Test ALT-011 Check	Good ☑	NA ☐	

Duct Dimensions (in.)		139		
Static Pres. (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]	
-0.85	46			

Start Time	15:49	Stop Time	16:49

Traverse Point Number	Min/pt. 5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. (ft³) [L]	Stack Temp. TS (°F)	Probe T (°F) Set Points (°F)	PM Filter T (°F) Set Points (°F)	SO Conv. T (°F) Set Points (°F)	SAM Filter Temp. (°F)	SAM Oven T_{amb} (°F)	DGM Inlet T_m (°F)	DGM Outlet T_m (°F)	Pump Vacuum (in. Hg)	Oxygen Indicator approx. (% dv)	Impinger Outlet Temp. (°F)
				688.580		750	500	175							
1-1	5		0.41	690.35	591	486	550	175	170	175	97	96	3.0	10.1	58
1-2	10			692.07	592	401	550	175	172	175	97	96	3.0	10.0	55
1-3	15			693.70	592	401	550	175	172	176	96	94	3.0	10.1	54
1-4	20			695.39	591	400	550	176	174	180	95	94	3.0	10.5	54
1-5	25			697.10	592	400	551	176	175	180	96	96	3.0	9.9	53
1-6	30			698.84	591	401	550	176	175	180	95	96	3.0	9.9	54
	35		0.45	700.67	591	400	551	175	178	188	98	96	3.0	9.8	57
	40		0.45	702.46	593	400	550	176	181	190	100	97	3.0	9.8	56
	45		0.45	704.32	594	401	550	176	180	188	101	98	3.0	9.8	57
	50		0.45	706.18	593	401	550	177	180	190	102	101	3.0	9.9	58
	55		0.45	708.05	592	401	550	177	179	189	102	100	3.0	9.8	59
	60		0.45	709.850	592	400	549	175	178	189	102	100	3.0	9.8	60
	Total		5.1600	21.2700	7106.0000						1182.0000	1162.0000			
	Average		0.4300		592.1667						97.2863				

3.45 dH

Sum of square roots.

Circle correct bracketed units on data sheet.

CleanAir ENGINEERING

QA/QC [illegible]

Date 10/4/21

TEST LOCATION: Stack | Sulfuric Acid Mist Testing | METHOD: CTM-013 Mod. PAGE 1 OF 1

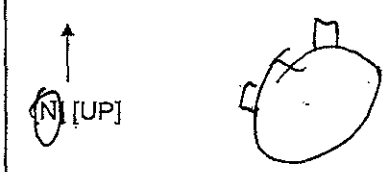
UNIT: Ellogg 29 RUN: 1

FIELD DATA SHEET

Client	Gustafson	Project No.	14185
Plant	Galesburg, MI	Date	6/5/21
Meter Operator	J. Kollin		
Probe Operator	AJ Hollyer		

Meter Box No.	6B-4	Sample Box No.	UR1
Meter Y	1.004	Meter ΔH@	1.8751
K Factor		Pitot Cp	0.84
Leak Rate Before	0.001 [cfm]	[Lpm] @	15 (in. Hg)
Leak Rate After	0.001 [cfm]	[Lpm] @	15 (in. Hg)
Pitot Leak Check Before: ☑	After: Good ☑	Bad ☐	

Cross-Section of Test Location



Duct Dimensions (in.)	129			
Stack Pres. (in. H_2O)	Port Len. (in.)	Gas Flow		First Point all the way
		[In]	[Out]	
-0.85	46	of page		[In] ☐ [Out]

Amb. Temp. (°F)	51	Bar. Press.	29.40 [in. Hg] [mbar]
Probe I.D. No.	6B-11-9-4		
Liner Material	1955		

Filter No.			
Thimble No.			
Nozzle Diameter		Nozzle I.D.	
Post-Test ALT-011 Check	Good ☑	NA ☐	

Start Time	08:40	Stop Time	09:40

Traverse Point Number	Min/pt. Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. (ft³) [L]	Stack Temp. (°F)	Probe T (°F) Set Points 350	PM Filter T (°F) 350	SO_2 Conv. T (°F) 175	SAM Filter Temp. (°F)	SAM Oven T_{sam} (°F)	DGM Inlet $T_{m,in}$ (°F)	DGM Outlet $T_{m,out}$ (°F)	Pump Vacuum (in. Hg)	Oxygen Indicator, approx. (%dv)	Impinger Outlet Temp. (°F)
				715.260											
2-1	5		0.5	717.17	589	400	549	176	177	185	71	71	3.0	9.9	66
2-2	10			719.05	588	401	550	175	176	188	71	71	3.0	10.0	63
2-3	15			720.94	588	401	550	176	176	183	73	72	3.0	9.9	60
2-4	20			722.81	588	400	550	175	175	185	73	72	3.0	9.8	59
2-5	25			724.68	589	400	551	176	176	184	75	73	3.0	9.8	57
2-6	30			726.56	588	400	551	177	176	184	76	73	3.0	9.9	56
3-1	35			728.45	588	400	549	177	176	183	78	73	3.0	9.9	56
3-2	40			730.34	589	401	549	176	175	184	78	73	3.0	9.8	56
3-3	45			732.22	589	400	550	175	175	183	78	73	3.0	9.9	56
3-4	50			734.10	589	400	551	174	175	184	79	73	3.0	9.8	57
3-5	55			736.00	588	400	550	173	176	185	79	73	3.0	9.9	57
3-6	60			737.880	589	399	550	173	175	185	79	74	3.0	9.9	58
	Total		6.0000	22.6200	2061.000						444.000	431.000			
	Average		0.5000		588.5714						74.000				

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

CleanAir ENGINEERING

QA/QC AJH
Date 6/5/21

TEST LOCATION: Stack

UNIT: EU00079 RUN: 2

Sulfuric Acid Mist Testing

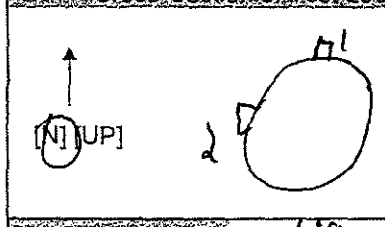
FIELD DATA SHEET

METHOD: CTM-013 Mod. PAGE 1 OF 1

Client	Guardian	Project No.	14485
Plant	Carlsbad, NM	Date	10/5/21
Meter Operator	J. Kelley		
Probe Operator	AJ Dalbec		

Meter Box No.	68-4	Sample Box No.	CLR1
Meter Ya	1.0004	Meter ΔH@	1.8754
K Factor		Pitot Cp	0.84
Leak Rate Before	0.001 [cfm]	[Lpm] @	15 (in. Hg)
Leak Rate After	0.001 [cfm]	[Lpm] @	15 (in. Hg)
Pitot Leak Check Before ☑	After: Good ☑	Bad ☐	

Cross-Section of Test Location



Duct Dimensions (in.)	149		
Static Pres (in. H_2O)	Port Len (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
-0.85	46	[Out]	[In]

Amb. Temp. (°F)	77	Bar. Press.	29.40 [in. Hg] [mbar]
Probe I.D. No.	68-LC-9-4		
Liner Material	Glass		

Filter No.	—	—	—
Thimble No.	—	—	—
Nozzle Diameter	—	Nozzle I.D.	—
Post-Test ALT-011 Check	Good ☑	NA ☐	
Start Time	10:35	Stop Time	11:35

Traverse Point Number	Min/pt. Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L]	Stack Temp. Ts (°F)	Probe T (°F) / Filter T (°F) Set Points	SO₂ Cond. T (°F)	SAM Filter Temp. (°F)	SAM Oven T_{sam} (°F)	DGM Inlet $T_{m,in}$ (°F)	DGM Outlet $T_{m,out}$ (°F)	Pump Vacuum (in. Hg)	Oxygen Indicator approx. (% dv)	Impinger Outlet Temp. (°F)
				743.850	350	500	175							
1-1	5		0.5	745.76	589	400	550	176	172	180	77	76	3.0	10.0	64
	10			747.66	589	401	551	174	173	185	79	76	3.0	9.9	62
	15			749.56	589	401	550	175	174	187	79	76	3.0	9.9	60
	20			751.45	589	402	551	176	175	188	80	77	3.0	9.9	58
	25			753.34	589	401	551	175	176	189	81	77	3.0	9.9	57
	30			755.24	588	400	551	176	177	191	82	77	3.0	9.9	56
	35			757.15	589	399	550	175	176	191	84	78	3.0	9.8	55
	40			759.06	589	400	550	174	175	191	84	78	3.0	9.8	55
	45			760.96	588	400	550	173	174	191	85	79	3.0	9.9	56
	50			762.86	588	401	549	174	176	195	84	78	3.0	9.8	57
	55			764.75	589	401	551	175	177	196	84	78	3.0	9.9	58
	60			766.64	589	402	550	175	176	196	84	78	3.0	9.9	59
	Total		6.0000	22.7900	7065.00						983.00	916.00			
	Average		0.5000		589.2500							79.658			

Sum of square roots

Circle correct bracketed units on data sheet.

CleanAir ENGINEERING

QA/QC JK

Date 10/5/21

TEST LOCATION: Stack | Sulfuric Acid Mist Testing | METHOD: CTM-013 Mod. PAGE 1 OF 1

UNIT: EU0079 RUN: 3

FIELD DATA SHEET

Client	Guardian	Project No	14485
Plant	Carleton, MI	Date	10/5/21
Meter Operator		J. Kolling	
Probe Operator		AT Dallone	

Cross-Section of Test Location

Amb. Temp. (°F)	78	Bar. Press	29.40 [in Hg] [mbar]
Probe I.D. No		68-4-9-4	
Liner Material		316S	

Meter Box No	68-4	Sample Box No	CC83
Meter Y	1.0004	Meter ΔH@	1.8354
K Factor	—	Pitot Cp	0.84
Leak Rate Before	0.00 [cfm] [Lpm]	@	15 (in Hg)
Leak Rate After	0.00 [cfm] [Lpm]	@	15 (in Hg)
Pitot Leak Check Before	☑	After Good ☑ Bad ☐	

Filter No	—	—	—
Thimble No	—	—	—
Nozzle Diameter	—	Nozzle I.D.	—
Post-Test ALT-011 Check	Good ☑	NA ☐	

Duct Dimensions (in.)	149		
Static Pres (in. H2O)	-0.85	Port Len. (in.)	46
Gas Flow	[In] [Out]	First point all the way	[In] [Out]
	of Page		

Start Time	12:26	Stop Time	13:26

Traverse Point Number	Min/pt. Elapsed Time	Velocity Head ΔP (in. H2O)	Orifice Setting ΔH (in. H2O)	Gas Sample Volume Vm Init. Vol. (ft³) [L]	Stack Temp. Ts (°F)	Probe T/C (°F) Set Points	PM Filter T/C (°F) Set Points	SO2 Cond. T/C (°F) Set Points	SAM Filter Temp. (°F)	SAM Oven Tm (°F)	DGM Inlet Tm (°F)	DGM Outlet Tm(out) (°F)	Pump Vacuum (in. Hg)	Oxygen Indicator approx. (%dv)	Impinger Outlet Temp (°F)
				771.500		350	500	175							
2-1	5		0.6	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			777.16	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	9.9	57
	35			784.72	586	401	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	53
	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	*	6.0000	22.7100	2931.000						464.000	911.0000			
	Average		0.5000		586.000							78.1667			

Sum of square roots.

Circle correct bracketed units on data sheet.

CleanAir. ENGINEERING

QA/QC YK

Date 10/6/21

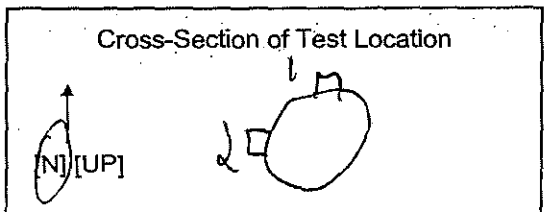
TEST LOCATION: Stack **UNIT:** EU00079

VELOCITY DETERMINATION FIELD DATA SHEET

PAGE 1 **OF** 1

Client	Guardia,	Project No.	14485
Plant	Carleton	Date	10/4/21
Meter Operator	J. Kolling		
Probe Operator	AT Fallace		
Source of Moisture and Molecular Weight Data			

Cross-Section of Test Location



Amb. Temp. (°F)	71	P_{bar}	29.10 [in Hg] [mbar]
Pitot Cp	0.84	Probe I.D. No.	IT-168-3
Duct Diameters from Disturbance			
Downstream	7.00	Upstream	11.1
First point all the way [In] [Out]		Port Len. (in.)	46
Gas Flow [In] [Out] of page			
Duct Dimensions (in.)	129		

Run	1	ALT-011 Ck. ☑	or NA ☐
Start Time	14:05	Stop Time	14:15
Static Press. (in. H_2O)	~0.85		
Post-Test Leak Check:	Pass ☐	Fail ☐	
Post-Test Pitot Check:	Good ☑	Bad ☐	

Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes
1-1	584	0.04	
1-1	584	0.04	
1-2	585	0.04	
1-4	585	0.04	
1-5	585	0.05	
1-6	585	0.05	
1-7	585	0.05	
1-8	586	0.05	
1-9	590	0.05	
1-10	578	0.04	
1-11	577	0.04	
1-12	577	0.03	
Total			
Average			

Run		ALT-011 Ck. ☐	or NA ☐
Start Time		Stop Time	
Static Press. (in. H_2O)			
Post-Test Leak Check:	Pass ☐	Fail ☐	
Post-Test Pitot Check:	Good ☐	Bad ☐	

Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes
2-1	584	0.03	
2-1	583	0.03	
2-3	584	0.03	
2-4	585	0.03	
2-5	584	0.04	
2-6	584	0.04	
2-7	583	0.04	
2-8	583	0.04	
2-9	583	0.03	
2-10	581	0.03	
2-11	581	0.03	
2-12	580	0.03	
	13996	4.6769	
	583.20	0.1949	

Run	Cyclonic	ALT-011 Ck. ☐	or NA ☐
Start Time		Stop Time	
Static Press. (in. H_2O)			
Post-Test Leak Check:	Pass ☐	Fail ☐	
Post-Test Pitot Check:	Good ☐	Bad ☐	

Traverse Point Number	Stack Temp. T_s (°F) ∠ 0°	Velocity Head ΔP (in.H_2O) ∠ Angle ΔP	Notes
1-1	0	0	
2	0	0	
3	0	0	
4	.01	3	
5	.01	5	
6	0	0	
7	0	0	
8	.01	4	
9	.02	2	
10	0	0	
11	0	0	
12	0	0	

Run		ALT-011 Ck. ☐	or NA ☐
Start Time		Stop Time	
Static Press. (in. H_2O)			
Post-Test Leak Check:	Pass ☐	Fail ☐	
Post-Test Pitot Check:	Good ☐	Bad ☐	

Traverse Point Number	Stack Temp. T_s (°F) ∠ 0°	Velocity Head ΔP (in.H_2O) ∠ Angle ΔP	Notes
2-1	0	0	
2	.01	5	
3	.01	3	
4	0	0	
5	0	0	
6	0	0	
7	0	0	
8	0	0	
9	0	0	
10	.01	3	
11	0	0	
12	0	0	

Sum of square roots.

Circle correct bracketed units on data sheet.

QA/QC GC
Date 10/4/21

NIST Thermocouple Serial Number: _____

CleanAir ENGINEERING

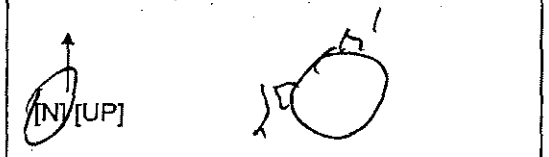
TEST LOCATION: Stack **PAGE** 1 **OF** 1

UNIT: EU00079

VELOCITY DETERMINATION FIELD DATA SHEET

Client	Zydeca
Plant	Collecton, MS
Meter Operator	J. Kellog
Probe Operator	A. Neilage
Source of Moisture and Molecular Weight Data	
Project No.	14485
Date	10/4/21

Cross-Section of Test Location



Amb. Temp. (°F)	81	P_{bar}	29.10 [in.Hg] [mbar]
Pitot Cp	0.84	Probe I.D. No.	TI-168-3
Duct Diameters from Disturbance			
Downstream	7.0	Upstream	11.0
First point all the way [In] [Out]		Port Len. (in.)	46
Gas Flow [In] [Out] of page			
Duct Dimensions (in.)	129		

Run	1	ALT-011 Ck. ☐	or NA ☑
Start Time	16:49	Stop Time	
Static Press. (in. H_2O)	-0.85		
Post-Test Leak Check:	Pass ☑	Fail ☐	
Post-Test Pitot Check:	Good ☑	Bad ☐	

Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes
1-1	591	0.04	
1-2	591	0.04	
1-3	591	0.04	
1-4	593	0.04	
1-5	593	0.05	
1-6	591	0.04	
1-7	590	0.05	
1-8	591	0.05	
1-9	590	0.04	
1-10	588	0.04	
1-11	587	0.04	
1-12	586	0.04	
Total			
Average			

Run	2	ALT-011 Ck. ☐	or NA ☑
Start Time		Stop Time	
Static Press. (in. H_2O)			
Post-Test Leak Check:	Pass ☑	Fail ☐	
Post-Test Pitot Check:	Good ☑	Bad ☐	

Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes
2-1	591	0.04	
2-2	591	0.03	
2-3	592	0.04	
2-4	593	0.04	
2-5	594	0.04	
2-6	593	0.04	
2-7	593	0.05	
2-8	591	0.04	
2-9	591	0.05	
2-10	589	0.04	
2-11	588	0.03	
2-12	587	0.03	
Total	14186.000	4.8376	
Average	590.833	0.0016	

Run	3	ALT-011 Ck. ☐	or NA ☐
Start Time	17:40	Stop Time	
Static Press. (in. H_2O)			
Post-Test Leak Check:	Pass ☑	Fail ☐	
Post-Test Pitot Check:	Good ☑	Bad ☐	

Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes
3-1			
3-2			
3-3			
3-4			
3-5			
3-6			
3-7			
3-8			
3-9			
3-10			
3-11			
3-12			

Run		ALT-011 Ck. ☐	or NA ☐
Start Time		Stop Time	
Static Press. (in. H_2O)			
Post-Test Leak Check:	Pass ☐	Fail ☐	
Post-Test Pitot Check:	Good ☐	Bad ☐	

Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes
4-1			
4-2			
4-3			
4-4			
4-5			
4-6			
4-7			
4-8			
4-9			
4-10			
4-11			
4-12			

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

QA/QC JC
Date 10/4/21

NIST Thermocouple Serial Number: _____

CleanAir ENGINEERING

TEST LOCATION: Stack

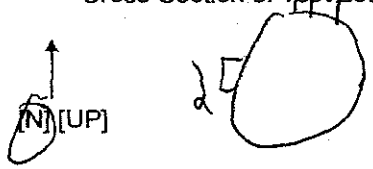
UNIT: EU00079

VELOCITY DETERMINATION FIELD DATA SHEET

PAGE 1 OF 1

Client	Brenntag	Project No.	14495
Plant	Carpentersville, IL	Date	10/5/21
Meter Operator	S. Kolling		
Probe Operator	AJ Nallsee		
Source of Moisture and Molecular Weight Data			

Cross-Section of Test Location



Amb. Temp. (°F)		P_{bar}	[in. Hg] [mbar]
Pitot Cp	0.84	Probe I.D. No.	10-168-3
Duct Diameters from Disturbance			
Downstream	2.0	Upstream	1.2
First point all the way [In] [Out]		Port Len. (in.)	46
Gas Flow [In] [Out] of page			
Duct Dimensions (in.)	129		

Run	3	ALT-011 Ck. ☑	or NA ☐
Start Time	8:00	Stop Time	9:00
Static Press. (in. H_2O)	-0.85		
Post-Test Leak Check:	Pass ☑	Fail ☐	
Post-Test Pitot Check:	Good ☑	Bad ☐	

Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes
1-1	584	0.04	
-2	583	0.04	
-3	583	0.04	
-4	583	0.04	
-5	584	0.04	
-6	584	0.04	
-7	584	0.05	
-8	584	0.05	
-9	583	0.04	
-10	583	0.04	
-11	580	0.03	
-12	580	0.03	
Total		*	
Average			

Run		ALT-011 Ck. ☐	or NA ☐
Start Time		Stop Time	
Static Press. (in. H_2O)			
Post-Test Leak Check:	Pass ☐	Fail ☐	
Post-Test Pitot Check:	Good ☐	Bad ☐	

Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes
1-1	584	0.03	
-2	584	0.03	
-3	583	0.04	
-4	583	0.04	
-5	583	0.04	
-6	584	0.04	
-7	584	0.04	
-8	582	0.04	
-9	581	0.04	
-10	580	0.04	
-11	580	0.04	
-12	578	0.04	
Total	13979.00	4.240	
Average	581.625	0.1975	

Run	4	ALT-011 Ck. ☑	or NA ☐
Start Time	9:41	Stop Time	10:00
Static Press. (in. H_2O)	-0.85		
Post-Test Leak Check:	Pass ☑	Fail ☐	
Post-Test Pitot Check:	Good ☑	Bad ☐	

Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes
1-1	584	0.04	
-2	581	0.04	
-3	581	0.03	
-4	583	0.04	
-5	583	0.04	
-6	583	0.05	
-7	584	0.05	
-8	583	0.04	
-9	581	0.04	
-10	580	0.03	
-11	579	0.03	
-12	579	0.03	
Total		*	
Average			

Run		ALT-011 Ck. ☐	or NA ☐
Start Time		Stop Time	
Static Press. (in. H_2O)			
Post-Test Leak Check:	Pass ☐	Fail ☐	
Post-Test Pitot Check:	Good ☐	Bad ☐	

Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes
1-1	582	0.03	
-2	581	0.03	
-3	583	0.03	
-4	583	0.04	
-5	584	0.04	
-6	584	0.04	
-7	583	0.04	
-8	582	0.05	
-9	581	0.04	
-10	581	0.04	
-11	579	0.04	
-12	578	0.04	
Total	13966.00	4.683	
Average	581.917	0.1951	

Sum of square roots.

Circle correct bracketed units on data sheet.

QA/QC [illegible]

Date 10/5/21

NIST Thermocouple Serial Number:

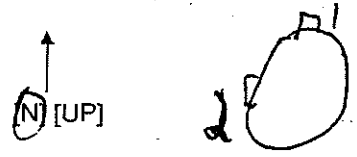
CleanAir. ENGINEERING

TEST LOCATION: Stack **VELOCITY DETERMINATION** **PAGE** 1 **OF** 1

UNIT: EU00079 **FIELD DATA SHEET**

Client	Guardian
Plant	Carleton, MI
Project No.	14495
Date	10/5/21
Meter Operator	J. Kellogg
Probe Operator	AJ Dalbec
Source of Moisture and Molecular Weight Data	

Cross-Section of Test Location



Amb. Temp. (°F)	77	P_{bar}	29.40 [in. Hg] [mbar]
Pitot Cp	0.84	Probe I.D. No.	TP-168-23
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. ☑	or NA ☐	Run	ALT-011 Ck. ☐	or NA ☐	Run 5	ALT-011 Ck. ☑	or NA ☐	Run	ALT-011 Ck. ☐	or NA ☐
Start Time 11:37	Stop Time 11:54		Start Time	Stop Time		Start Time 13:10	Stop Time 13:55		Start Time	Stop Time	
Static Press. (in. H_2O) -0.85			Static Press. (in. H_2O)			Static Press. (in. H_2O) -0.85			Static Press. (in. H_2O)		
Post-Test Leak Check: Pass ☑ Fail ☐			Post-Test Leak Check: Pass ☐ Fail ☐			Post-Test Leak Check: Pass ☑ Fail ☐			Post-Test Leak Check: Pass ☐ Fail ☐		
Post-Test Pitot Check: Good ☑ Bad ☐			Post-Test Pitot Check: Good ☐ Bad ☐			Post-Test Pitot Check: Good ☑ Bad ☐			Post-Test Pitot Check: Good ☐ Bad ☐		

Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes	Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes	Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes	Traverse Point Number	Stack Temp. T_s (°F)	Velocity Head ΔP (in.H_2O)	Notes
1-1	588	0.03		2-1	584	0.03		1-1	586	0.03		2-1	584	0.04	
-2	586	0.03		-2	584	0.04		-2	585	0.04		-2	584	0.04	
-3	585	0.04		-3	585	0.04		-3	581	0.03		-3	583	0.04	
-4	584	0.04		-4	584	0.04		-4	585	0.04		-4	583	0.04	
-5	584	0.04		-5	583	0.04		-5	584	0.04		-5	583	0.04	
-6	584	0.04		-6	583	0.04		-6	584	0.04		-6	583	0.05	
-7	584	0.04		-7	583	0.05		-7	583	0.04		-7	583	0.05	
-8	584	0.04		-8	582	0.05		-8	583	0.04		-8	583	0.04	
-9	584	0.04		-9	581	0.04		-9	583	0.04		-9	582	0.04	
-10	583	0.03		-10	581	0.04		-10	583	0.04		-10	580	0.03	
-11	581	0.03		-11	579	0.03		-11	581	0.03		-11	579	0.04	
-12	579	0.03		-12	578	0.03		-12	580	0.03		-12	579	0.03	
	5														
Total		*			13793.00	*4.6219				*			13698.00	*4.6864	
Average					(583.042)	(0.1930)							(581.833)	0.1953	

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

QA/QC KK Date 10/5/21

NIST Thermocouple Serial Number:

CleanAir. ENGINEERING

Sulfate Analysis Laboratory Data
Barium / Thorin Titration

Client GUARDIAN INDUSTRIES	Project Number 14485	Analyst E. DOAK
Plant CARLETON, MI.	Unit LINE #1 STACK	Date 10/4/21

Titrant Standardization

$$\text{Normality of Titrant (N)} = \frac{(\text{Normality } H_2SO_4 \text{ Standard}) \times (\text{ml } H_2SO_4 \text{ Standard})}{(\text{ml Titrant})}$$

$$N = \frac{0.02 \times 10}{20} = 0.010$$

Run No.	Impinger I.D.	Total Volume (ml)	Aliquot Volume (ml)	ml of Titrant		Average (ml)
				Trial 1	Trial 2	
R0	COND. RINSE	100	10	0.60	0.50	0.55
NA	AUDIT	1000	20	2.30	2.30	2.30
R1	COND. RINSE	100	20	0.80	0.80	0.80
R2	COND. RINSE	100	20	0.60	0.60	0.60
R3	COND. RINSE	100	20	0.90	0.85	0.875
	Standard	10	10	20.0	20.0	20.0
	Blank	20	20	0.05	0.05	0.05

QA/QC EA
Date 10/5/21

CleanAir ENGINEERING

APPENDIX F: FIELD DATA PRINTOUTS

USEPA Method 3 Laboratory Data

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

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

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	☐ 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	☐ 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	☐ 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:								☐ Fo value within expected range.

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@@@@

Field Data Printout

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

Location:	EU00079 Stack		Bar. Press. (in. Hg):	28.40	Nozzle ID No:	N/A
Test Run:	3		Static P:	-0.85	Nozzle Diameter (D_n):	N/A
Client:	Guardian Industries, LLC		O_2 (dry volume %):	11.10	Probe ID No:	TP-168-3
Project No:	14485		CO_2 (dry volume %):	7.90	Pitot C_p:	0.840
Source Area (ft^2):	90.76258		N_2+CO (dry volume %):	81.00	Pitot Leak Check:	☑ Pass ☐ Fail
Meter Operator:	J. Kolling	684				
Probe Operator:	A. Pallone	675			Meter Box ID. No:	N/A
Test Date:	10/05/21				Meter ΔH@:	N/A
Start Time:	09:45				Meter Y_d:	N/A
Stop Time:	10:00					
Leak Rate Before:	N/A cfm	N/A				
Leak Rate After:	N/A cfm	N/A				

Traverse Point	Run Time 5.0 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{}$in. H_2O)	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		Sq.Rt.ΔP								
QC-Check: Field Averages		0.1951			581.9169					
		☑ Avg. OK	☐ Avg. OK	☐ Avg. OK	☑ Avg. OK		☐ Avg. OK			

102521 112206

Field Data Printout

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

Location: EU00079 Stack
Test Run: 4
Client: Guardian Industries, LLC
Project No: 14485
Source Area (ft^2): 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
O_2 (dry volume %): 10.80
CO_2 (dry volume %): 8.50
N_2+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 ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
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		Sq.Rt ΔP								
QC-Check: Field Averages		0.1930			583.0417					
		☑ Avg. OK	☐ Avg. OK	☐ Avg. OK	☑ Avg. OK		☐ Avg. OK			

102521 112206

Field Data Printout

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

Location:	EU00079 Stack		Bar. Press. (in. Hg):	28.40	Nozzle ID No:	N/A
Test Run:	5		Static P:	-0.85	Nozzle Diameter (D_n):	N/A
Client:	Guardian Industries, LLC		O_2 (dry volume %):	10.40	Probe ID No:	TP-168-3
Project No:	14485		CO_2 (dry volume %):	8.90	Pitot C_p:	0.840
Source Area (ft^2):	90.76258		N_2+CO (dry volume %):	80.70	Pitot Leak Check:	☑ Pass ☐ Fail
Meter Operator:	J. Kolling	684				
Probe Operator:	A. Pallone	675			Meter Box ID. No:	N/A
Test Date:	10/05/21				Meter ΔH@:	N/A
Start Time:	13:30				Meter Y_d:	N/A
Stop Time:	13:50					
Leak Rate Before:	N/A	cfm N/A				
Leak Rate After:	N/A	cfm N/A				

Traverse Point	Run Time 5.0 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{}$in. H_2O)	Volume (calculated) (ft^3)	Isokinetics (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		Sq.Rt.ΔP								
QC-Check: Field Averages		0.1953			582.8333					
		☑ Avg. OK	☐ Avg. OK	☐ Avg. OK	☑ Avg. OK	☐ Avg. OK				

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USEPA Method 3 Laboratory Data

Test Method: CTM-013
Analyte: H2SO4

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

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	☐ 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	☐ 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	☐ 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:								☐ 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				

Rinse: (ml or gm)

		Field Data Check	
74.0	Liquid (gm)		
0.0	less rinse (gm)		
74.0	Net Liquid (gm)	74.0	☑ QA/QC OK
+ 5.9	Silica Gel (gm)	5.9	☑ QA/QC OK
79.9	Total Vlc (gm)	79.9	☑ QA/QC OK

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				

Rinse: (ml or gm)

		Field Data Check	
65.8	Liquid (gm)		
0.0	less rinse (gm)		
65.8	Net Liquid (gm)	65.8	☑ QA/QC OK
+ 5.3	Silica Gel (gm)	5.3	☑ QA/QC OK
71.1	Total Vlc (gm)	71.1	☑ QA/QC OK

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	576.6	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				

Rinse: (ml or gm)

		Field Data Check	
72.9	Liquid (gm)		
0.0	less rinse (gm)		
72.9	Net Liquid (gm)	72.9	☑ QA/QC OK
+ 7.1	Silica Gel (gm)	7.1	☑ QA/QC OK
80.0	Total Vlc (gm)	80.0	☑ QA/QC OK

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				

Rinse: (ml or gm)

		Field Data Check	
	Liquid (gm)		
	less rinse (gm)		
	Net Liquid (gm)		☐ QA/QC OK
	Silica Gel (gm)		☐ QA/QC OK
	Total Vlc (gm)		☐ QA/QC OK

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Field Data Printout

			Test Method:	**CTM-013**	
Location:	EU00079 Stack		**Analyte:**	**H2SO4**	
Test Run:	1				
Client:	Guardian Industries, LLC		Bar. Press. (in. Hg):	29.40	Nozzle ID No: N/A
Project No:	14485		Static P:	-0.85	Nozzle Diameter (D_n): N/A
Source Area (ft^2):	90.76258		O_2 (dry volume %):	11.10	Probe ID No: 68-CC-9-4
Meter Operator:	J. Kolling	684	CO_2 (dry volume %):	7.90	Pitot C_p: 0.840
Probe Operator:	A. Pallone	675	N_2+CO (dry volume %):	81.00	Pitot Leak Check: ☑ Pass ☐ Fail
Test Date:	10/05/21				
Start Time:	08:40				
Stop Time:	09:40		H_2O (condensate, ml or gm):	74.0	Meter Box ID. No: 68-4
Leak Rate Before:	0.001 cfm	@ 15 "Hg	H_2O (silica, g):	5.9	Meter ΔH@: 1.87540
Leak Rate After:	0.001 cfm	@ 15 "Hg	Actual Moisture (%):	14.60	Meter Y_d: 1.00040

Traverse Point	Run Time 5.0 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{}$in. H_2O)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	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		Sq.Rt.ΔP								
QC-Check: Field Averages			0.5000	22.6200	588.5000	74.2500				
		☐ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Field Data Printout

			Test Method:		**CTM-013**
Location:	EU00079 Stack		**Analyte:**		**H2SO4**
Test Run:	2				
Client:	Guardian Industries, LLC		Bar. Press. (in. Hg):	29.40	Nozzle ID No: N/A
Project No:	14485		Static P:	-0.85	Nozzle Diameter (D_n): N/A
Source Area (ft^2):	90.76258		O_2 (dry volume %):	10.80	Probe ID No: 68-CC-9-4
Meter Operator:	J. Kolling	684	CO_2 (dry volume %):	8.50	Pitot C_p: 0.840
Probe Operator:	A. Pallone	675	N_2+CO (dry volume %):	80.70	Pitot Leak Check: ☑ Pass ☐ Fail
Test Date:	10/05/21				
Start Time:	10:35				
Stop Time:	11:35		H_2O (condensate, ml or gm):	65.8	Meter Box ID. No: 68-4
Leak Rate Before:	0.001 cfm	@ 15 "Hg	H_2O (silica, g):	5.3	Meter ΔH@: 1.87540
Leak Rate After:	0.001 cfm	@ 15 "Hg	Actual Moisture (%):	13.23	Meter Y_d: 1.00040

Traverse Point	Run Time 5.0 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}$ H_2O)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0		0.50	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.RLΔP								
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

			Test Method:		**CTM-013**
Location:	EU00079 Stack		**Analyte:**		**H2SO4**
Test Run:	3				
Client:	Guardian Industries, LLC		Bar. Press. (in. Hg):	29.40	Nozzle ID No: N/A
Project No:	14485		Static P:	-0.85	Nozzle Diameter (D_n): N/A
Source Area (ft^2):	90.76258		O_2 (dry volume %):	10.40	Probe ID No: 68-CC-9-4
Meter Operator:	J. Kolling	684	CO_2 (dry volume %):	8.90	Pitot C_p: 0.840
Probe Operator:	A. Pallone	675	N_2+CO (dry volume %):	80.70	Pitot Leak Check: ☑ Pass ☐ Fail
Test Date:	10/05/21				
Start Time:	12:26				
Stop Time:	13:26		H_2O (condensate, ml or gm):	72.9	Meter Box ID. No: 68-4
Leak Rate Before:	0.001 cfm	@ 15 "Hg	H_2O (silica, g):	7.1	Meter ΔH@: 1.87540
Leak Rate After:	0.001 cfm	@ 15 "Hg	Actual Moisture (%):	14.66	Meter Y_d: 1.00040

Traverse Point	Run Time 5.0 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{}$in. H_2O)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			771.500						
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		Sq.Rt.ΔP								
QC-Check: Field Averages			0.5000	22.7100	586.0000	78.1167				
		☐ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☐ 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: Sulfate

Standards Calibration Data

Calibration Point	**Date of**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Conc. (mg/L)	**Injection**	**0.0000**	**0.2999**	**0.4999**	**0.9998**	**1.9996**	**4.9989**	**5.9987**
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	0.1455	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**	**0.1459**	**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 ess 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	
Intercept	b =	0.0050	
Coeff.	R^2 =	0.9997	Yes

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:	105/21
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_4Cl	KCl	$MgCl_2 \cdot 6H_2O$	$CaCl_2 \cdot 2H_2O$
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%
Recomended Analyte Concentration (mg/l)	500	1,200	2,500	2,500	2,500	3,500

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	AliquotStock	
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:	10/5/21
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_2HPO_4	Na_2SO_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%
Recomended Analyte Concentration (mg/L)	500	1007.21	2000	3000	3000	5000	5000	7000

Amount of Solid Required to Achieve the Above Stock Solution Concentration In The Listed Volumetric Flask:

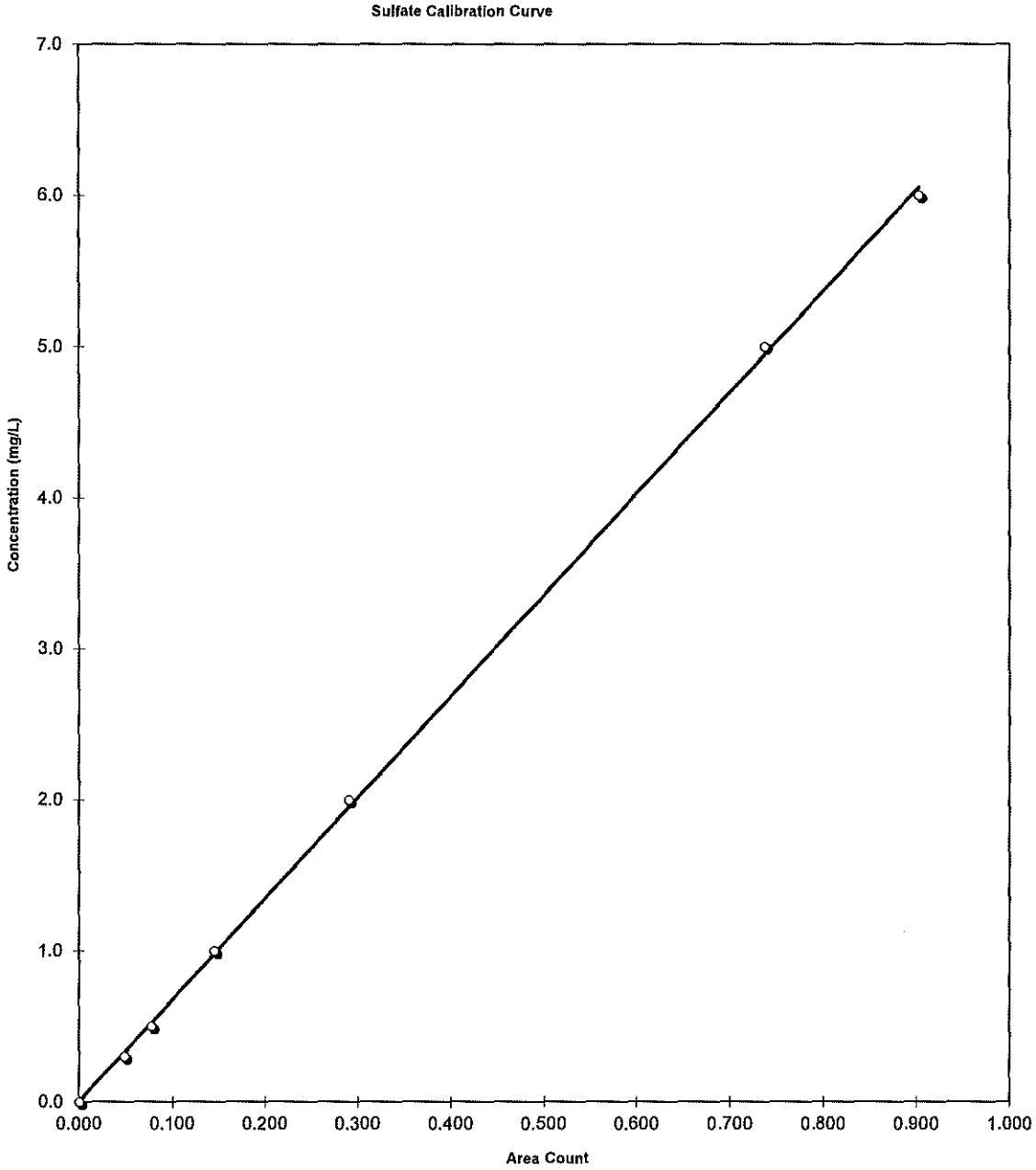
500 ml	0.5525	0.8302	1.4997	1.9316	2.0561	3.7370	3.6964	4.1341
Size of Flask	500 ml							
Amount of Solid Used							3.6956 g	
Actual Concentration (mg/L)							4998.91	

Concentration in the Five Cal Flasks (mg/L)
Stock (1 liter Flask) Solution Concentrations
10 ml Original Solution Used 49.9891

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:	10/5/21
Applicable Analytical Method:			U.S. EPA Method 300.1	Analyte:	Sulfate



Page 1 of 1
File: 14485_SPS-64-005_StandardICS90_V22
Date: 10/28/2021
Time: 3:26 PM

Sample Information

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

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:	105/21
Applicable Analytical Method:			U.S. EPA Method 300.1	Analyte:	Sulfate

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

Average Flow Rate

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_{soln} (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

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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

									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

MDL Reference	40 CFR 136, Appendix B
CleanAir Reference	SOP EPA5-11
Matrix	Deionized Water
Analyte	Sulfate
Spike Concentration	0.2999 mg/L
Slope	6.7083
Intercept	0.0050
Coefficient of Corr.	0.9997

Non-Iterative Study

No. of Replicates	$t_{(n-1,0.99)}$
7	3.143
8	2.998
9	2.896
10	2.821
11	2.764
16	2.602
21	2.528

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:	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

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

$$\Delta_{Injection} = |Area_{Trial\ 2} - Area_{Trial\ 1}|$$

Where:

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

$D_{Injection}$ = 0.0003
$Area_{Trial2}$ = 0.0755
$Area_{Trial1}$ = 0.0752

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

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

Where:

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.

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

$D_{PreMean\%}$ = 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.

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

$\overline{X}$ = 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.

$\overline{X}$ = 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 = $\overline{X}_{All}$
y_i = Actual area concentration values for each individual injection.
$\bar{y}$ = Average of all concentration values = $\overline{Y}_{All}$
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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Where:
b = Y-axis intercept.
$\bar{x}$ = Average of all area count values = $\overline{X}_{All}$
$\bar{y}$ = Average of all concentration values = $\overline{Y}_{All}$

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:	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

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 = $\overline{X}_{All}$
$\bar{y}$ = Average of all concentration values = $\overline{Y}_{All}$
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:	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

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.

$$\Delta_{Injection} = |Area_{Trial\ 2} - Area_{Trial\ 1}|$$

Where:

$D_{Injection}$ = 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:	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

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

$$\Delta_{Injection} = \frac{\left|Area_{Trail2} - Avg_{Inj}\right|}{Avg_{Inj}} 100$$

$D_{Injection}$	=	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).

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

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.

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

Where:

$AvgM_{f\_i}$	=	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:	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

15b. Determination of standard deviation of spike result.

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

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.

$$V_{f\_i} = \left(\sigma_{f\_i}\right)^2$$

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.

$$R_f = 100 \frac{AvgM_{f\_i}}{RA}$$

Where:

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:	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

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).

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

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_i} = Standard deviation of spike result.

MDL = 0.018
$t_{(n-1, 0.99)}$ = 2.998
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

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

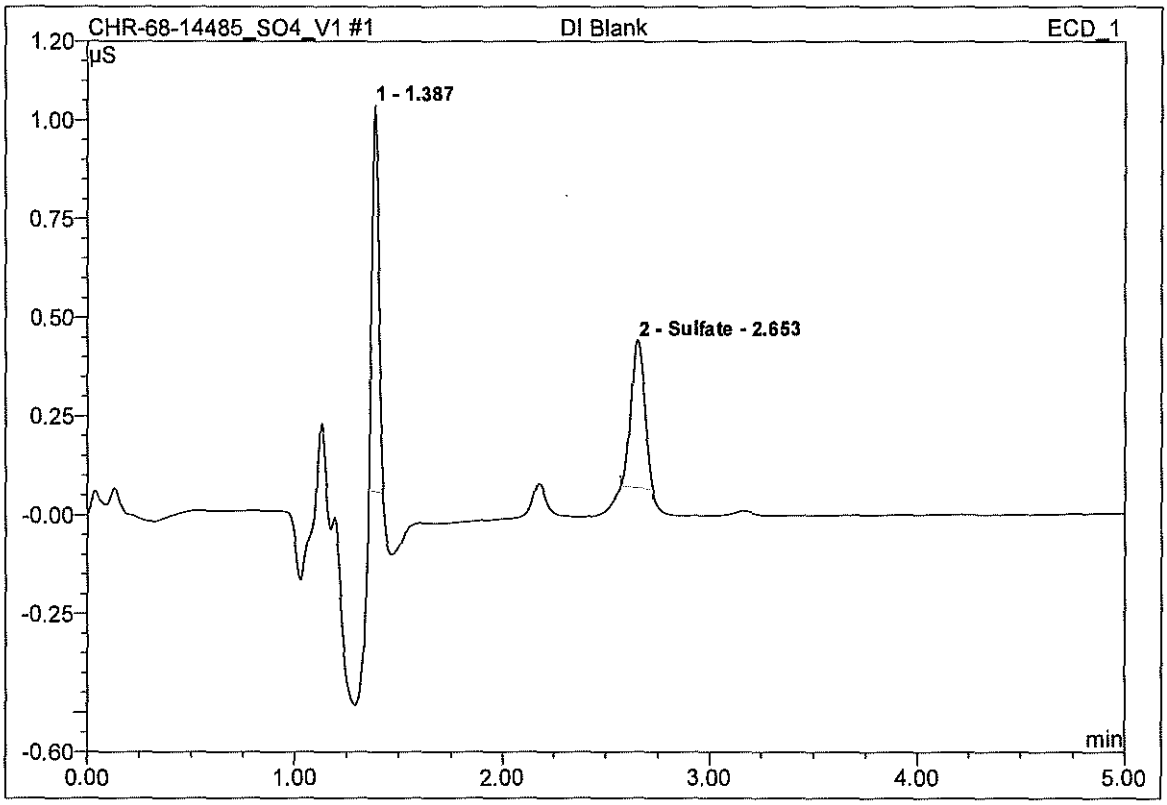
10/5/2021 12:00	411
10/5/2021 13:00	411
10/5/2021 14:00	411
Average	**411**

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**

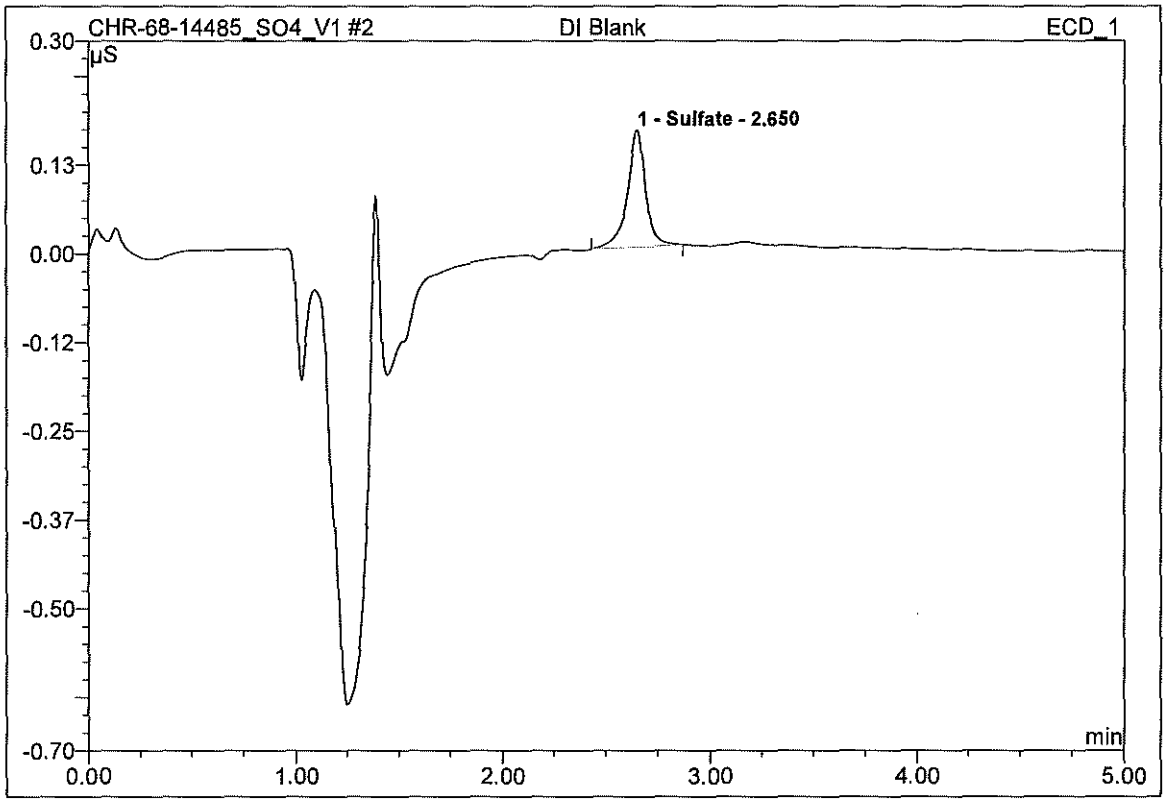


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	1.39	n.a.	0.977	0.037	57.05	n.a.	BM
2	2.65	Sulfate	0.374	0.028	42.95	n.a.	BMB
Total:			1.351	0.065	100.00	0.000	

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**

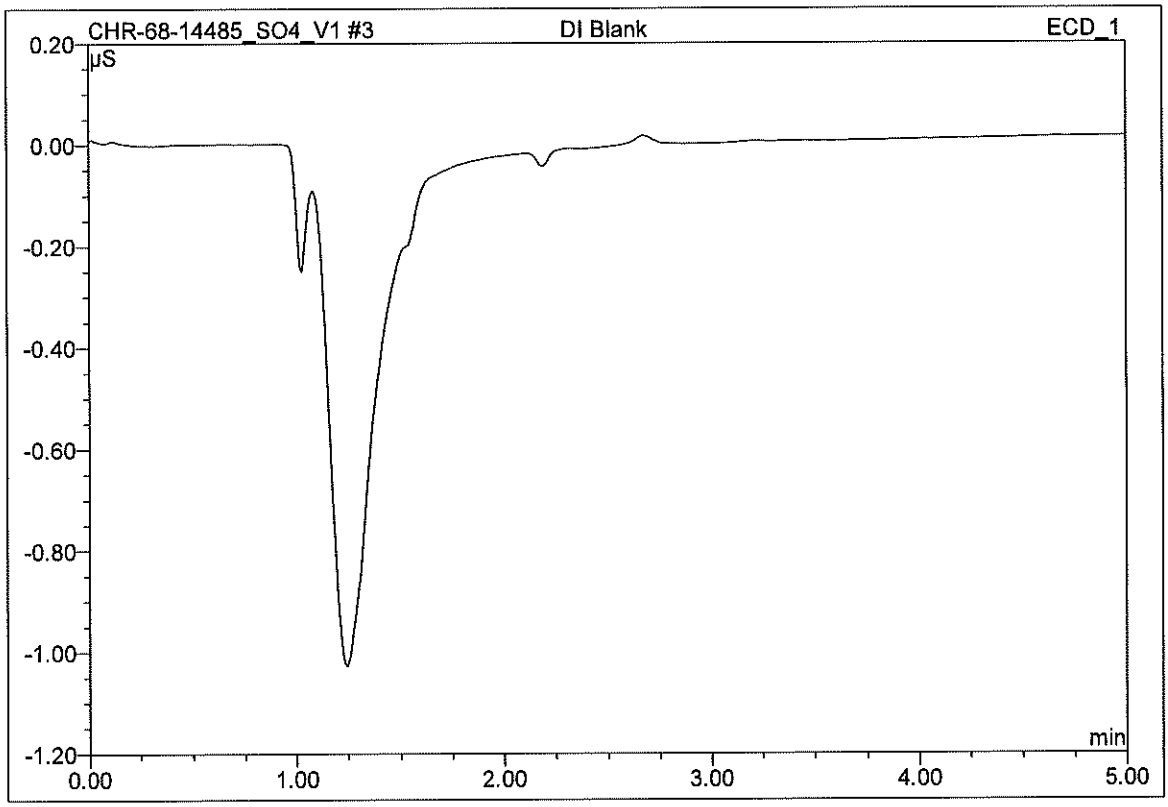


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	0.164	0.017	100.00	n.a.	BMB
Total:			0.164	0.017	100.00	0.000	

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**

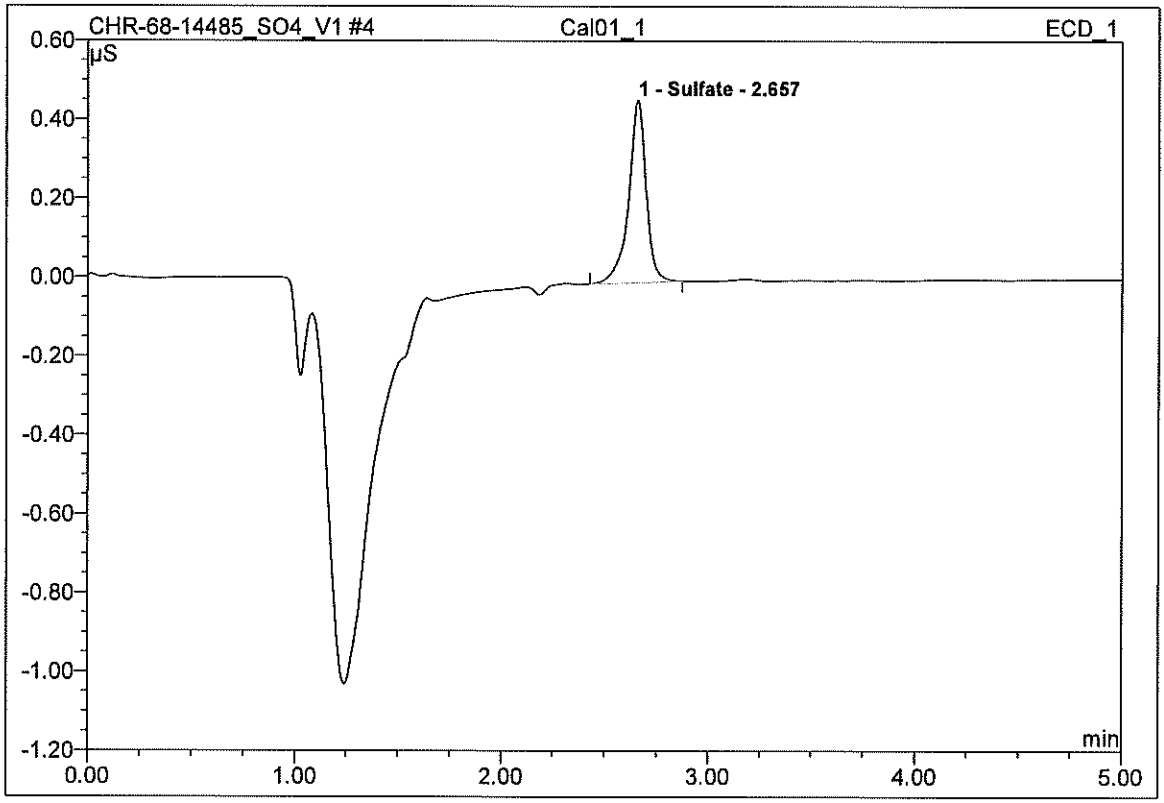


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

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**

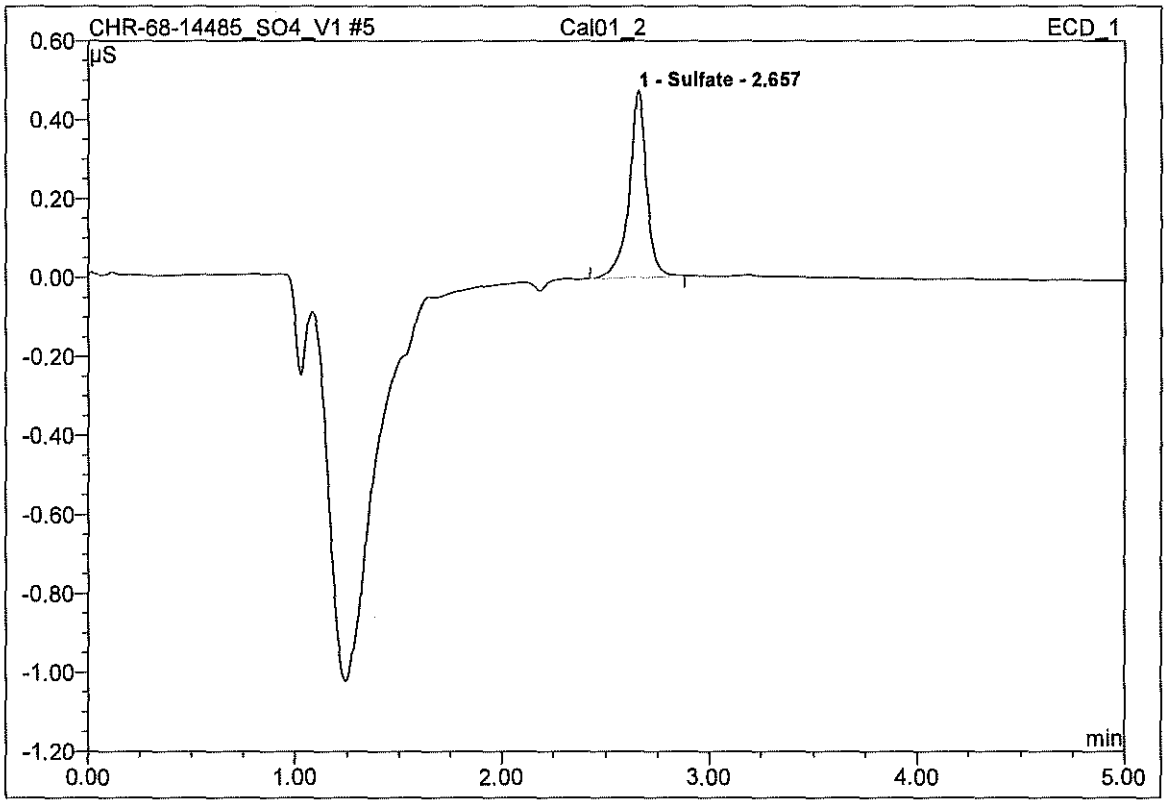


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.462	0.045	100.00	n.a.	BMB
Total:			0.462	0.045	100.00	0.000	

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**

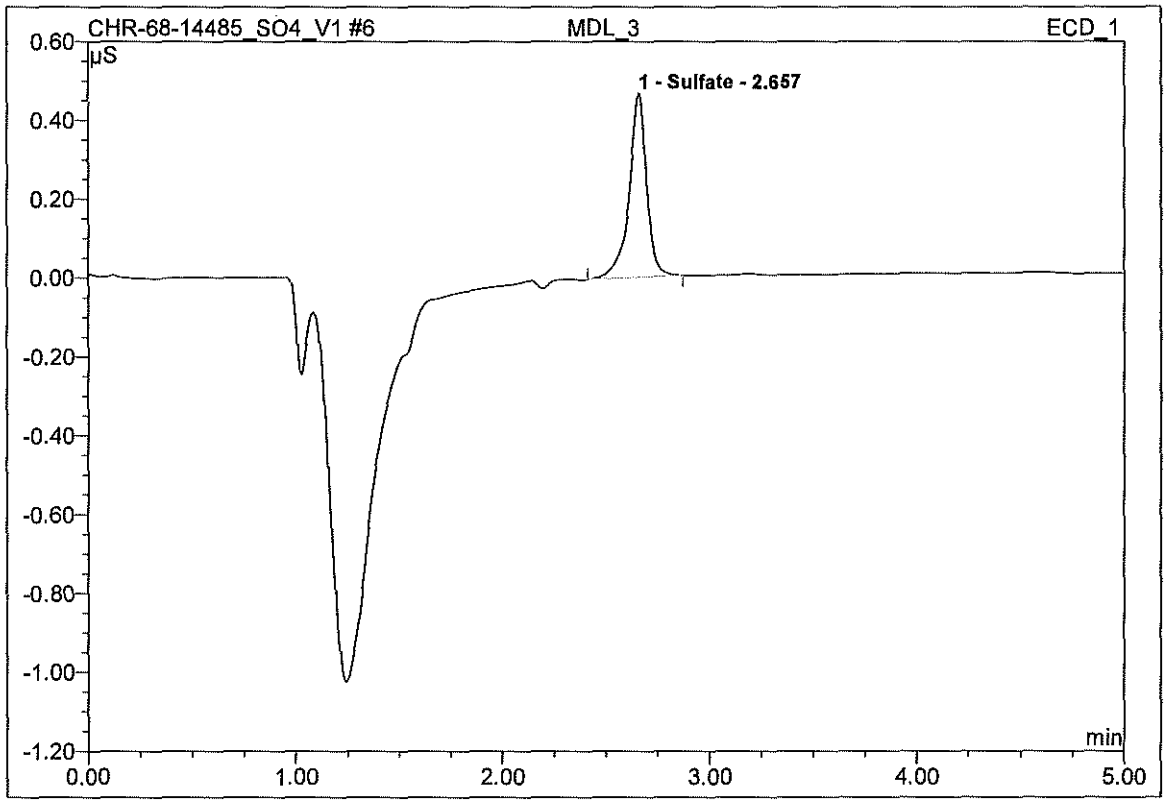


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.472	0.047	100.00	n.a.	BMB
Total:			0.472	0.047	100.00	0.000	

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**

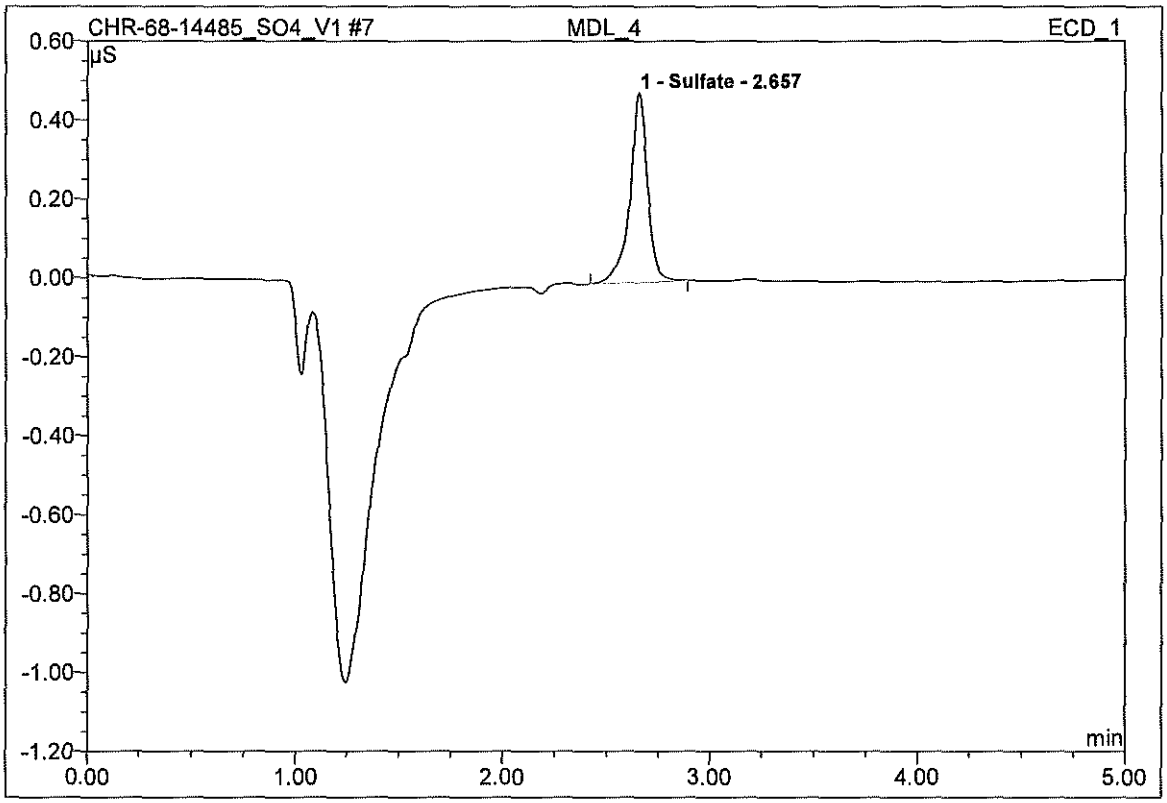


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.466	0.046	100.00	n.a.	BMB
Total:			0.466	0.046	100.00	0.000	

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**

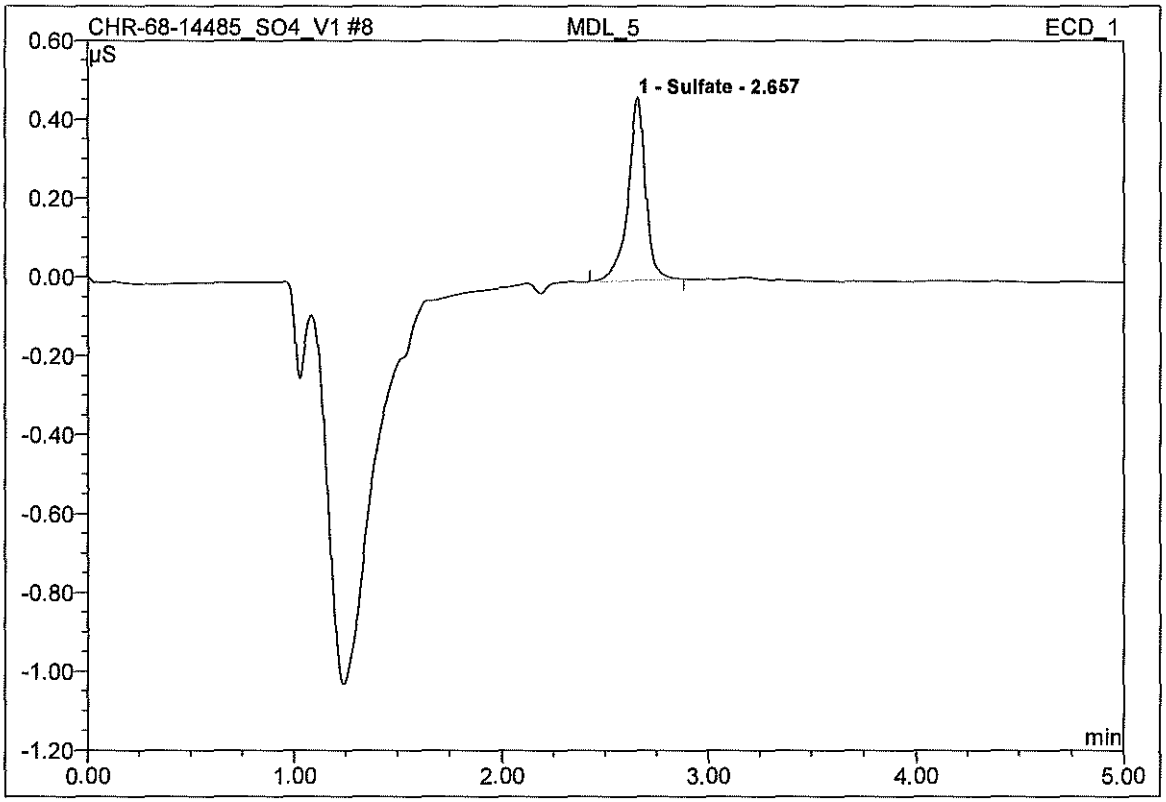


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.481	0.048	100.00	n.a.	BMB
Total:			0.481	0.048	100.00	0.000	

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**

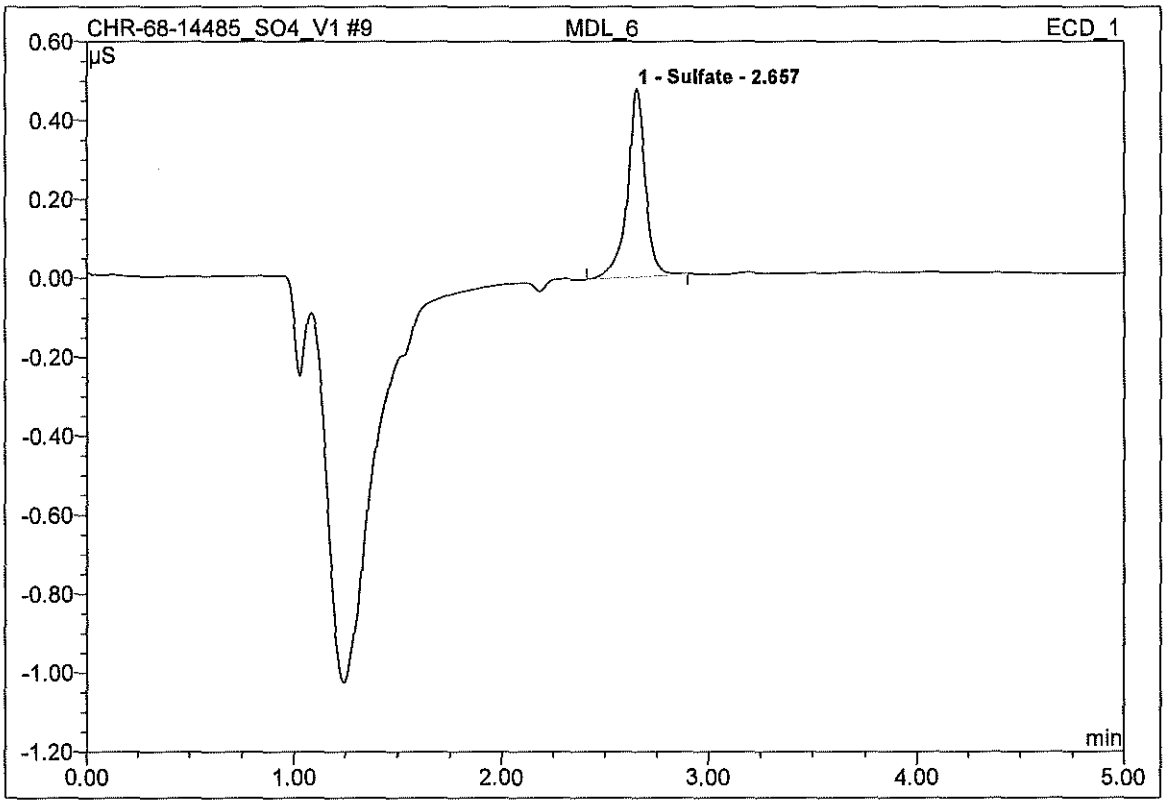


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.462	0.046	100.00	n.a.	BMB
Total:			0.462	0.046	100.00	0.000	

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**

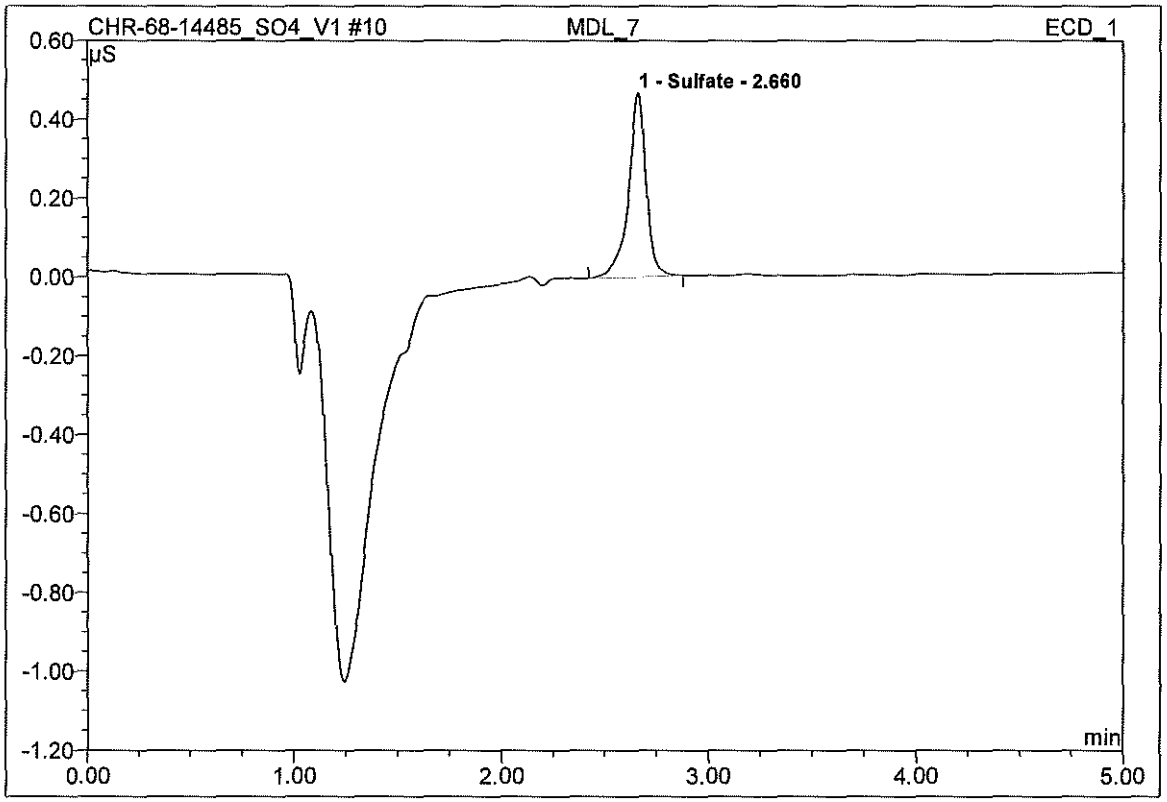


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.478	0.048	100.00	n.a.	BMB
Total:			0.478	0.048	100.00	0.000	

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**

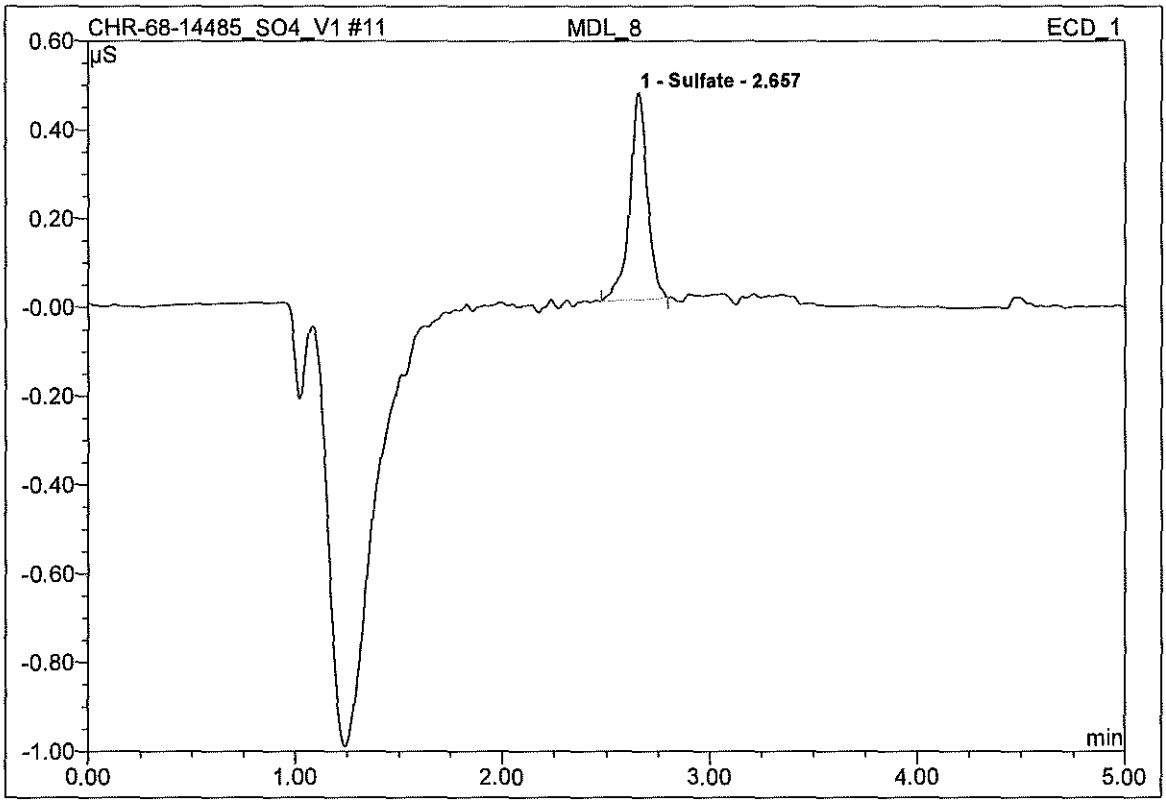


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.467	0.046	100.00	n.a.	BMB
Total:			0.467	0.046	100.00	0.000	

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**

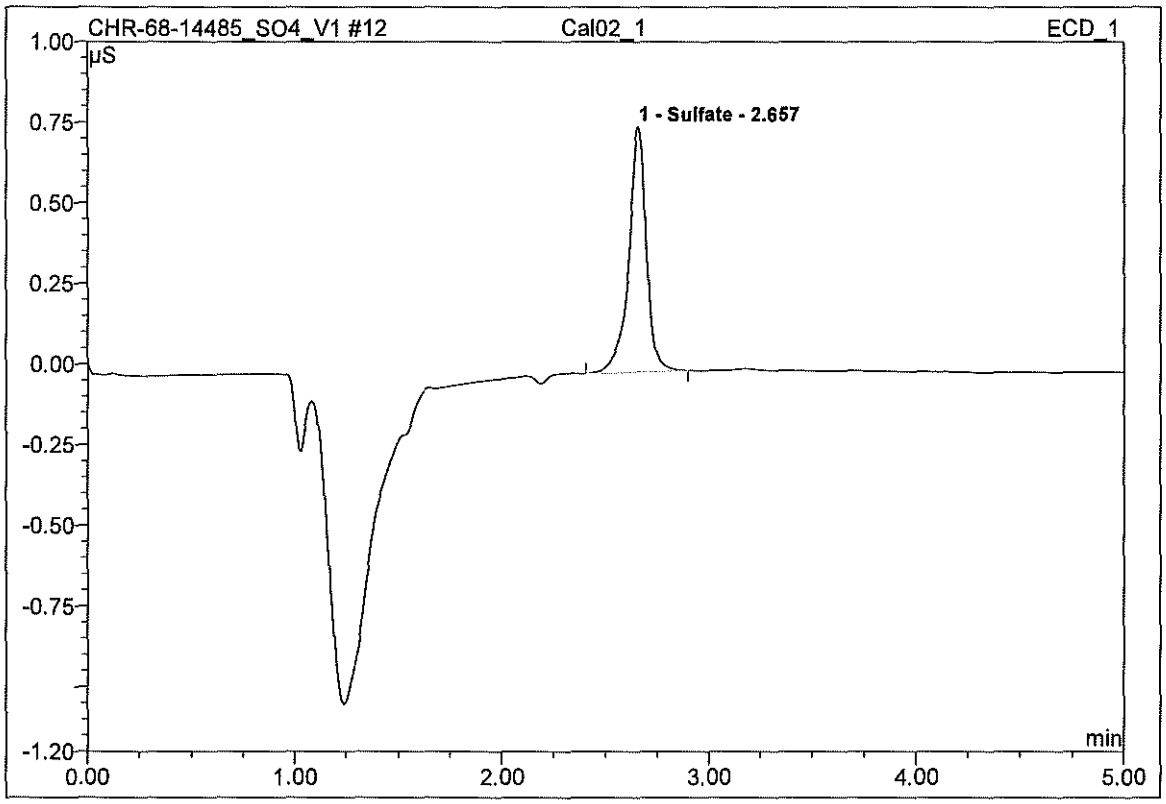


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.467	0.046	100.00	n.a.	BMB
Total:			0.467	0.046	100.00	0.000	

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**

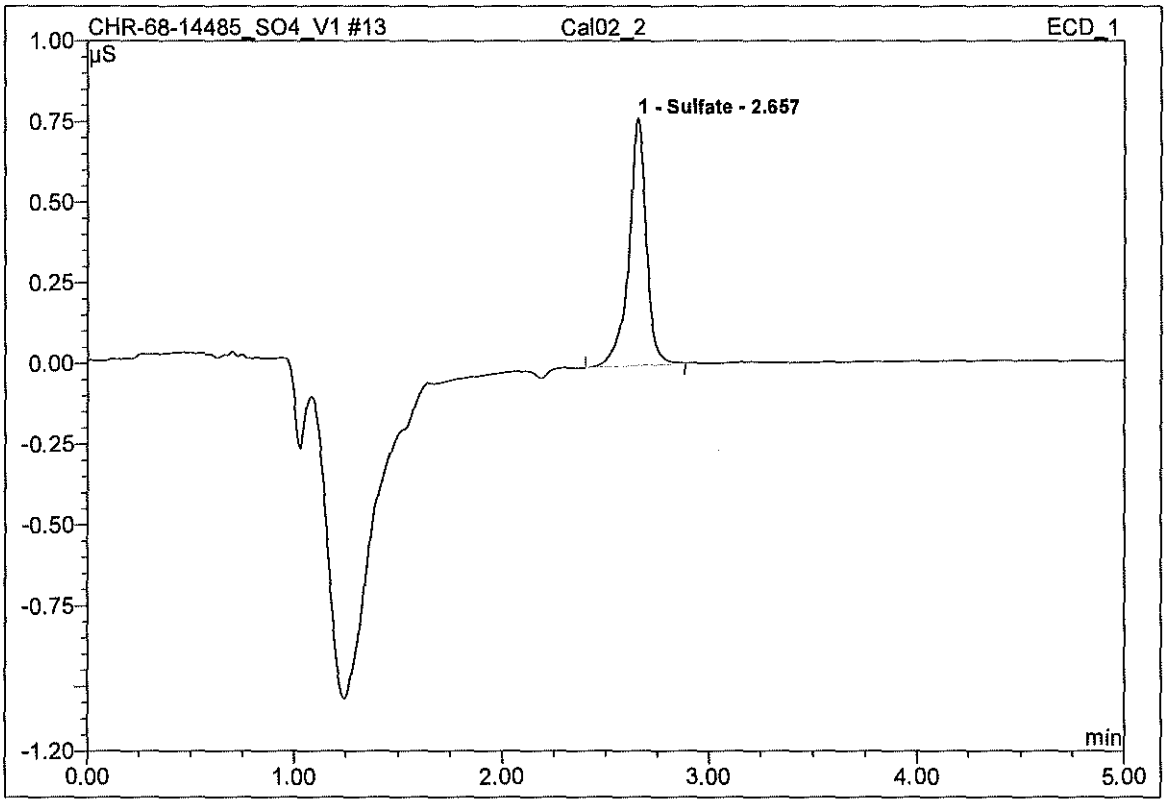


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.763	0.075	100.00	n.a.	BMB
Total:			0.763	0.075	100.00	0.000	

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**

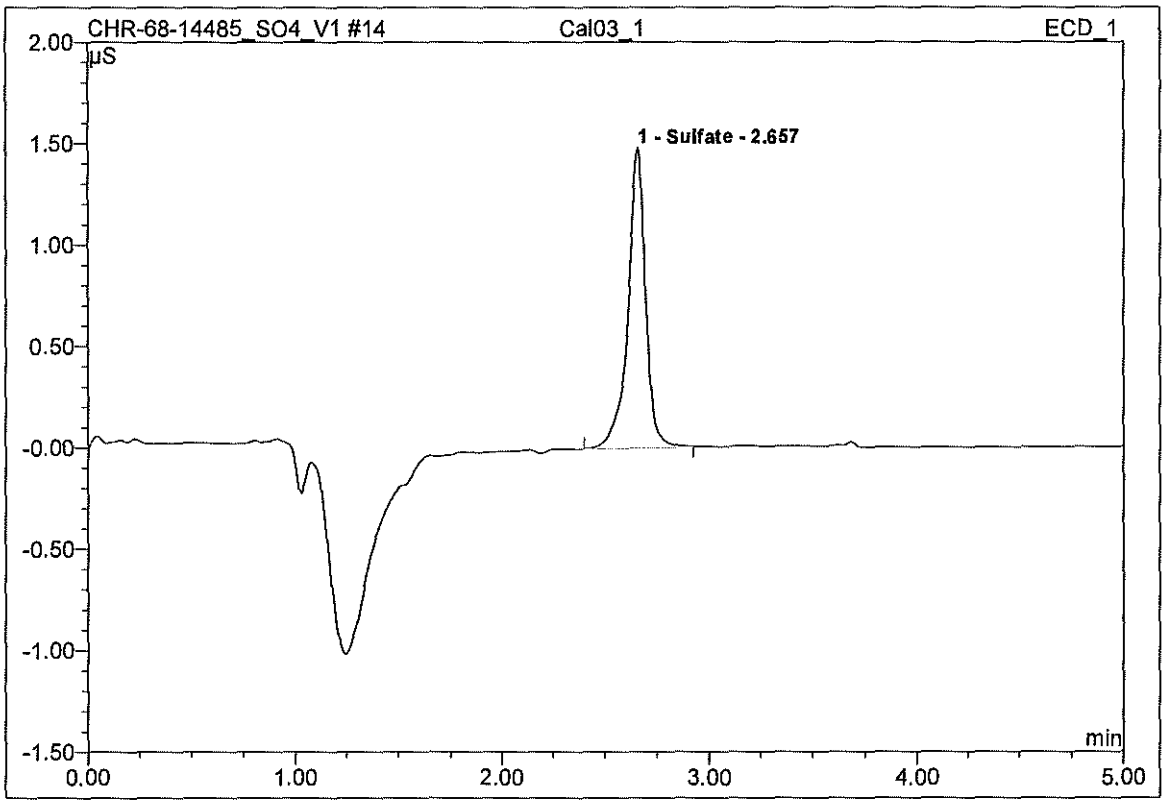


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.766	0.075	100.00	n.a.	BMB
Total:			0.766	0.075	100.00	0.000	

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**

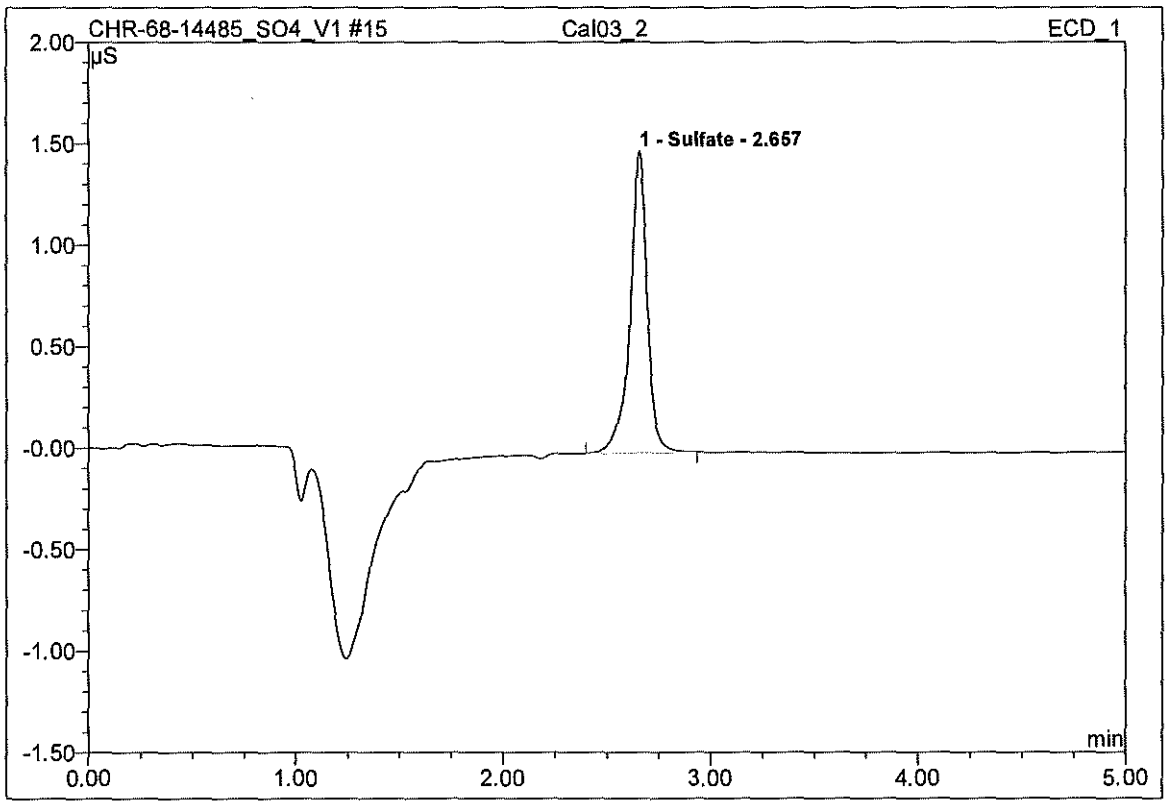


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	1.478	0.145	100.00	n.a.	BMB
Total:			1.478	0.145	100.00	0.000	

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**

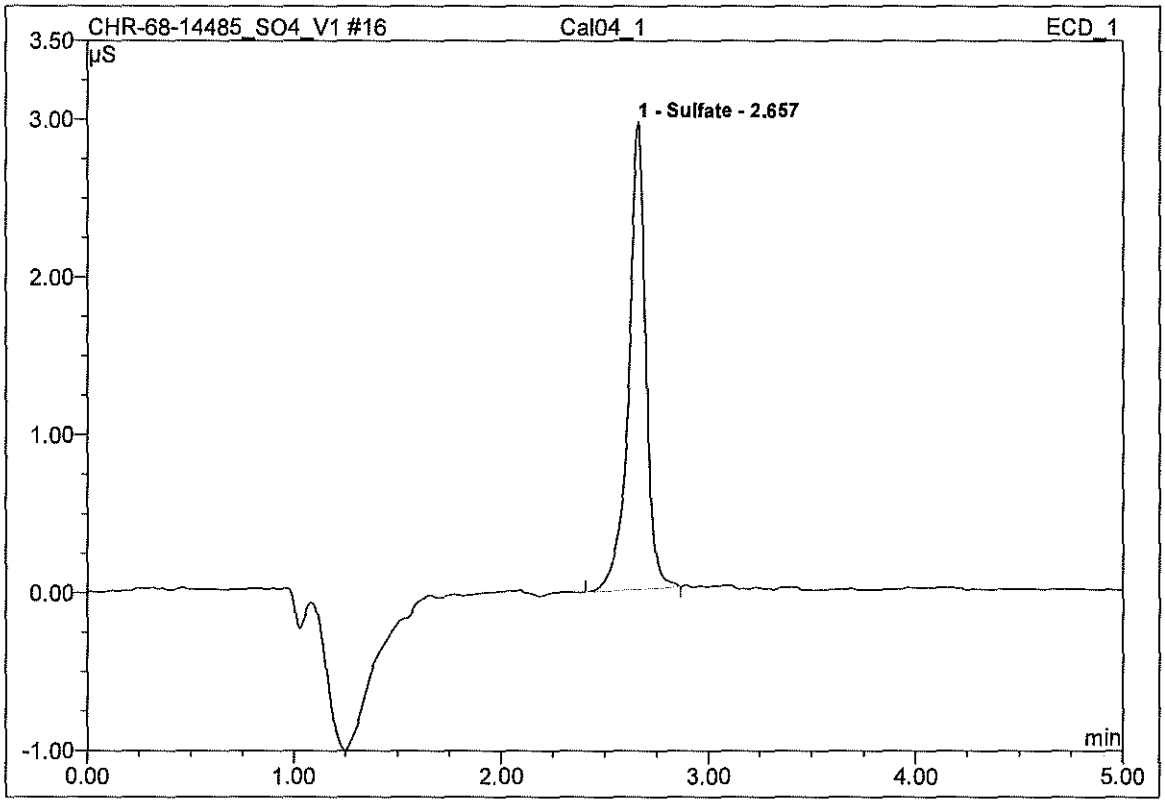


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	1.489	0.146	100.00	n.a.	BMB
Total:			1.489	0.146	100.00	0.000	

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**

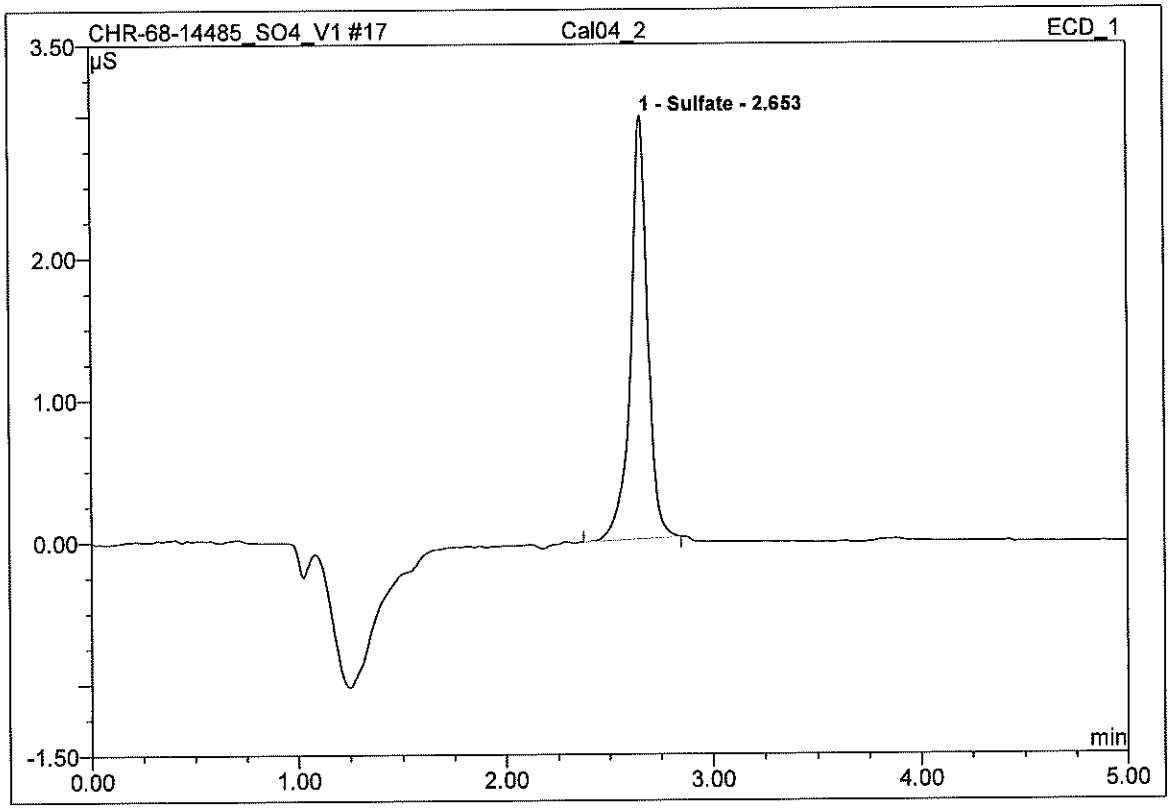


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	2.959	0.284	100.00	n.a.	BMB
Total:			2.959	0.284	100.00	0.000	

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**

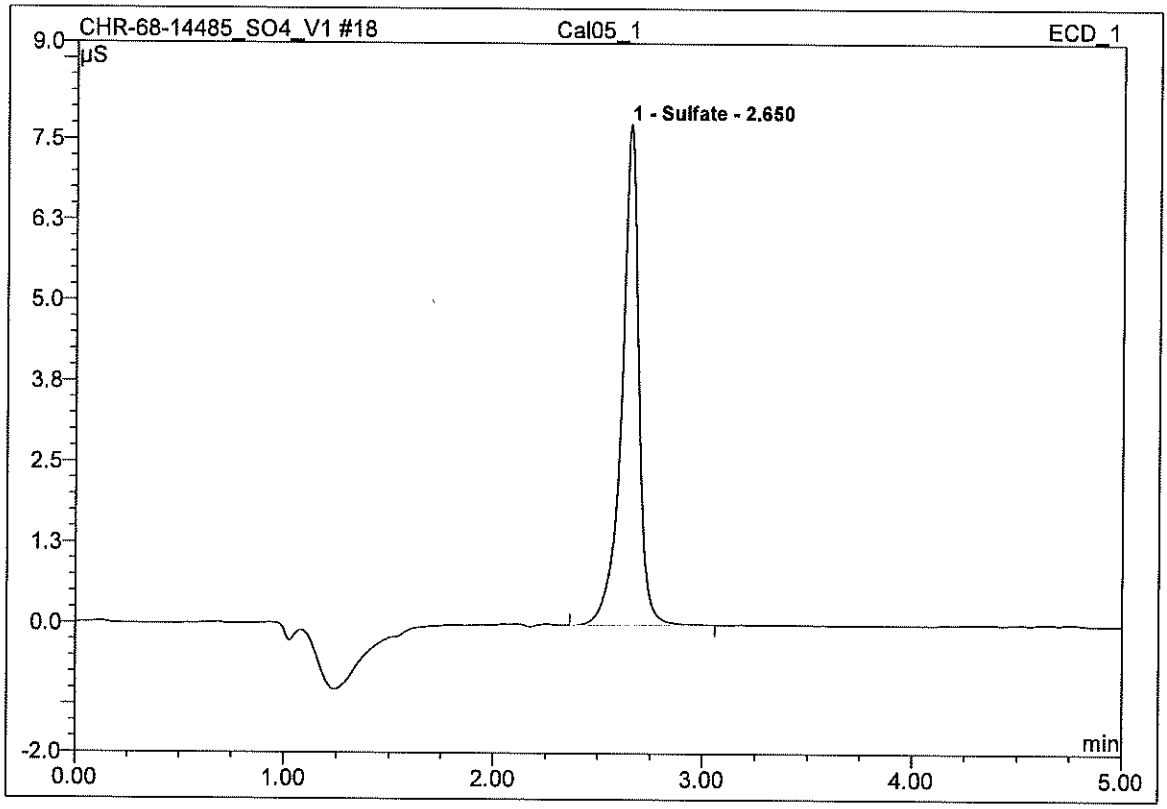


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	2.978	0.286	100.00	n.a.	BMB
Total:			2.978	0.286	100.00	0.000	

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**

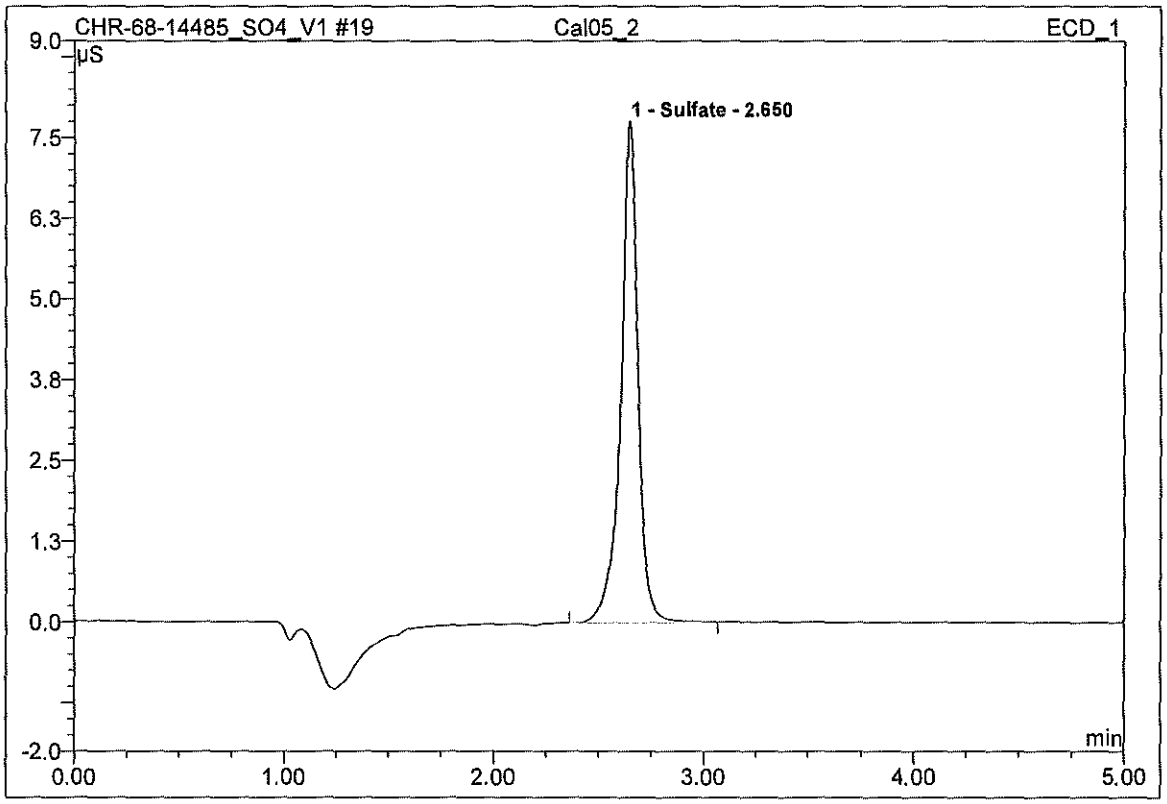


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	7.757	0.735	100.00	n.a.	BMB
Total:			7.757	0.735	100.00	0.000	

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**

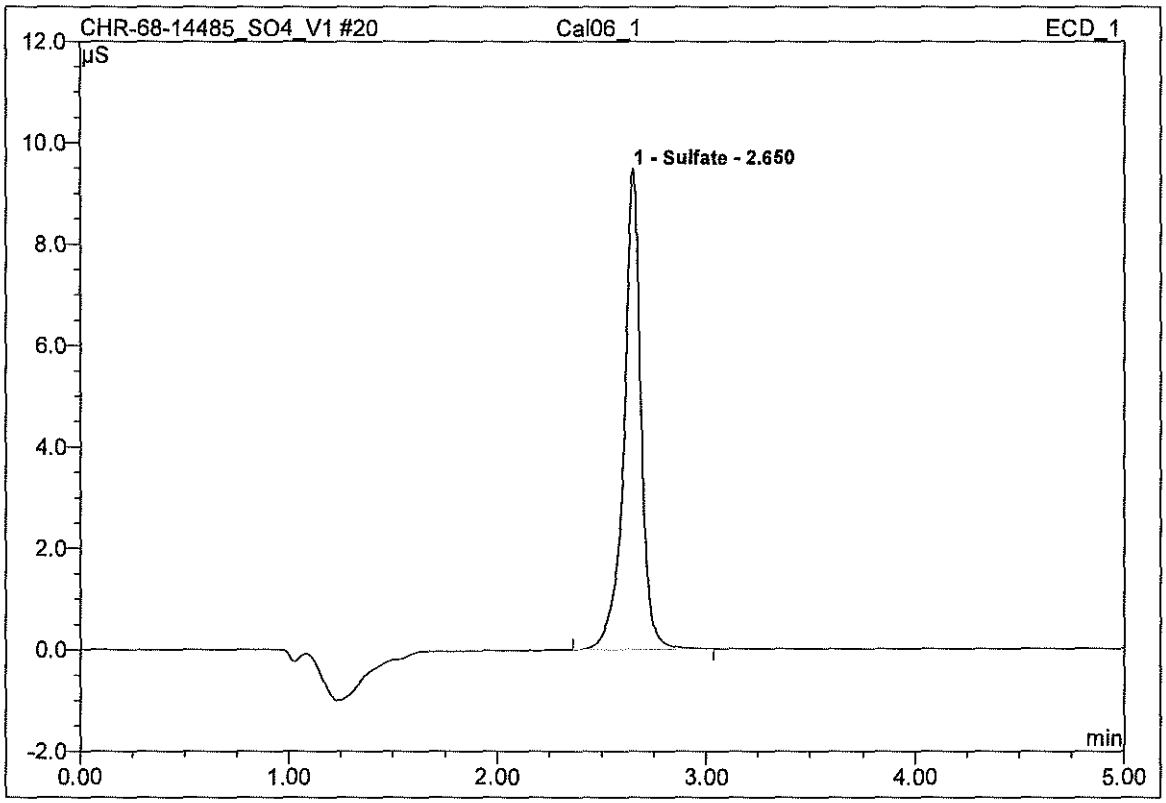


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	7.770	0.738	100.00	n.a.	BMB
Total:			7.770	0.738	100.00	0.000	

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**

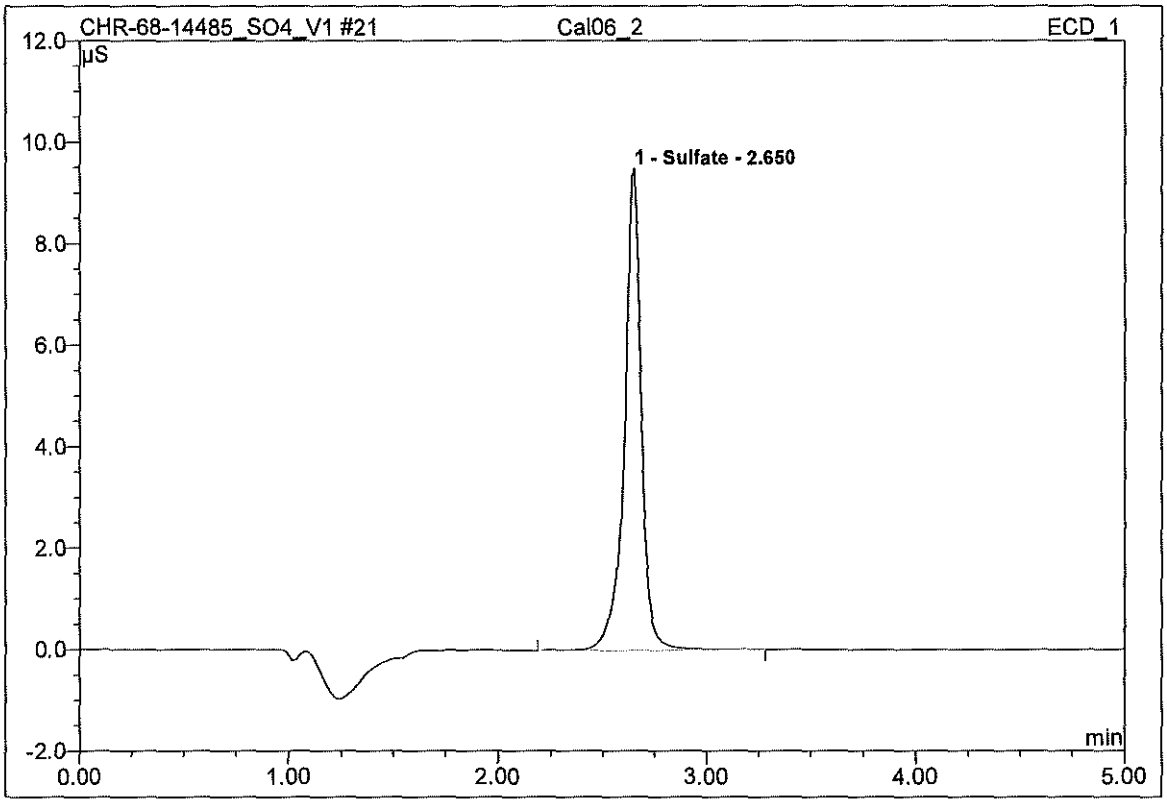


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	9.477	0.894	100.00	n.a.	BMB
Total:			9.477	0.894	100.00	0.000	

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**

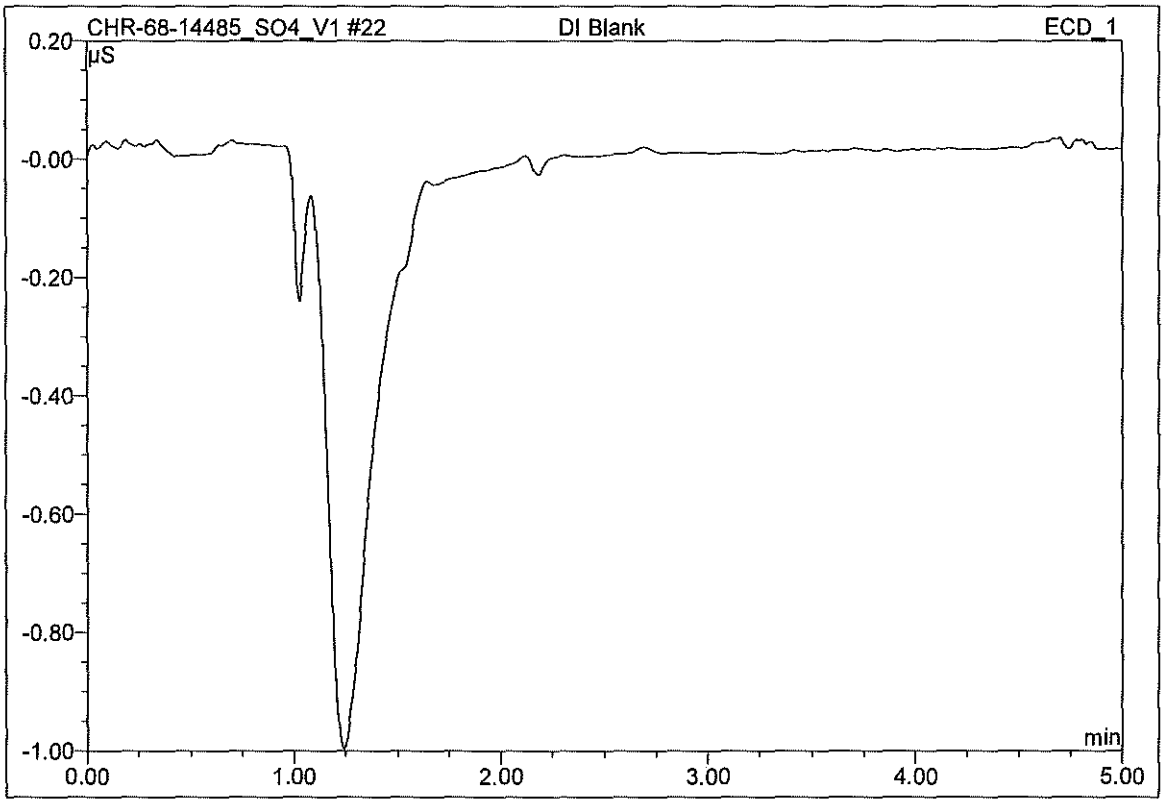


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	9.490	0.908	100.00	n.a.	BMB
Total:			9.490	0.908	100.00	0.000	

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

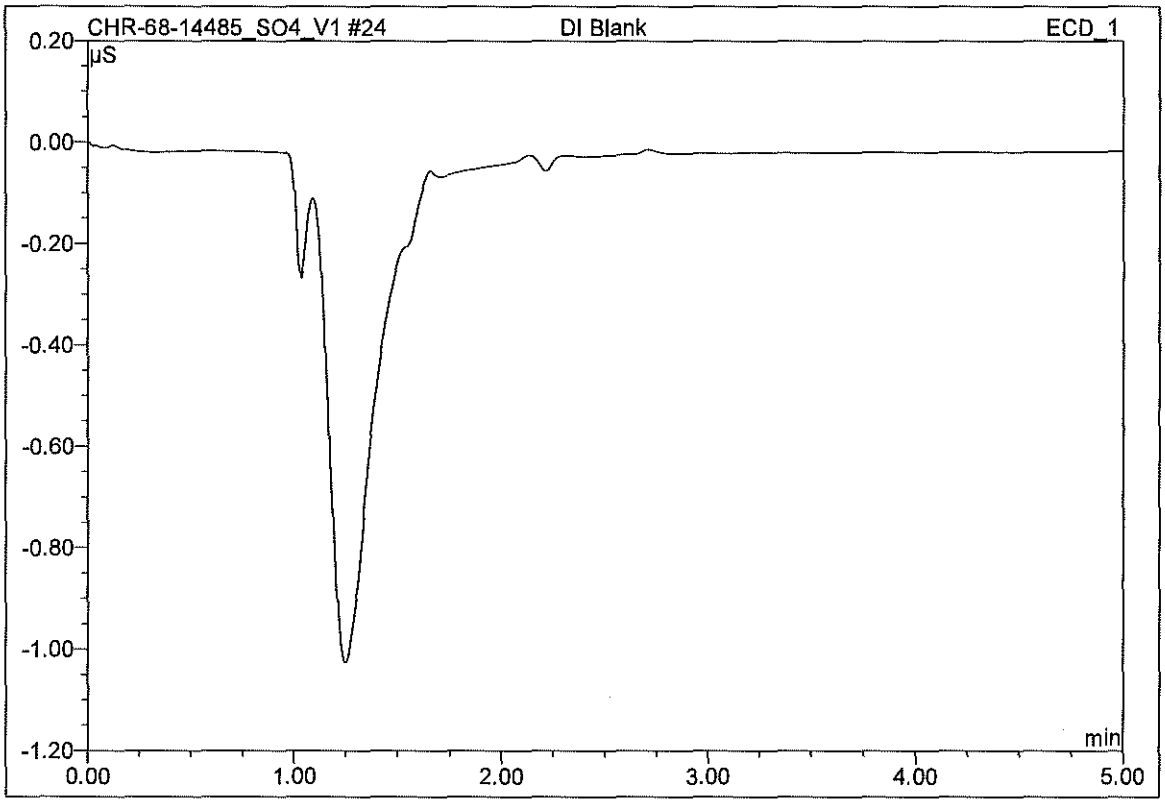
Can't open raw data file "C:\Chromel\data\08011110_1\2_Data\14485\CHR-68-14485_SO4_V1.SEQ\ECD_1.CHL\11434.acd".
The system cannot find the file specified.

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**

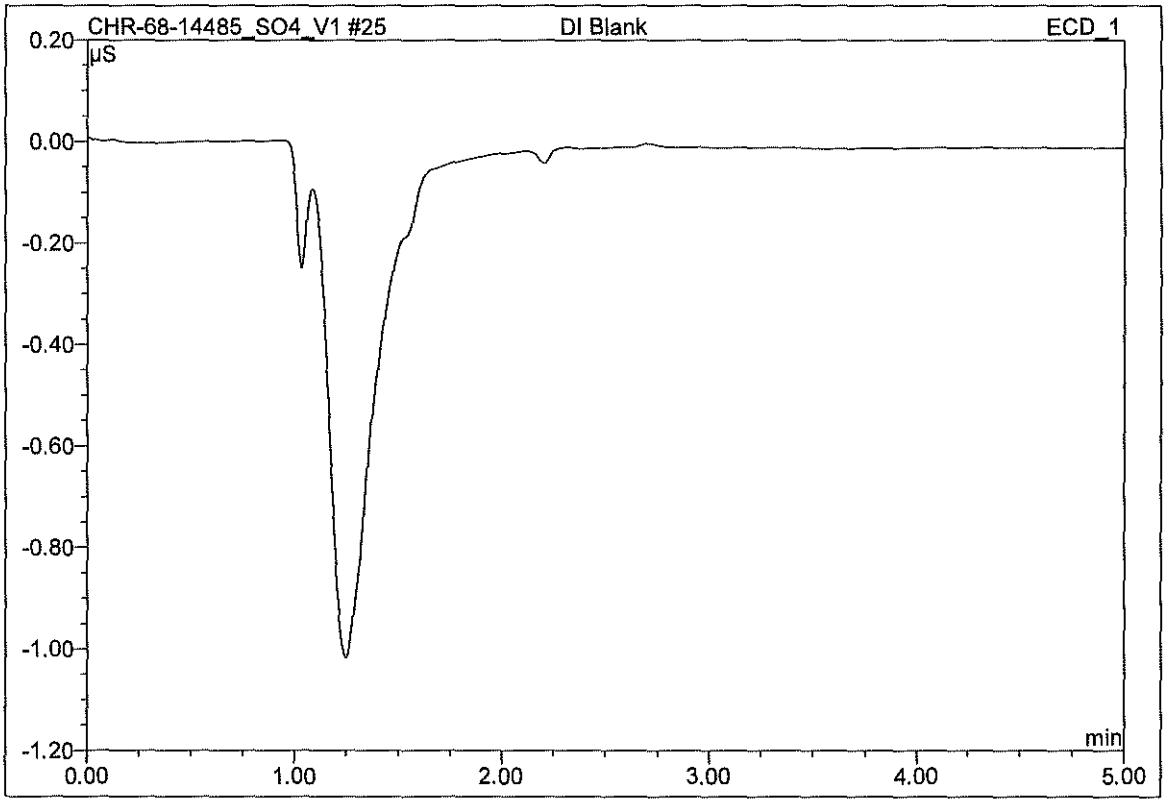


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

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**

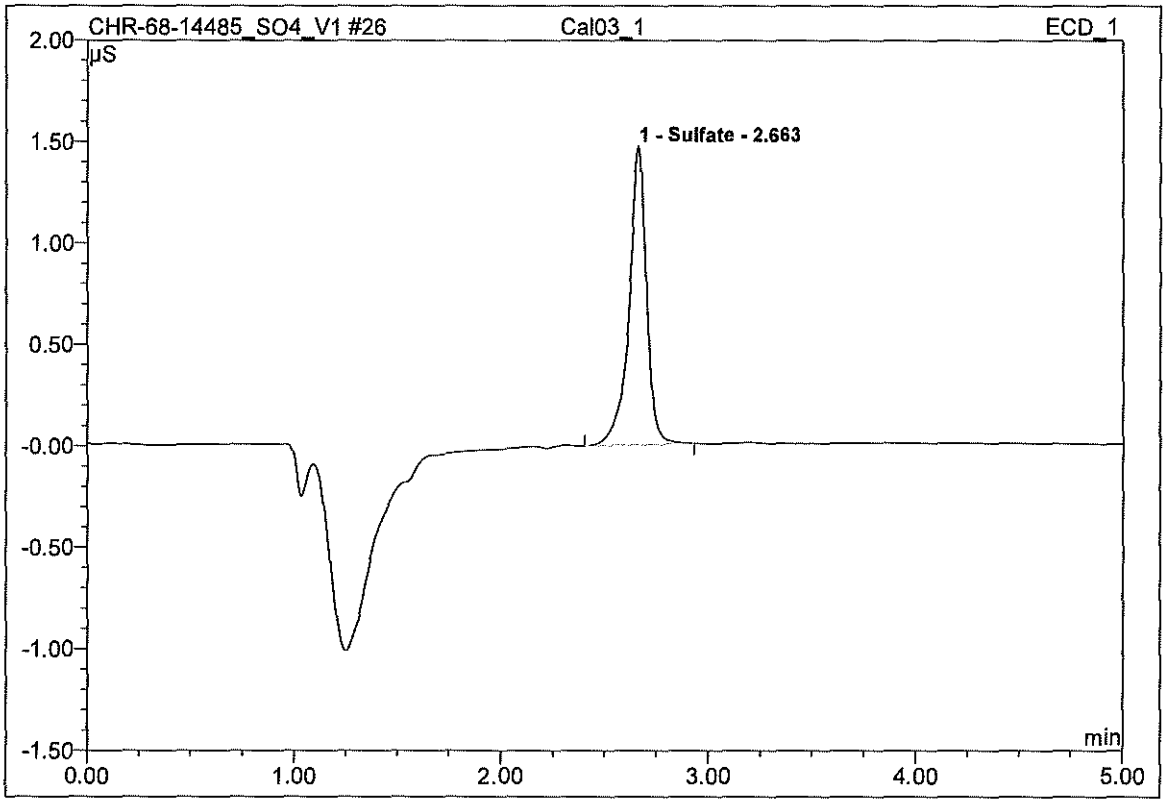


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

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**

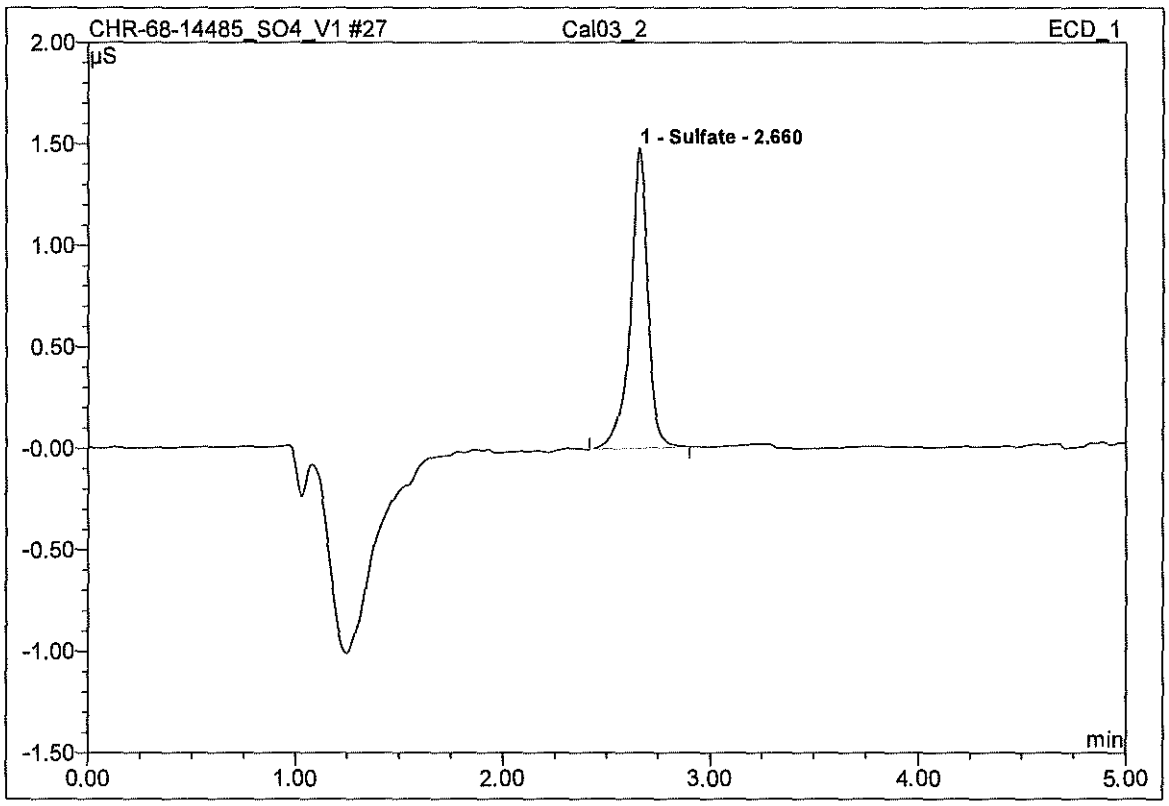


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	1.472	0.145	100.00	n.a.	BMB
Total:			1.472	0.145	100.00	0.000	

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**

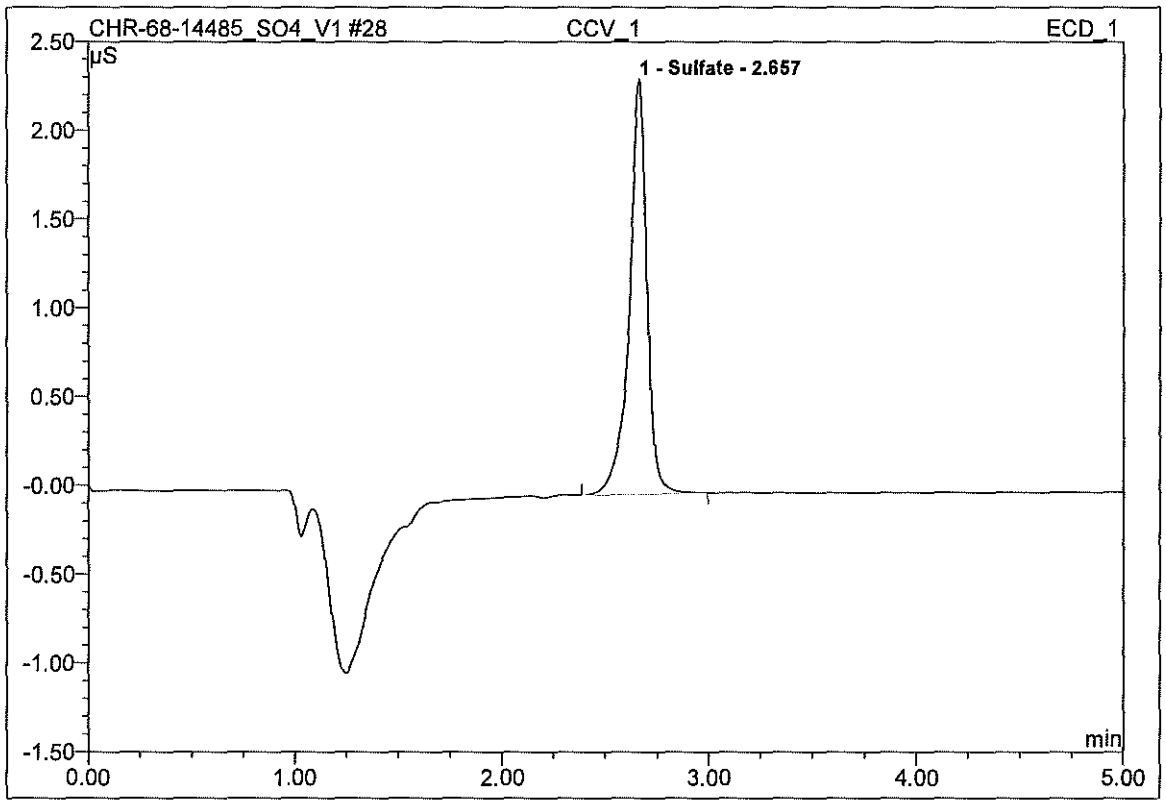


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	1.478	0.146	100.00	n.a.	BMB
Total:			1.478	0.146	100.00	0.000	

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**

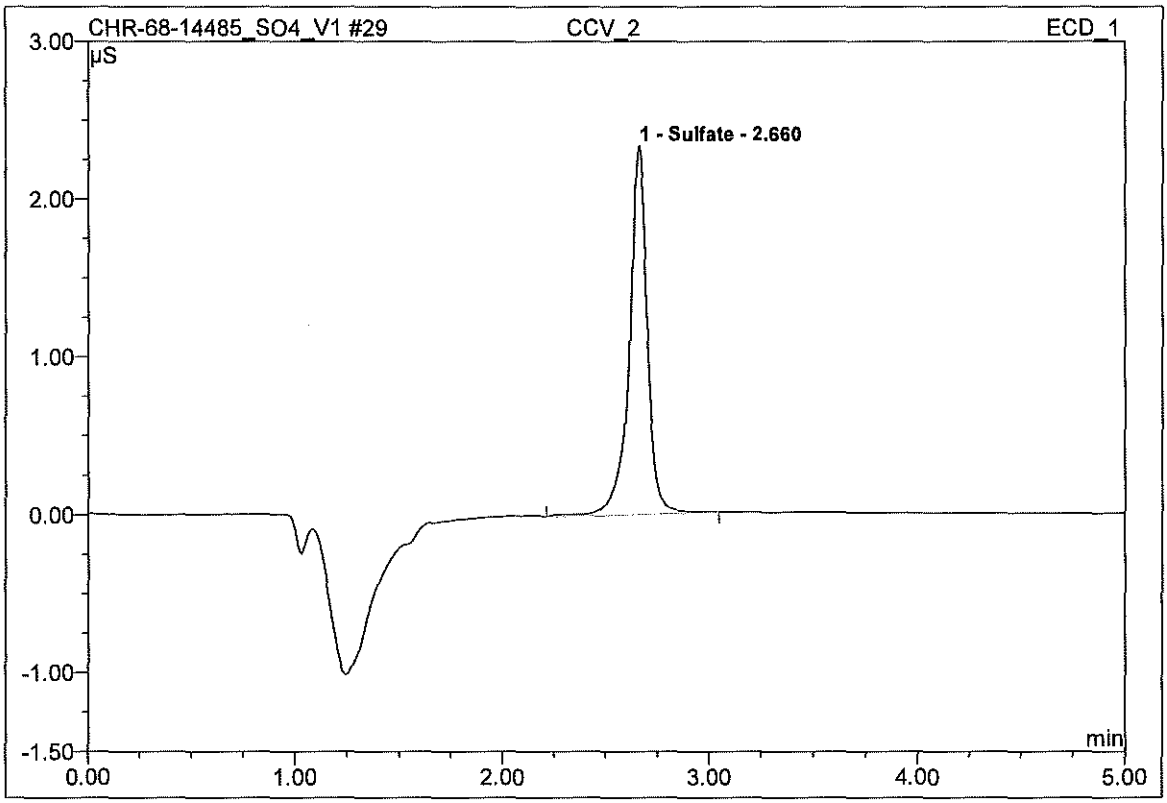


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	2.337	0.229	100.00	n.a.	BMB
Total:			2.337	0.229	100.00	0.000	

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**

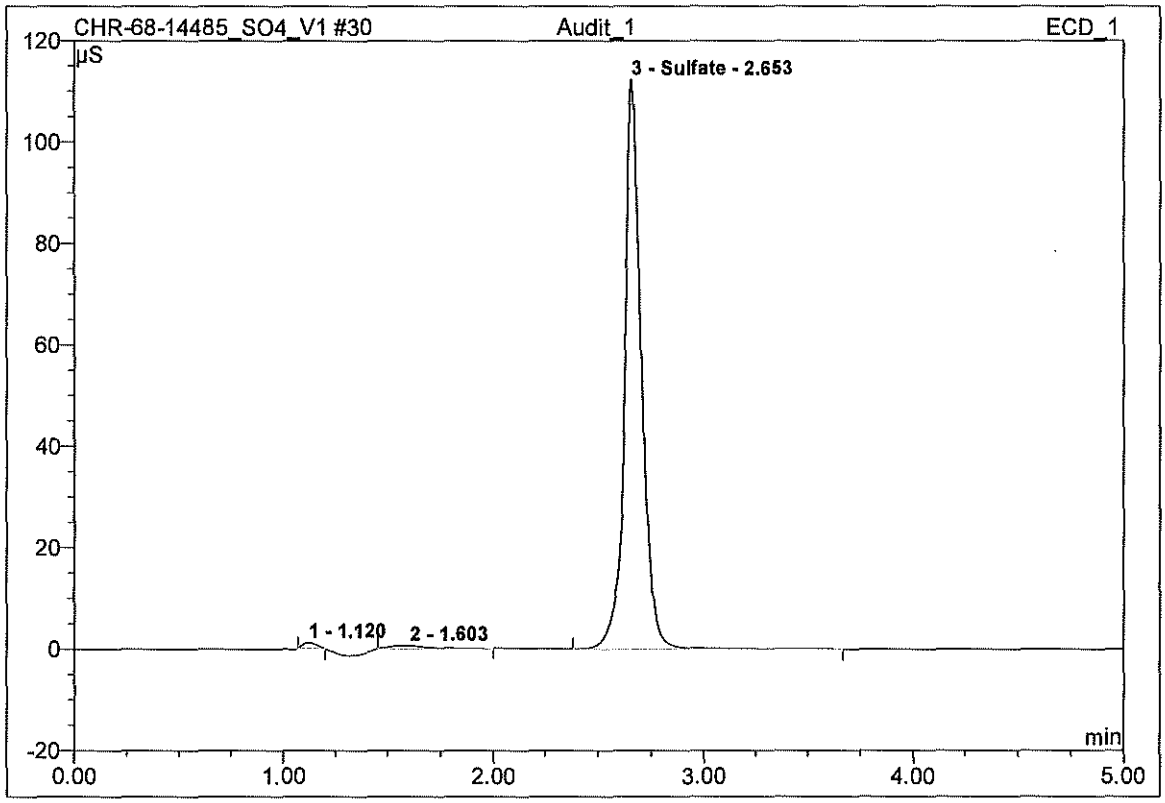


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	2.337	0.237	100.00	n.a.	BMB
Total:			2.337	0.237	100.00	0.000	

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:	**AS40-5Inj1Start**	*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**

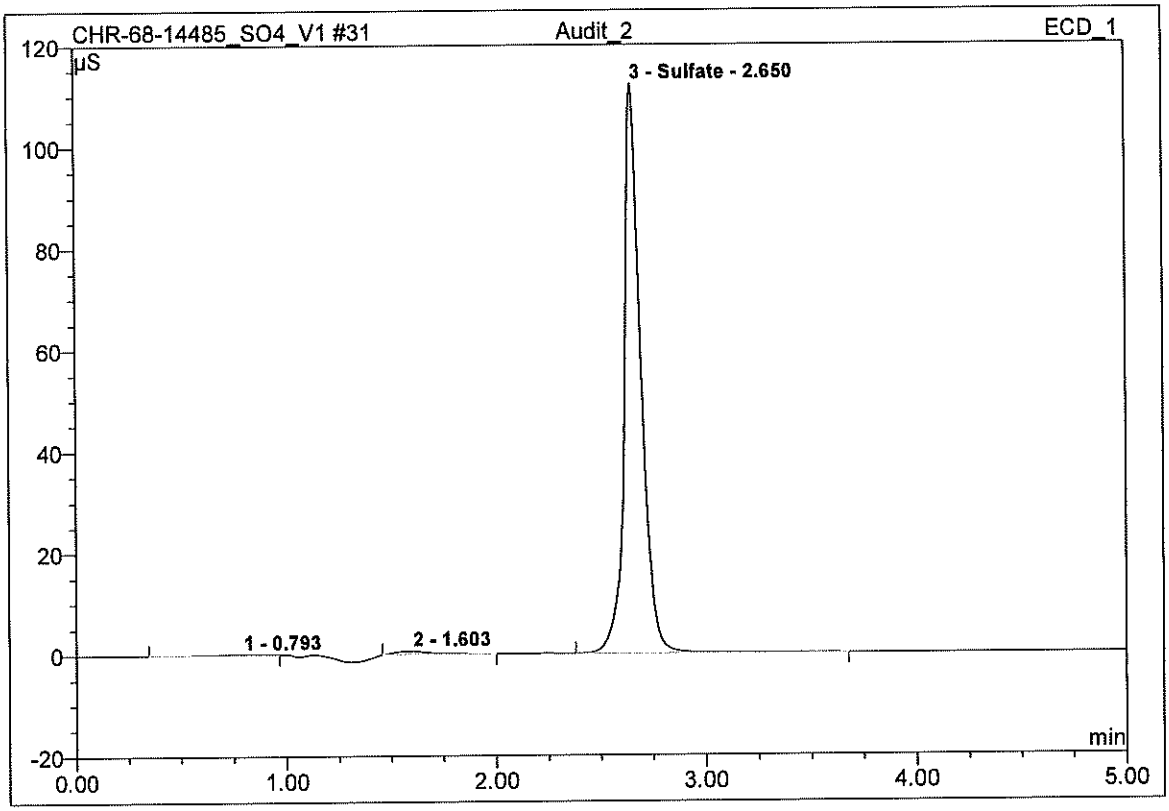


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	1.12	n.a.	1.170	0.090	0.84	n.a.	BMB
2	1.60	n.a.	0.654	0.124	1.17	n.a.	BMB
3	2.65	Sulfate	112.297	10.447	97.99	n.a.	BMB
Total:			114.122	10.661	100.00	0.000	

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**

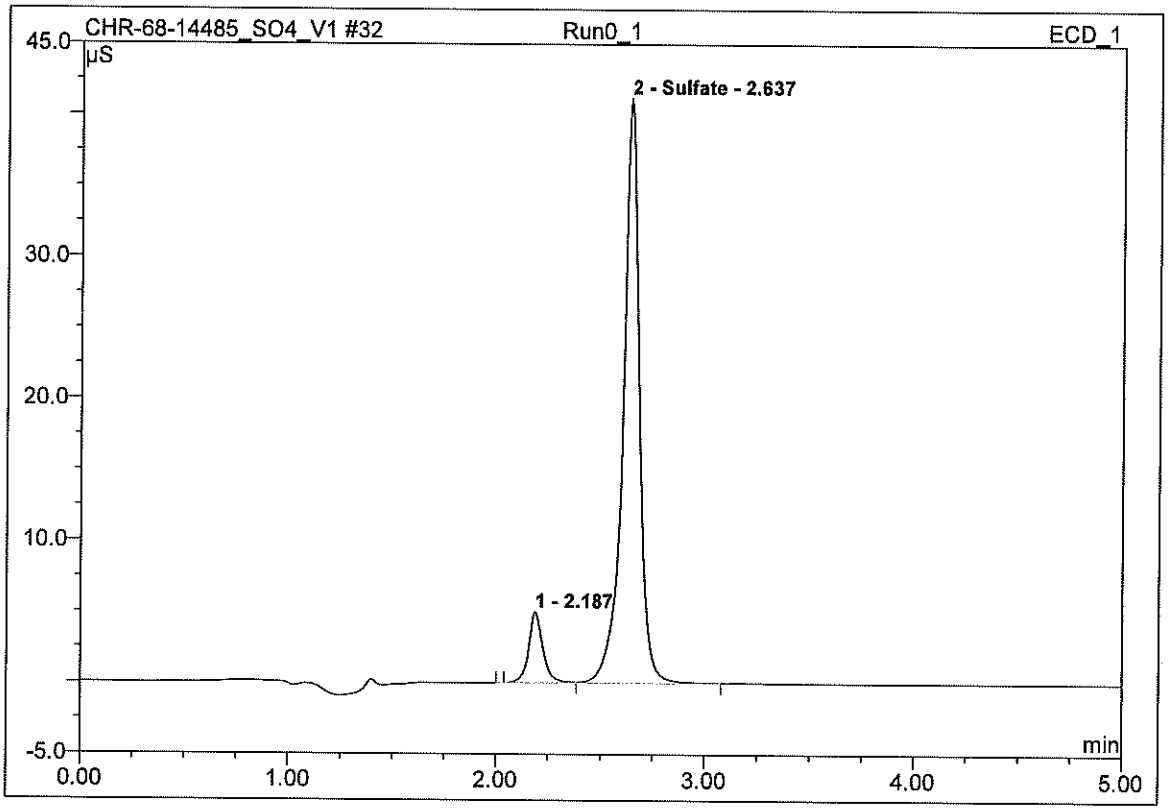


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	0.79	n.a.	0.160	0.039	0.37	n.a.	BM
2	1.60	n.a.	0.638	0.120	1.13	n.a.	BMB
3	2.65	Sulfate	112.229	10.443	98.50	n.a.	BMB
Total:			113.027	10.602	100.00	0.000	

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**

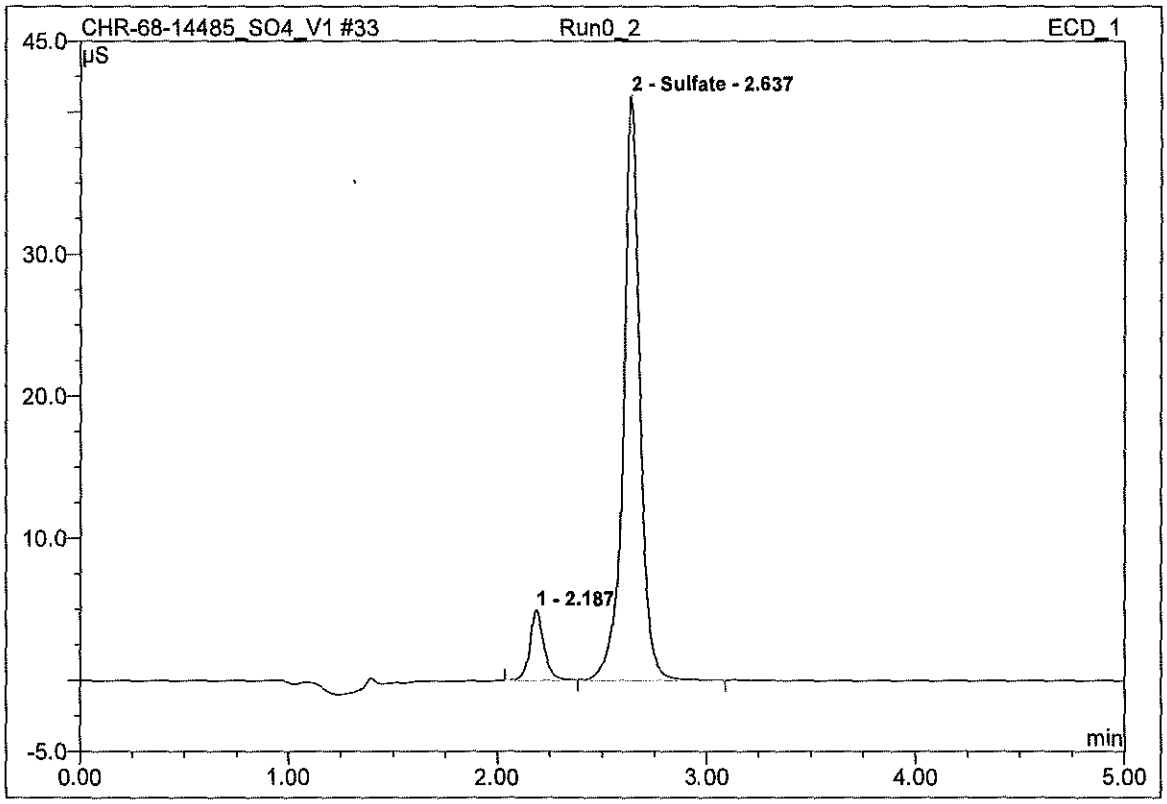


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.19	n.a.	4.953	0.386	9.24	n.a.	Ru
2	2.64	Sulfate	41.161	3.792	90.76	n.a.	BMB
Total:			46.114	4.178	100.00	0.000	

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**

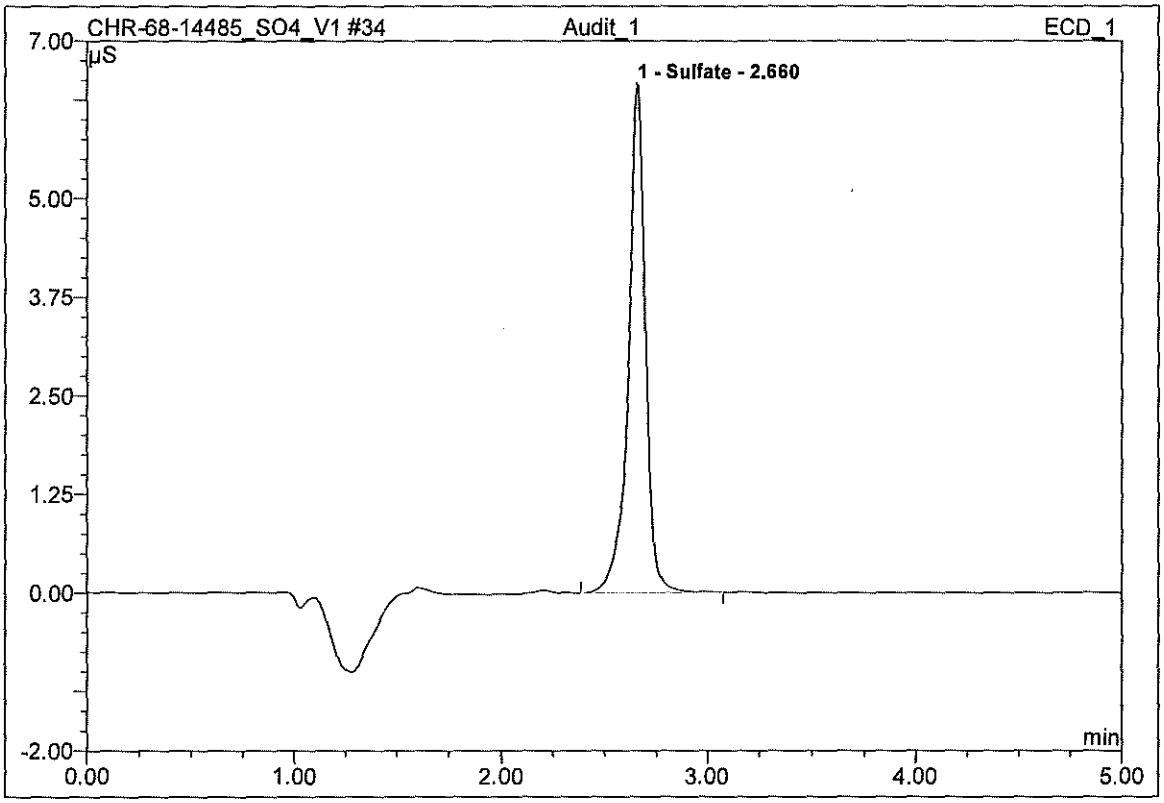


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.19	n.a.	4.948	0.386	9.24	n.a.	Ru
2	2.64	Sulfate	41.191	3.793	90.76	n.a.	BMB
Total:			46.139	4.179	100.00	0.000	

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**

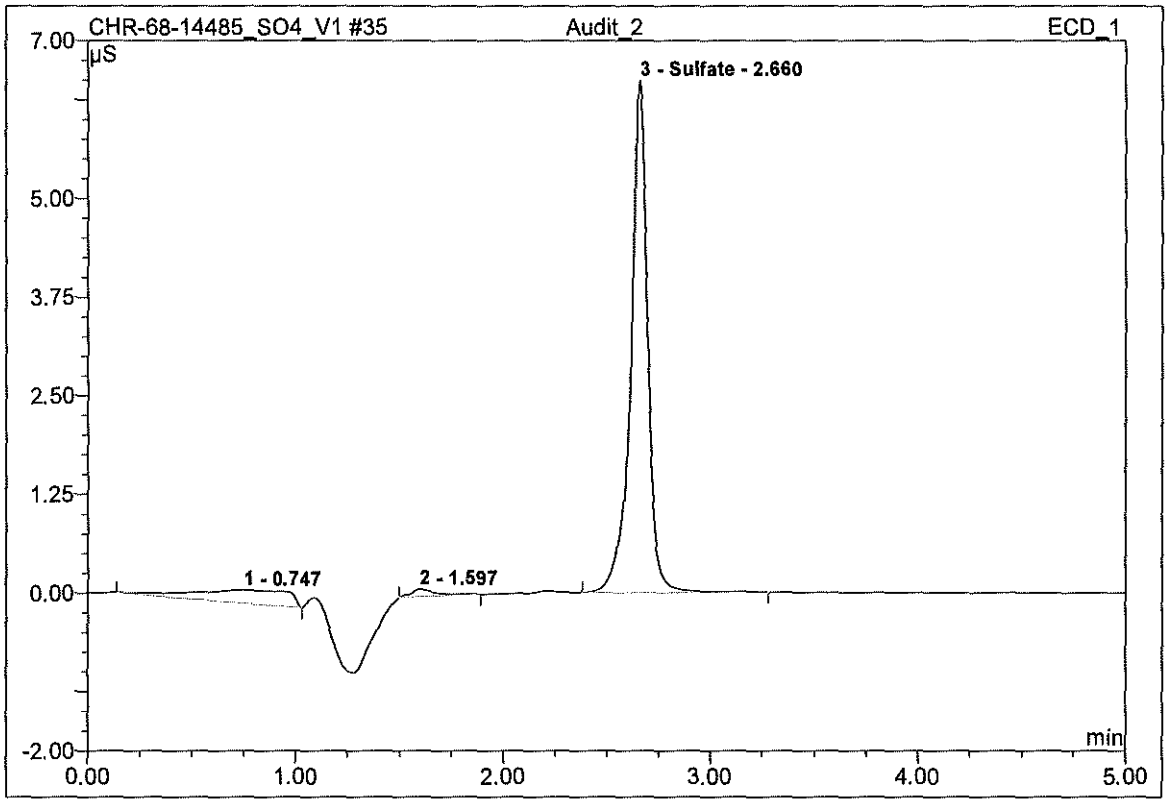


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	6.460	0.614	100.00	n.a.	BMB
Total:			6.460	0.614	100.00	0.000	

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**

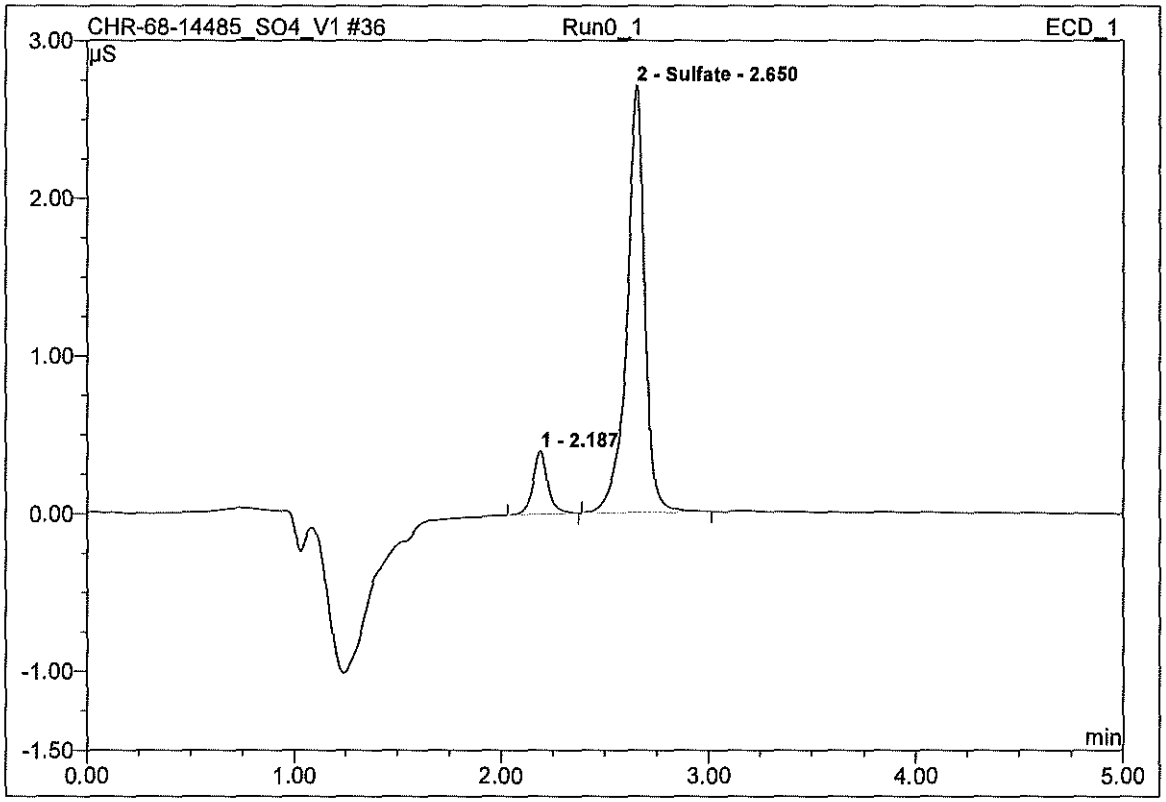


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	0.75	n.a.	0.163	0.088	12.28	n.a.	BMB
2	1.60	n.a.	0.094	0.013	1.79	n.a.	BMB
3	2.66	Sulfate	6.488	0.618	85.93	n.a.	BMB
Total:			6.745	0.720	100.00	0.000	

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**

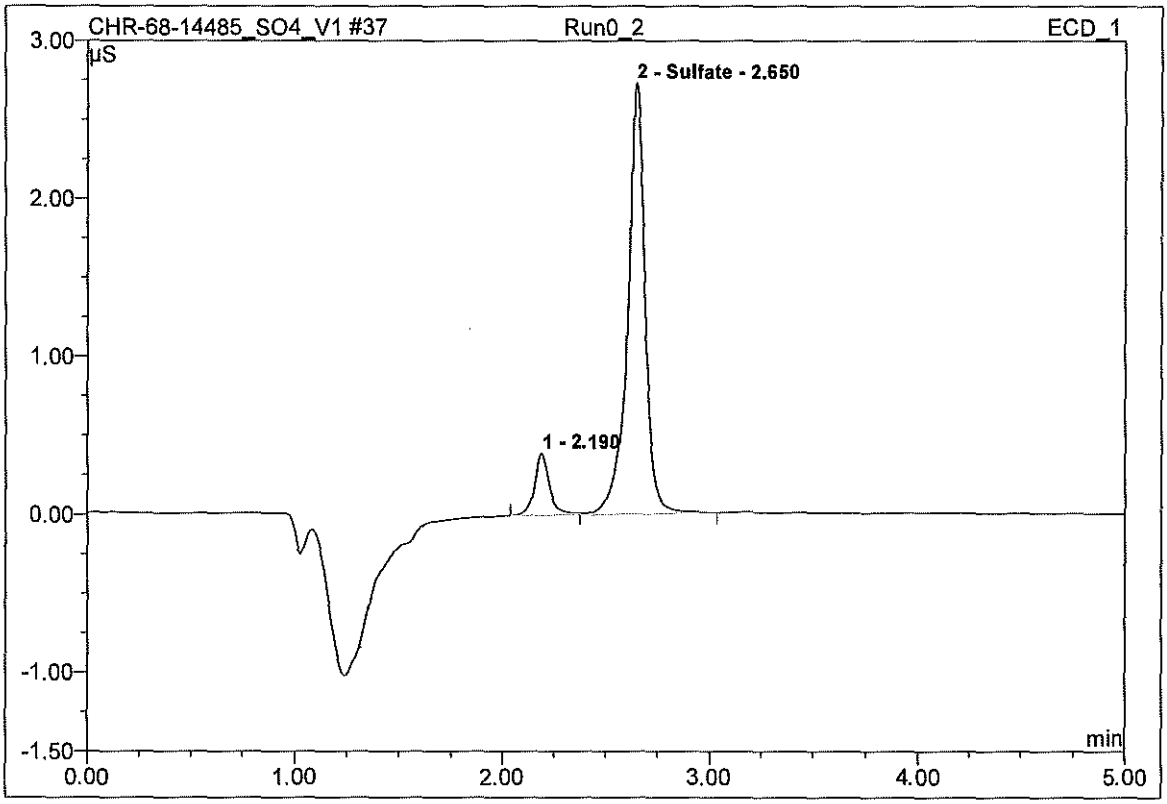


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.19	n.a.	0.398	0.033	11.01	n.a.	BMB
2	2.65	Sulfate	2.704	0.265	88.99	n.a.	BMB
Total:			3.101	0.298	100.00	0.000	

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**

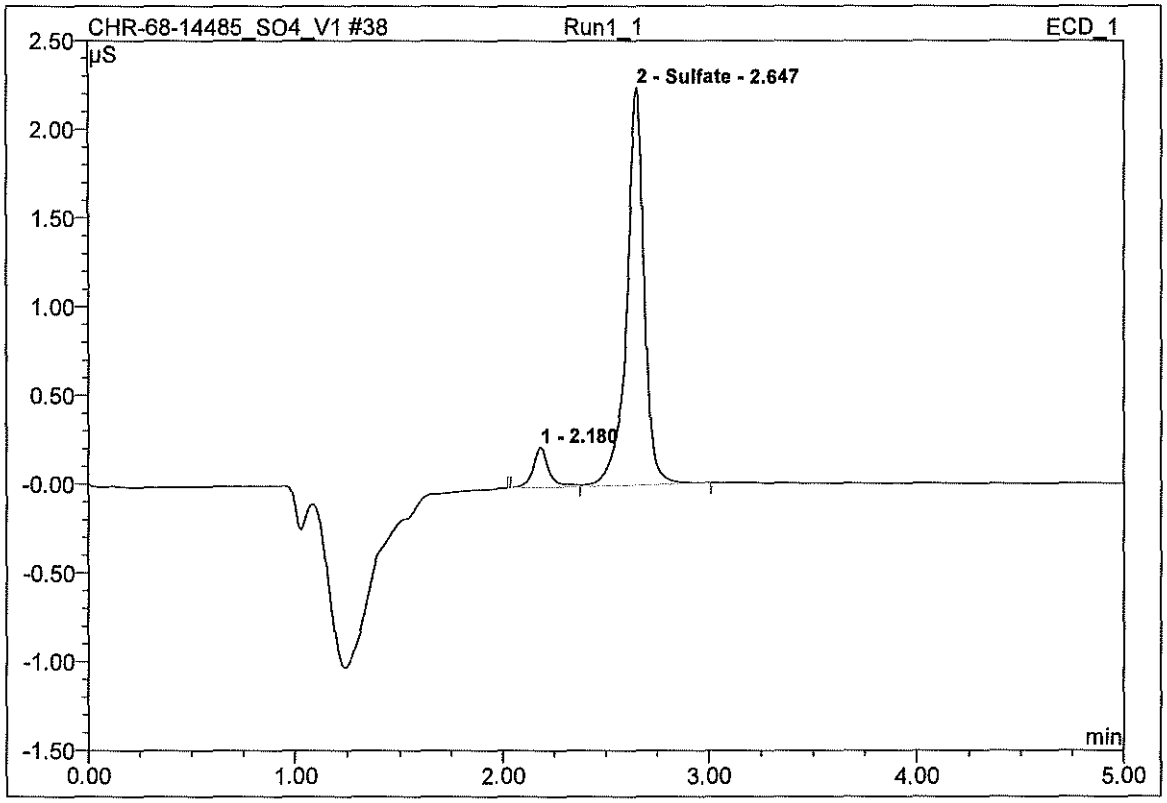


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.19	n.a.	0.389	0.032	10.51	n.a.	Ru
2	2.65	Sulfate	2.726	0.271	89.49	n.a.	BMB
Total:			3.115	0.303	100.00	0.000	

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**

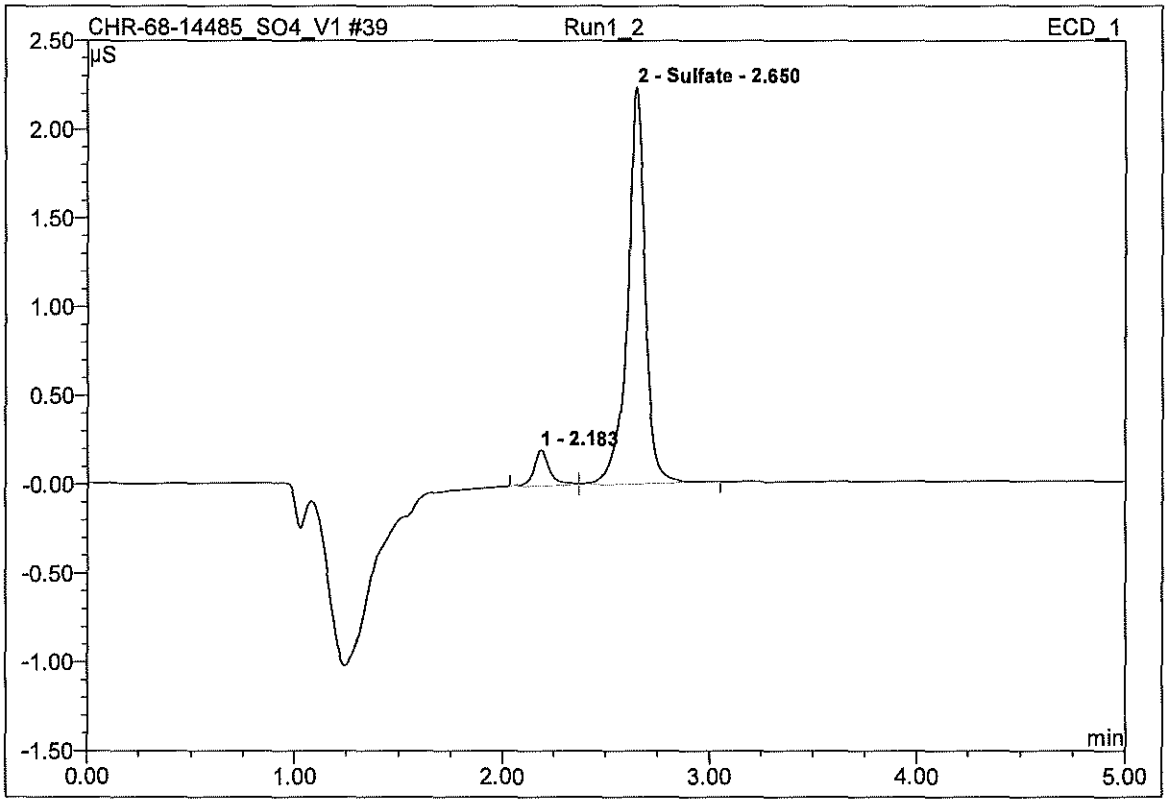


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.18	n.a.	0.223	0.019	7.82	n.a.	Ru
2	2.65	Sulfate	2.238	0.223	92.18	n.a.	BMB
Total:			2.461	0.242	100.00	0.000	

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**

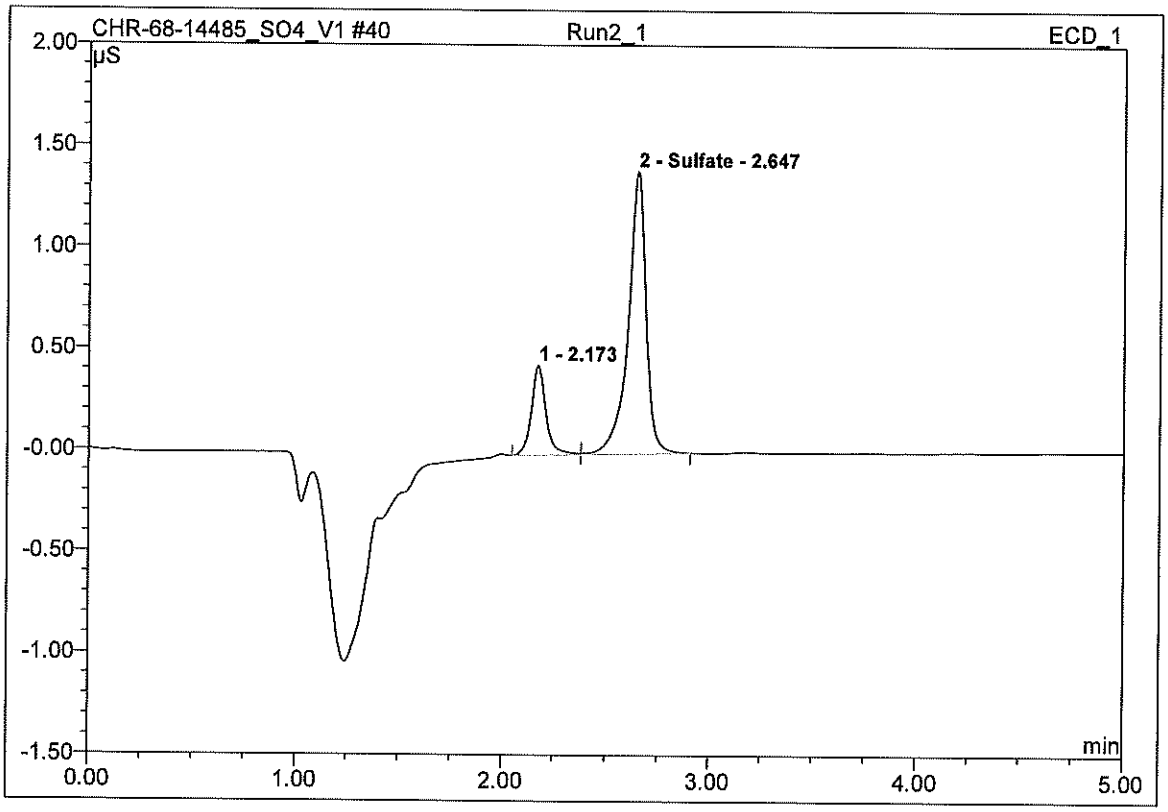


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.18	n.a.	0.202	0.018	7.47	n.a.	BM
2	2.65	Sulfate	2.233	0.222	92.53	n.a.	MB
Total:			2.435	0.240	100.00	0.000	

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**

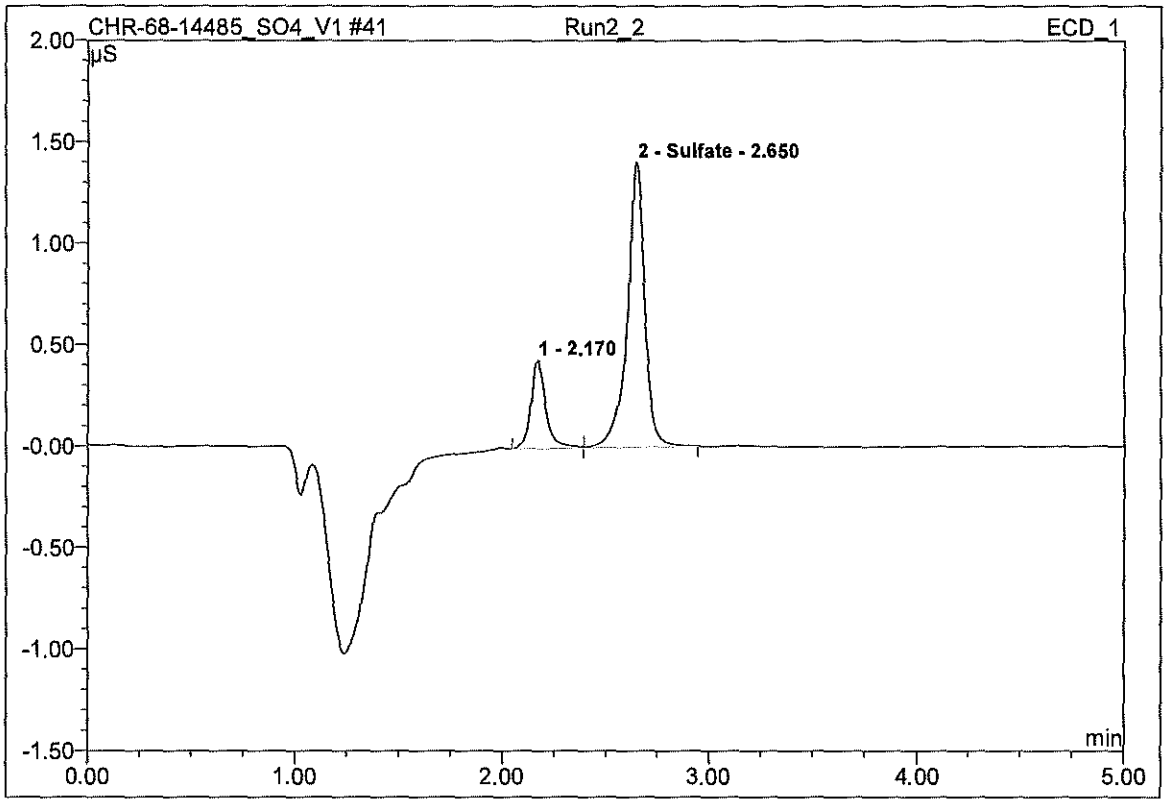


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.17	n.a.	0.444	0.037	20.86	n.a.	BM
2	2.65	Sulfate	1.392	0.139	79.14	n.a.	MB
Total:			1.836	0.175	100.00	0.000	

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**

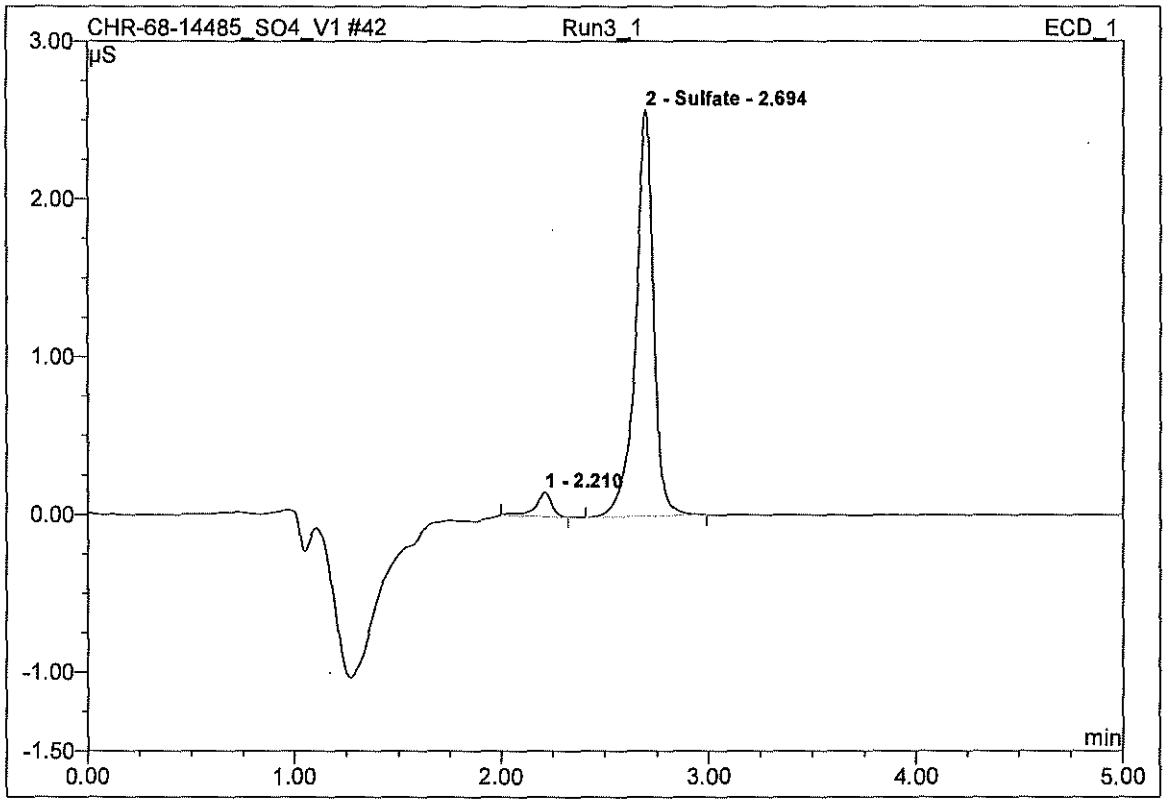


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.17	n.a.	0.436	0.036	20.50	n.a.	BM
2	2.65	Sulfate	1.403	0.139	79.50	n.a.	MB
Total:			1.839	0.175	100.00	0.000	

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:	**AS40-5Inj1Start**	*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**

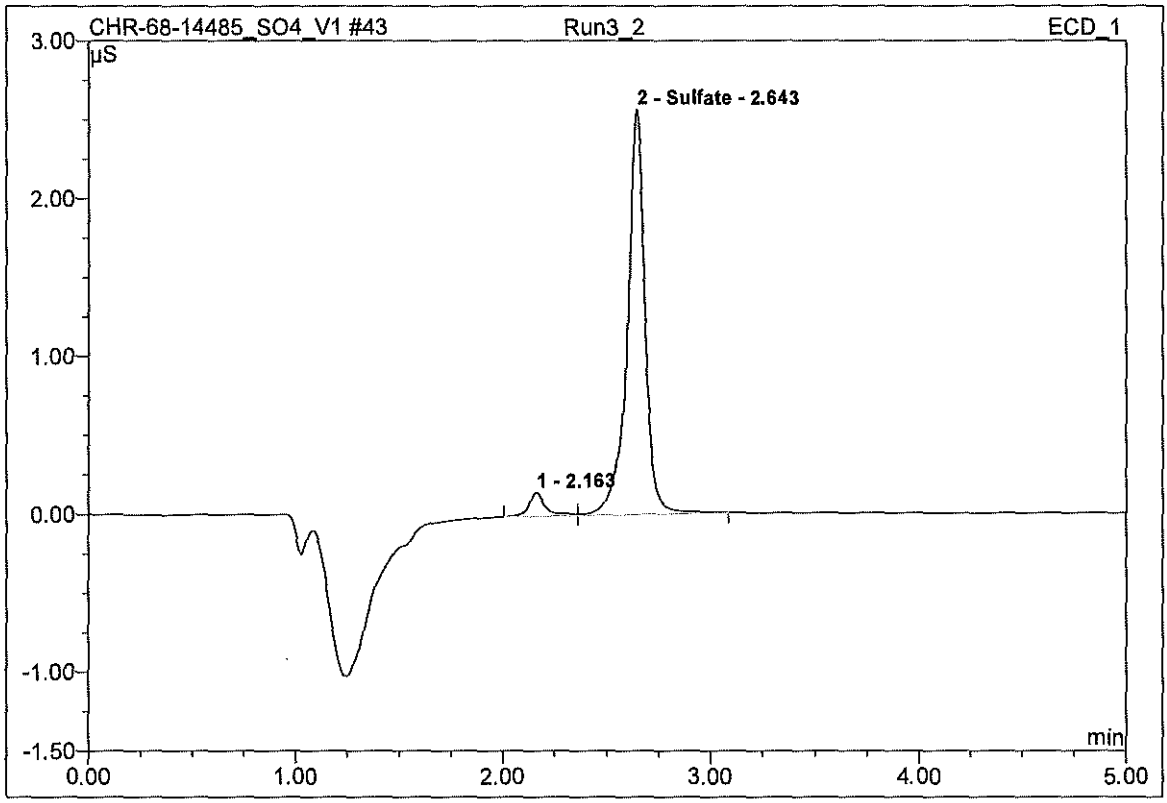


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.21	n.a.	0.155	0.014	5.37	n.a.	BMB
2	2.69	Sulfate	2.575	0.252	94.63	n.a.	BMB
Total:			2.730	0.267	100.00	0.000	

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**

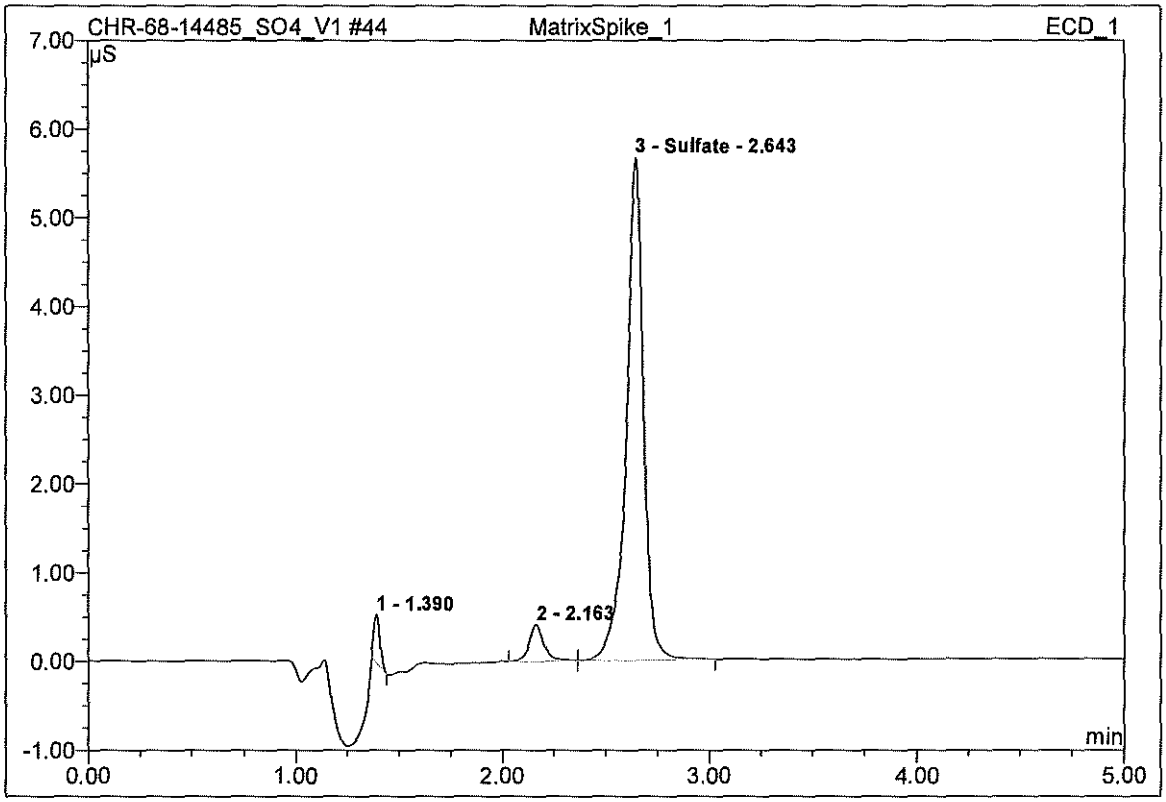


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.16	n.a.	0.153	0.014	5.24	n.a.	BM
2	2.64	Sulfate	2.567	0.256	94.76	n.a.	MB
Total:			2.720	0.270	100.00	0.000	

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**

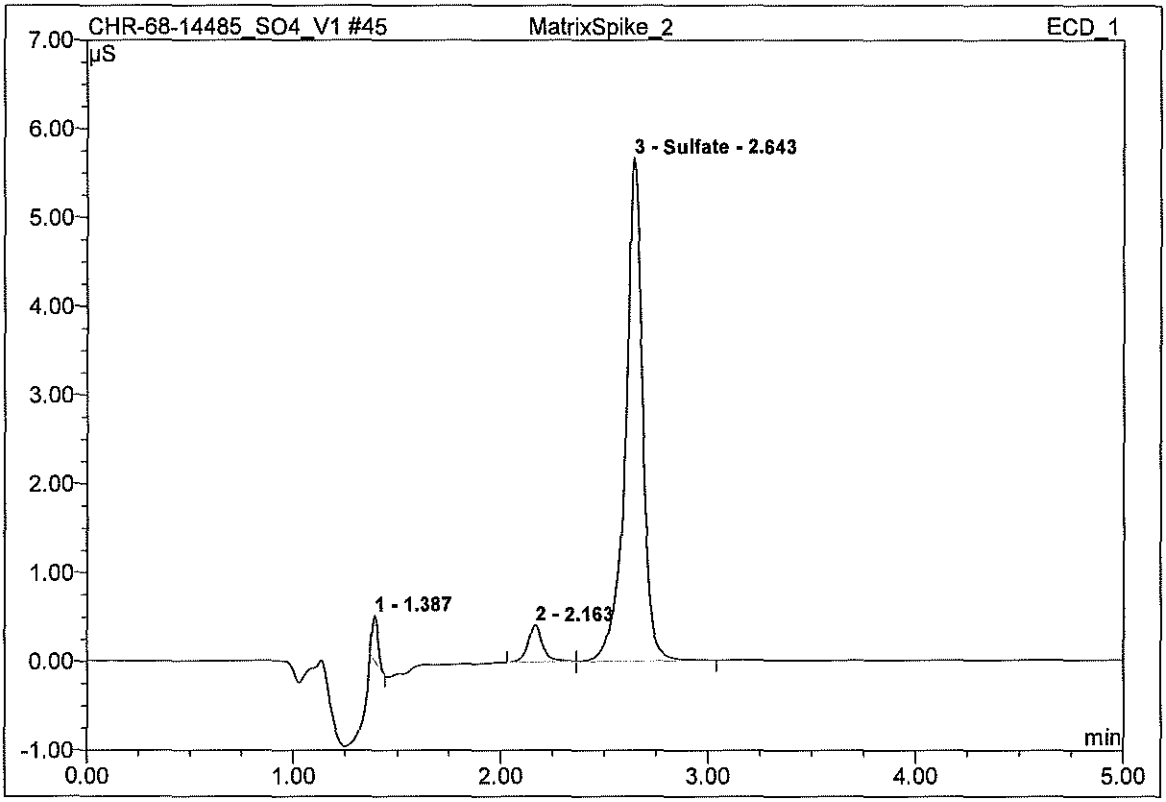


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	1.39	n.a.	0.542	0.019	3.20	n.a.	BMB
2	2.16	n.a.	0.418	0.035	5.77	n.a.	BM
3	2.64	Sulfate	5.666	0.546	91.03	n.a.	MB
Total:			6.626	0.600	100.00	0.000	

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**

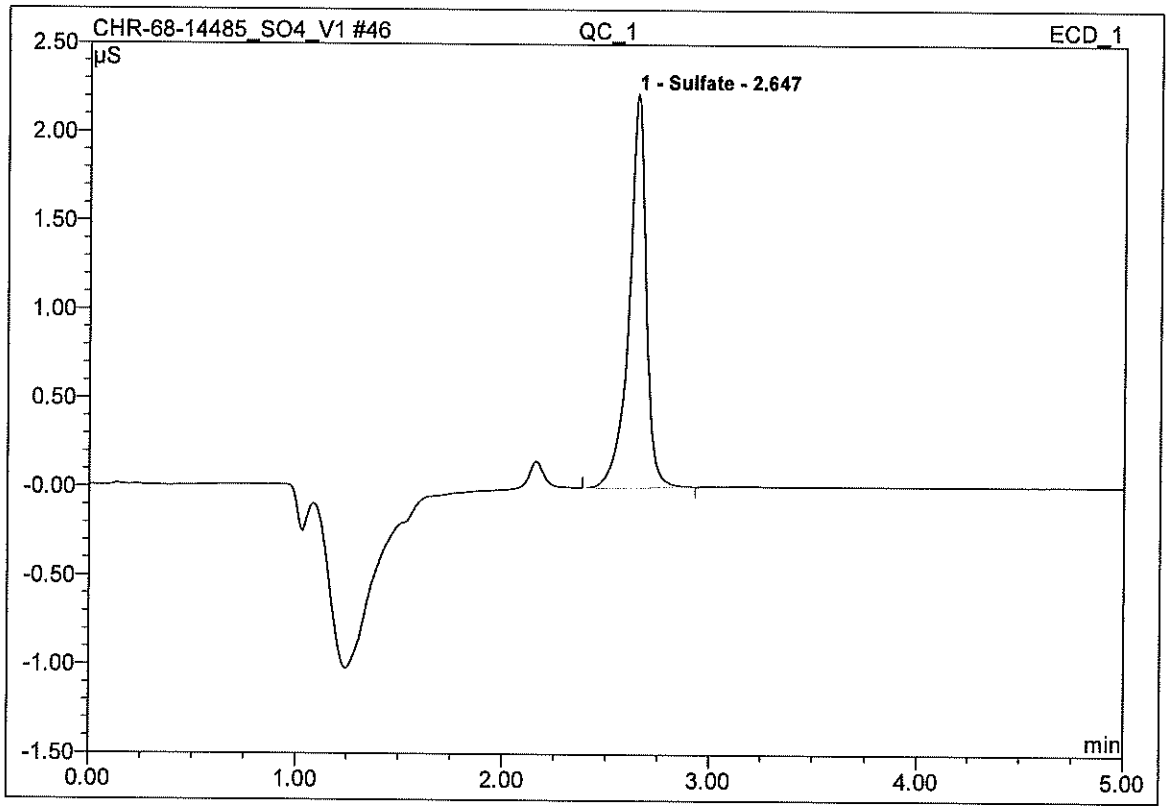


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	1.39	n.a.	0.500	0.017	2.86	n.a.	BMB
2	2.16	n.a.	0.416	0.034	5.73	n.a.	BM
3	2.64	Sulfate	5.668	0.547	91.42	n.a.	MB
Total:			6.583	0.599	100.00	0.000	

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**

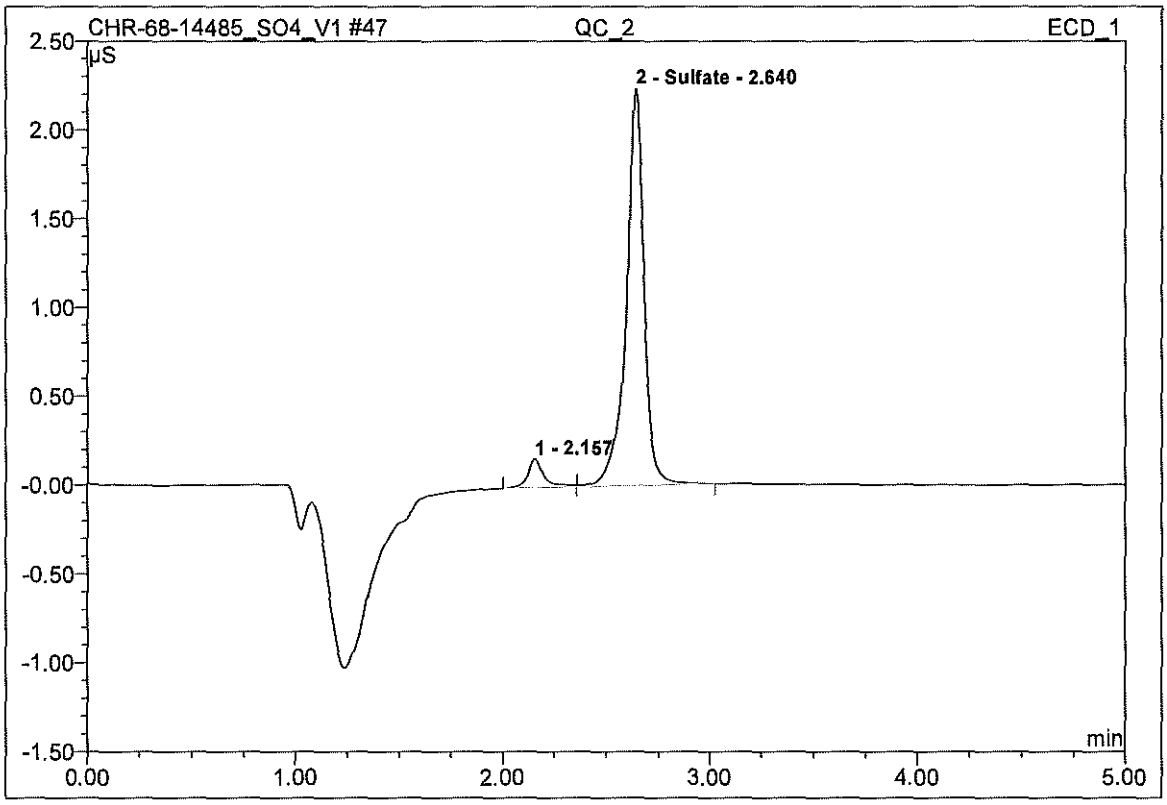


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	2.216	0.216	100.00	n.a.	BMB
Total:			2.216	0.216	100.00	0.000	

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**

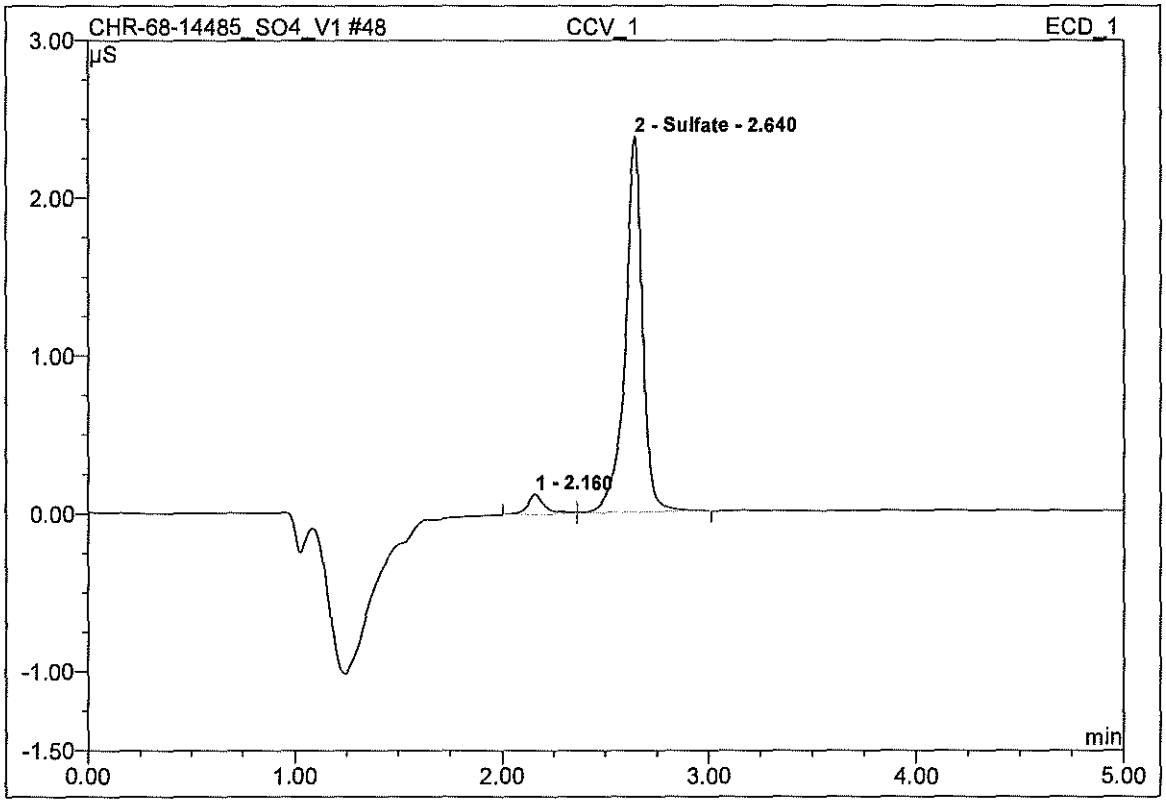


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.16	n.a.	0.160	0.015	6.21	n.a.	BM
2	2.64	Sulfate	2.233	0.222	93.79	n.a.	MB
Total:			2.393	0.236	100.00	0.000	

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**

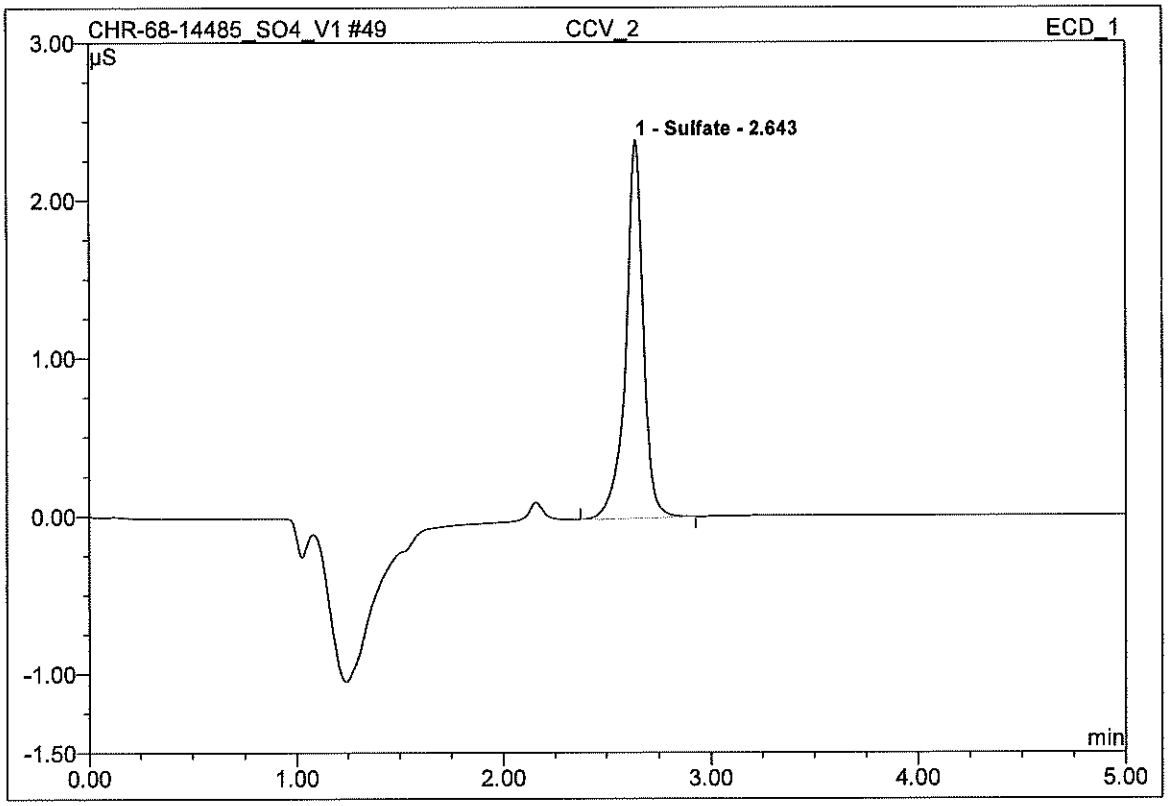


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.16	n.a.	0.128	0.012	5.00	n.a.	BM
2	2.64	Sulfate	2.382	0.235	95.00	n.a.	MB
Total:			2.510	0.247	100.00	0.000	

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**

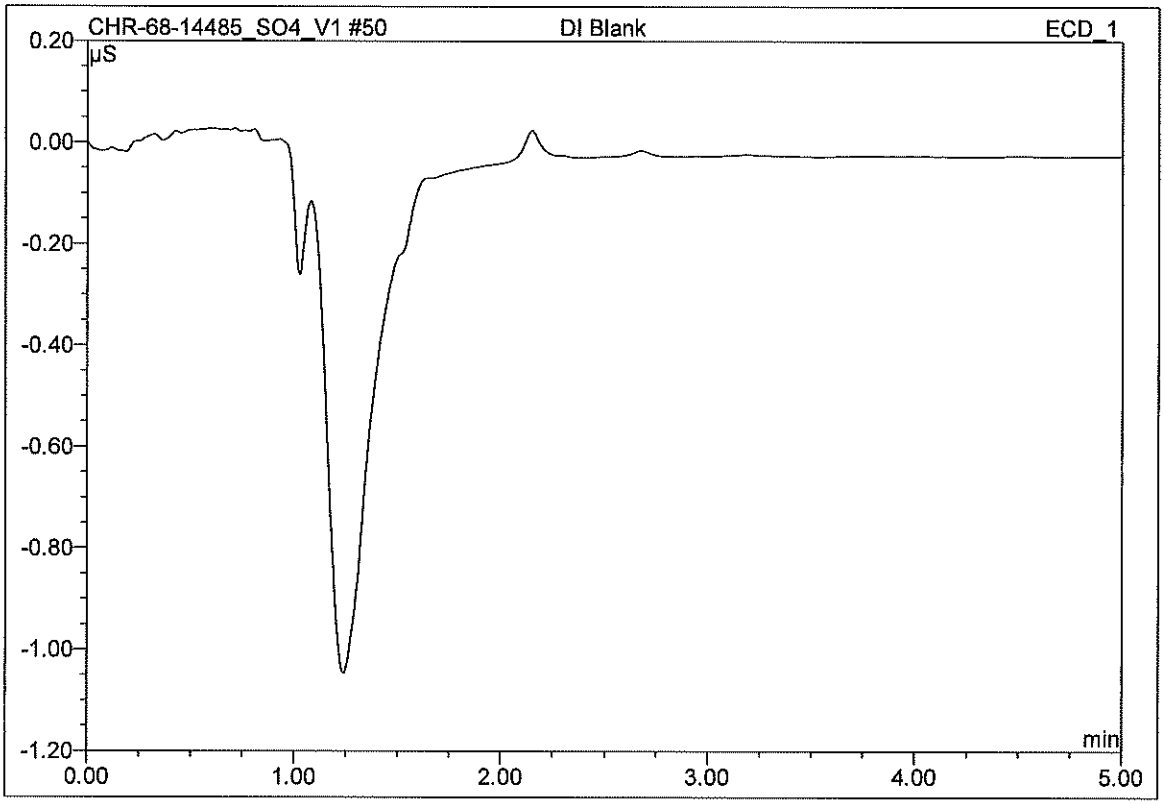


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	2.397	0.235	100.00	n.a.	BMB
Total:			2.397	0.235	100.00	0.000	

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**

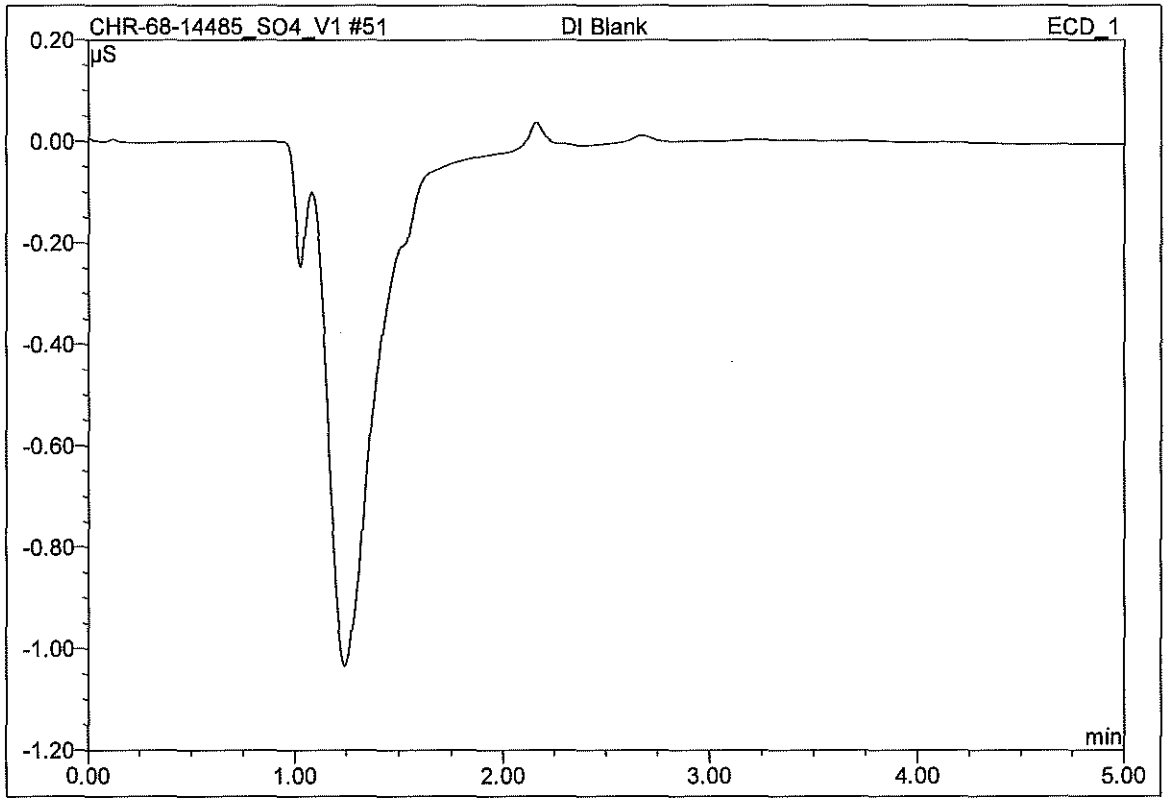


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

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**

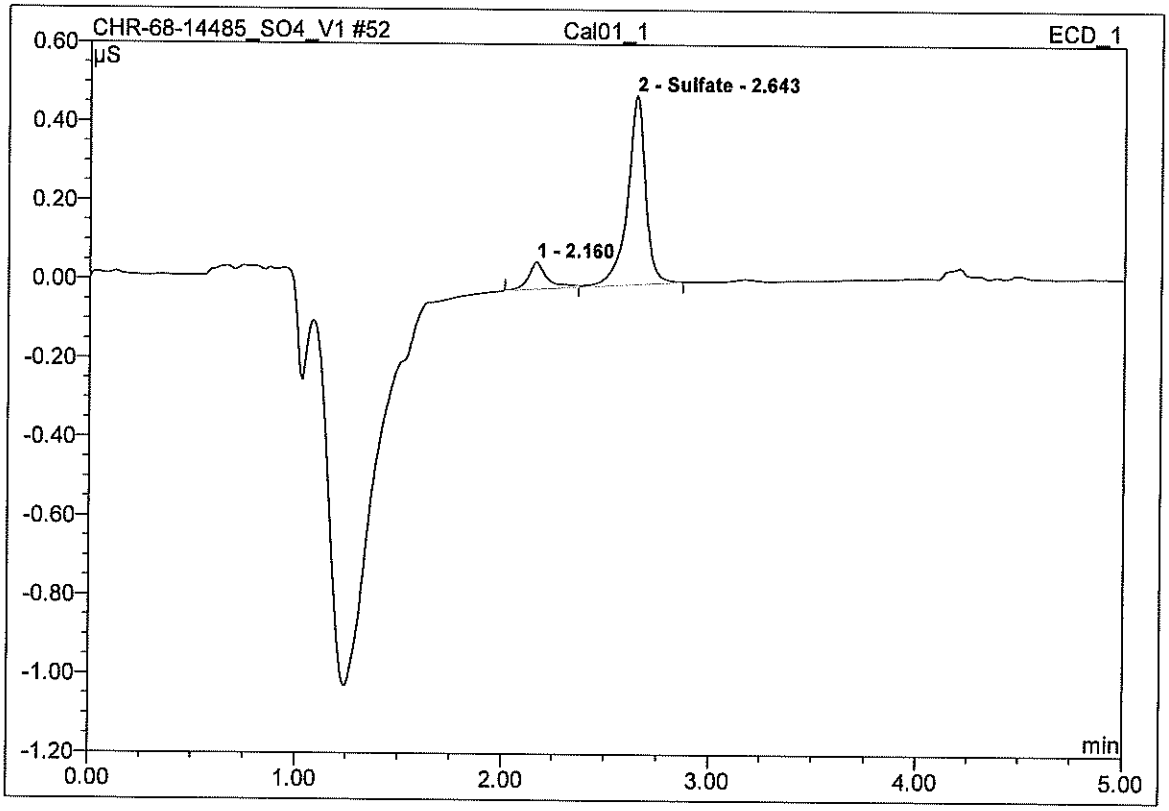


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

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**

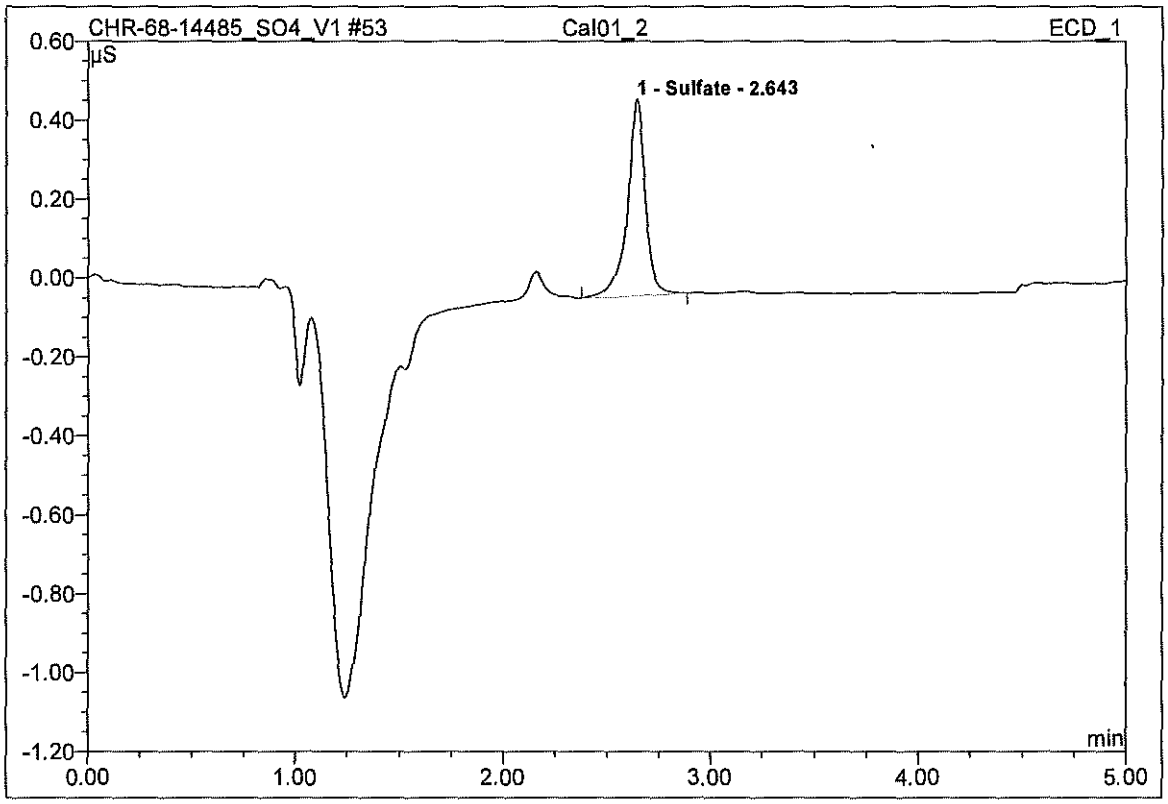


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.16	n.a.	0.067	0.007	11.83	n.a.	Ru
2	2.64	Sulfate	0.477	0.049	88.17	n.a.	BMB
Total:			0.544	0.056	100.00	0.000	

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**

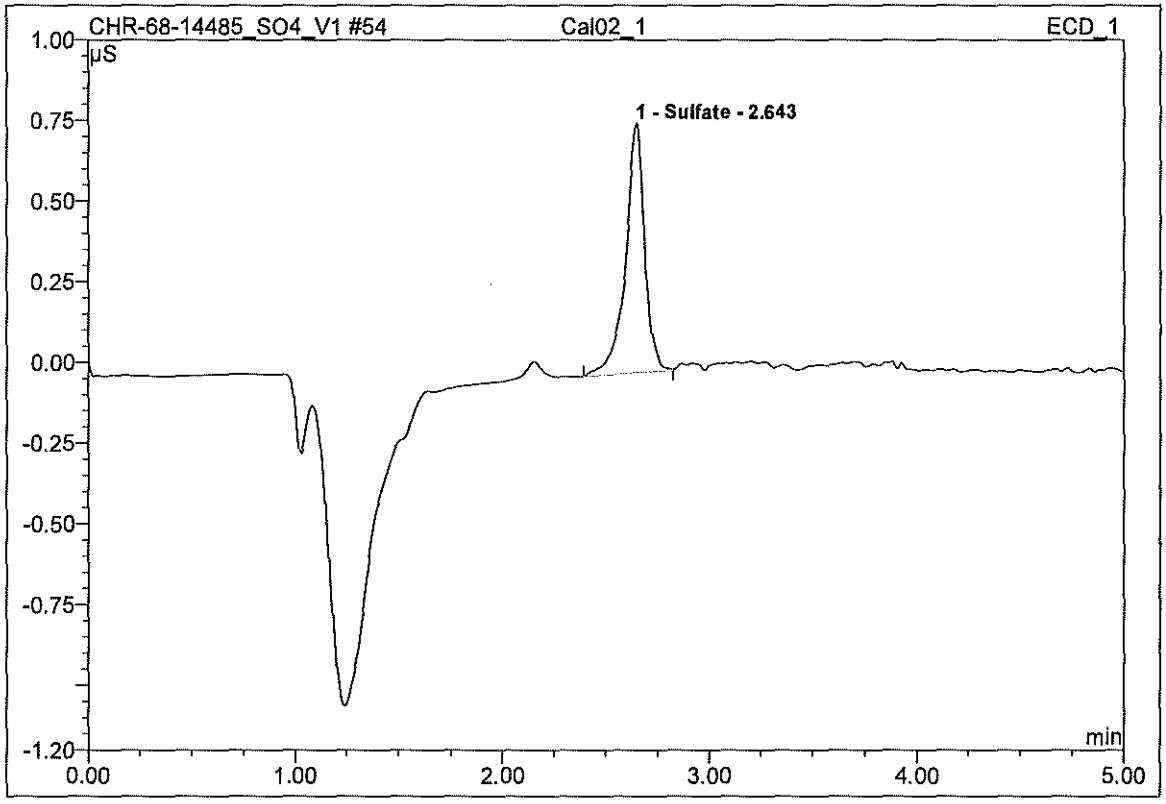


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	0.497	0.051	100.00	n.a.	BMB
Total:			0.497	0.051	100.00	0.000	

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**

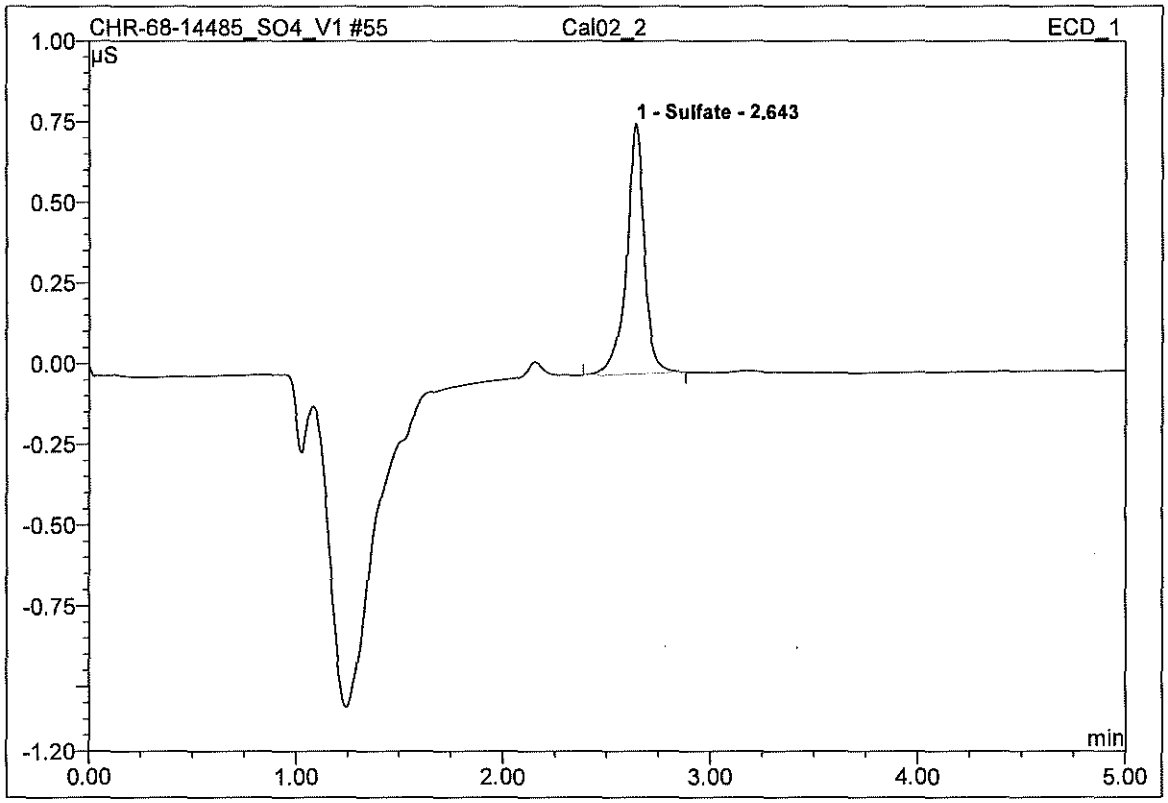


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	0.772	0.082	100.00	n.a.	BMB
Total:			0.772	0.082	100.00	0.000	

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**

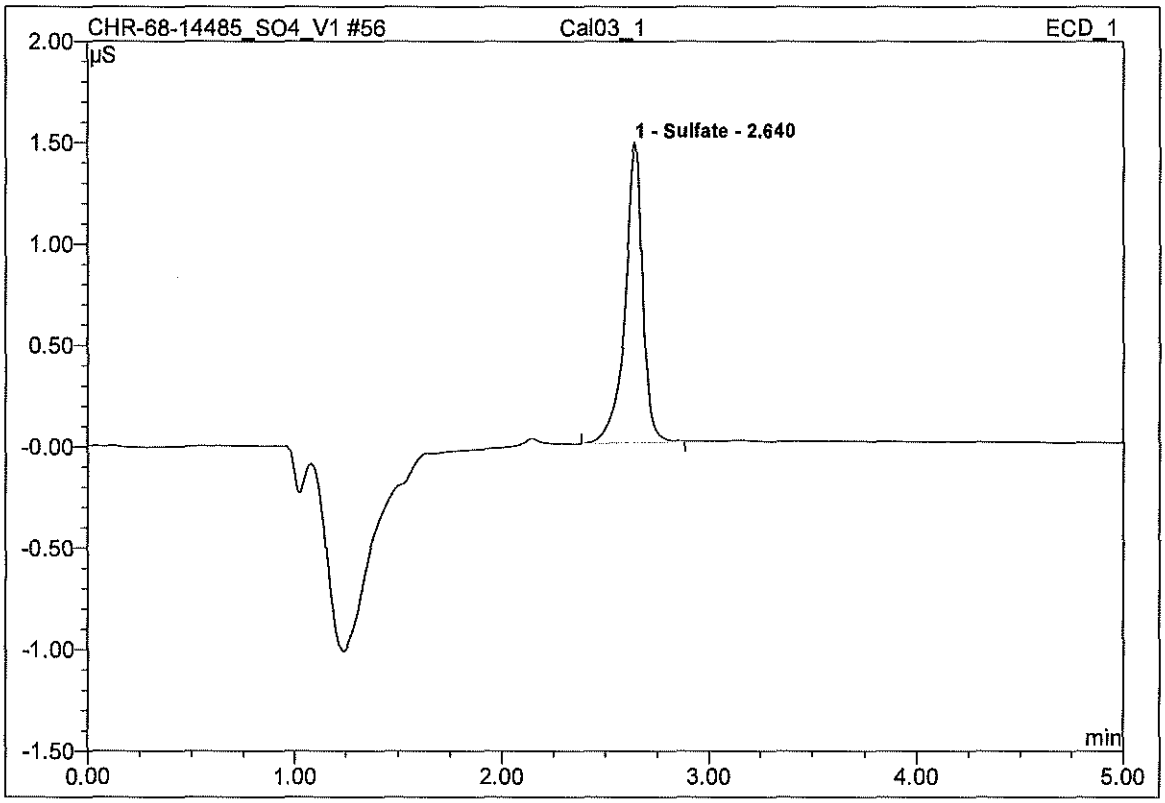


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	0.775	0.077	100.00	n.a.	BMB
Total:			0.775	0.077	100.00	0.000	

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**

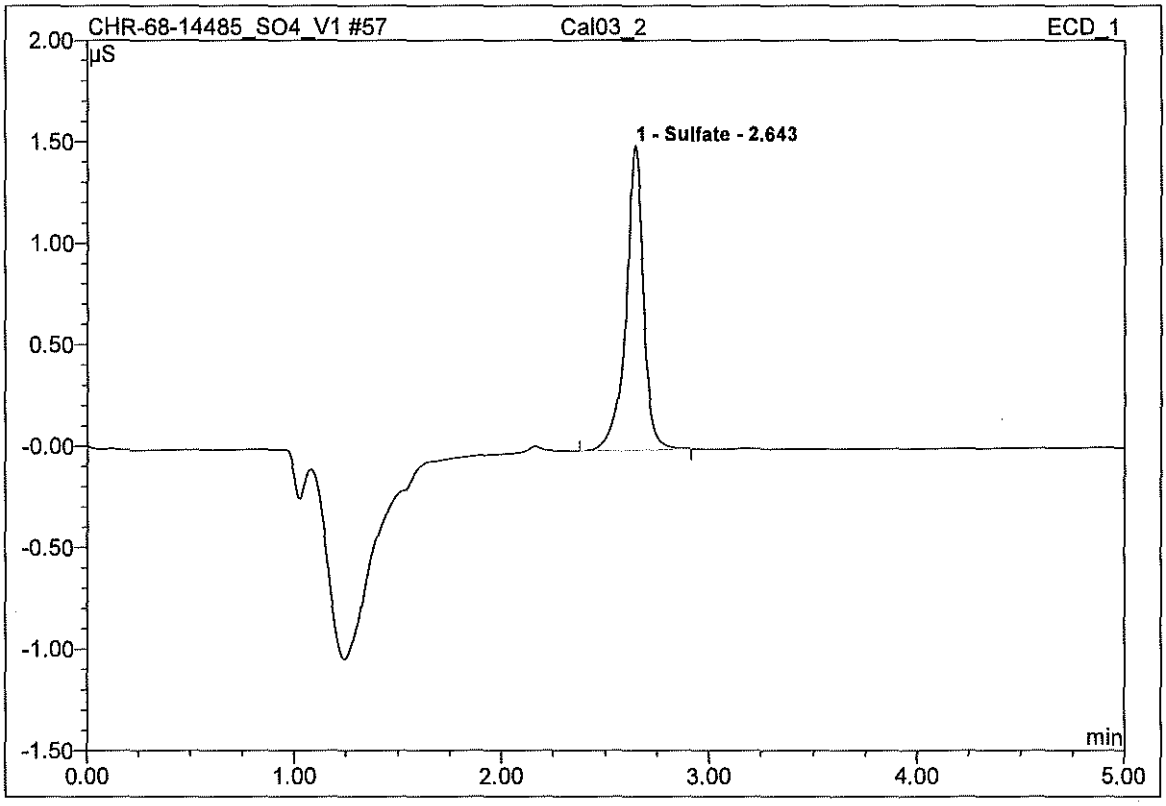


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	1.481	0.145	100.00	n.a.	BMB
Total:			1.481	0.145	100.00	0.000	

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**

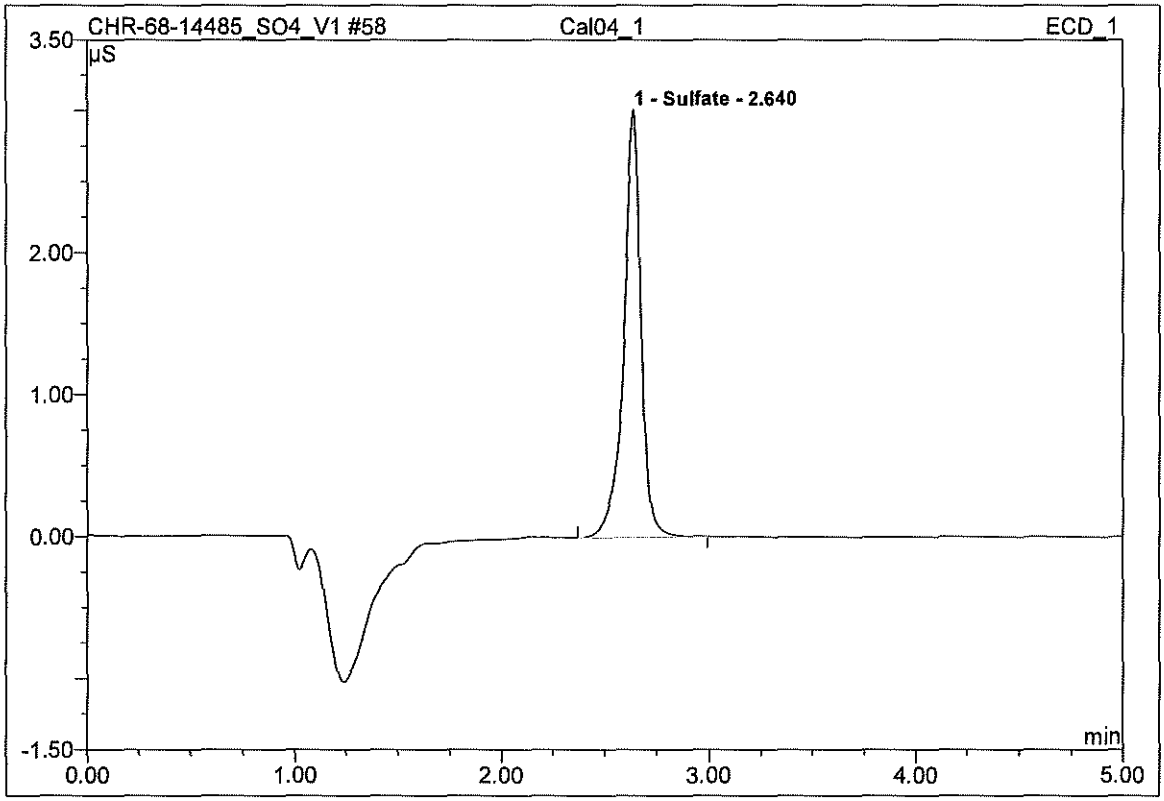


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	1.501	0.148	100.00	n.a.	BMB
Total:			1.501	0.148	100.00	0.000	

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**

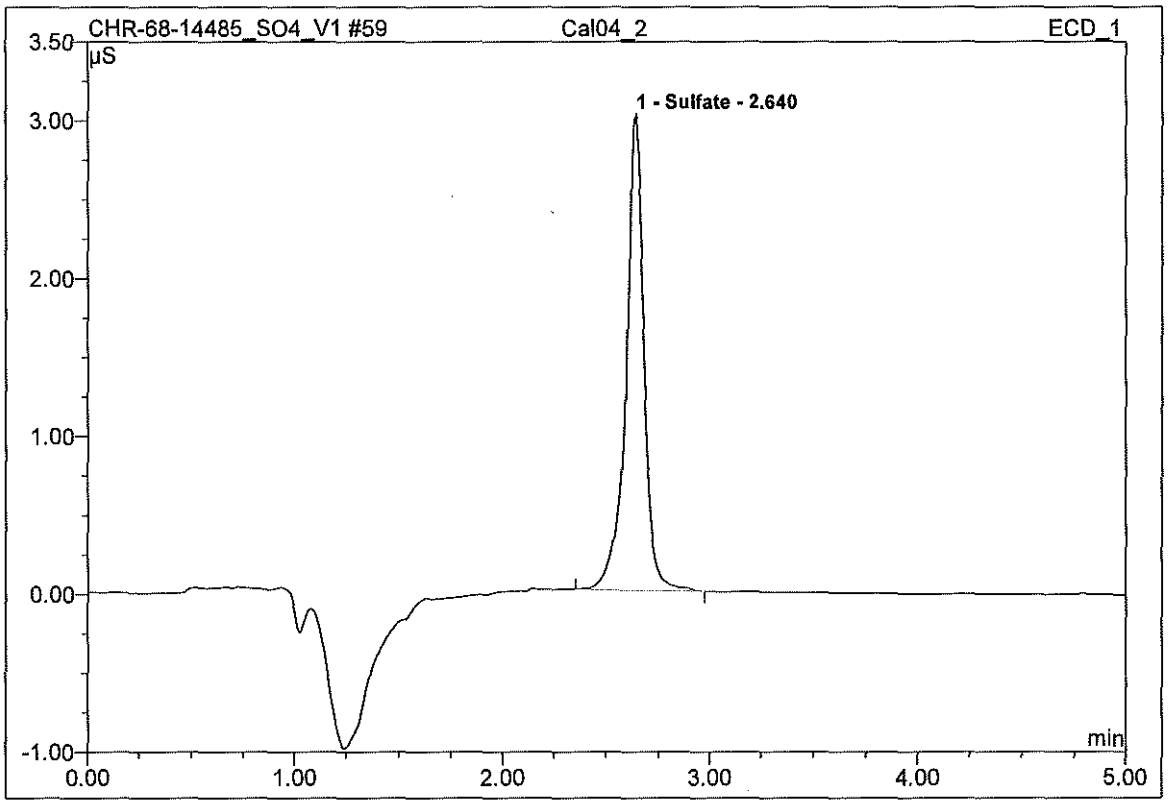


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	3.010	0.293	100.00	n.a.	BMB
Total:			3.010	0.293	100.00	0.000	

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**

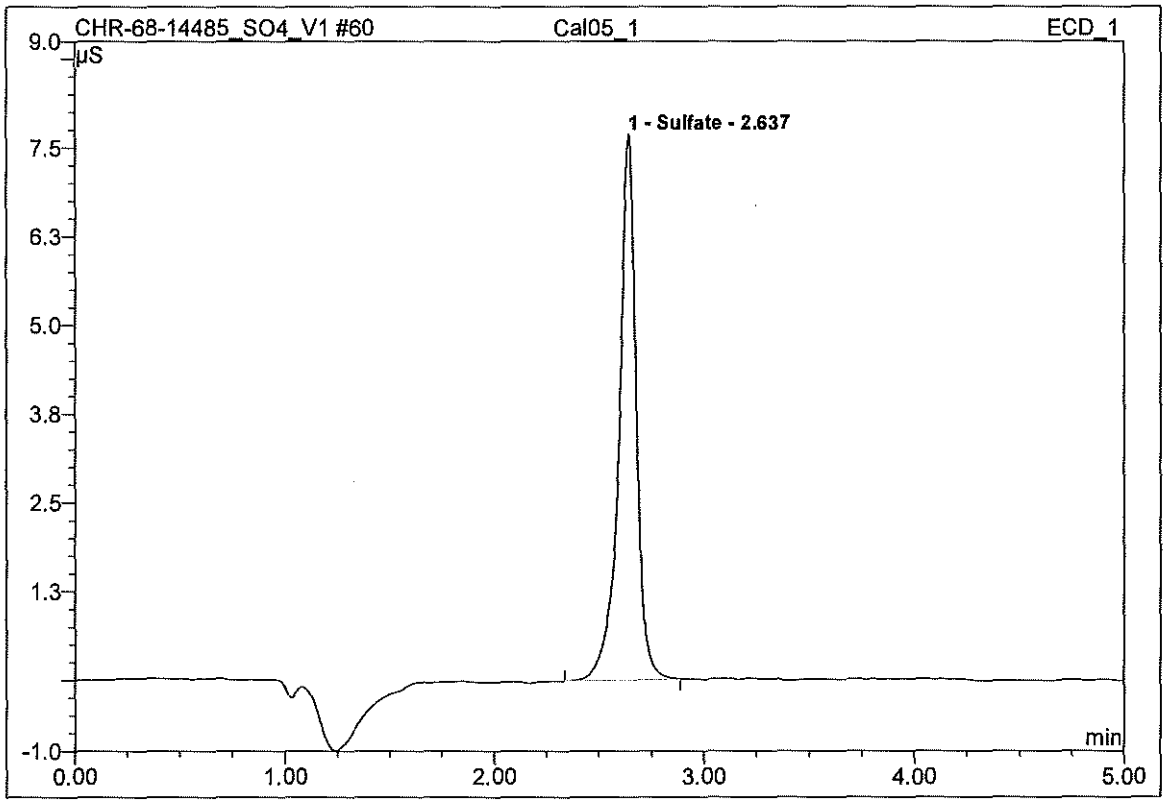


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	3.023	0.299	100.00	n.a.	BMB
Total:			3.023	0.299	100.00	0.000	

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**

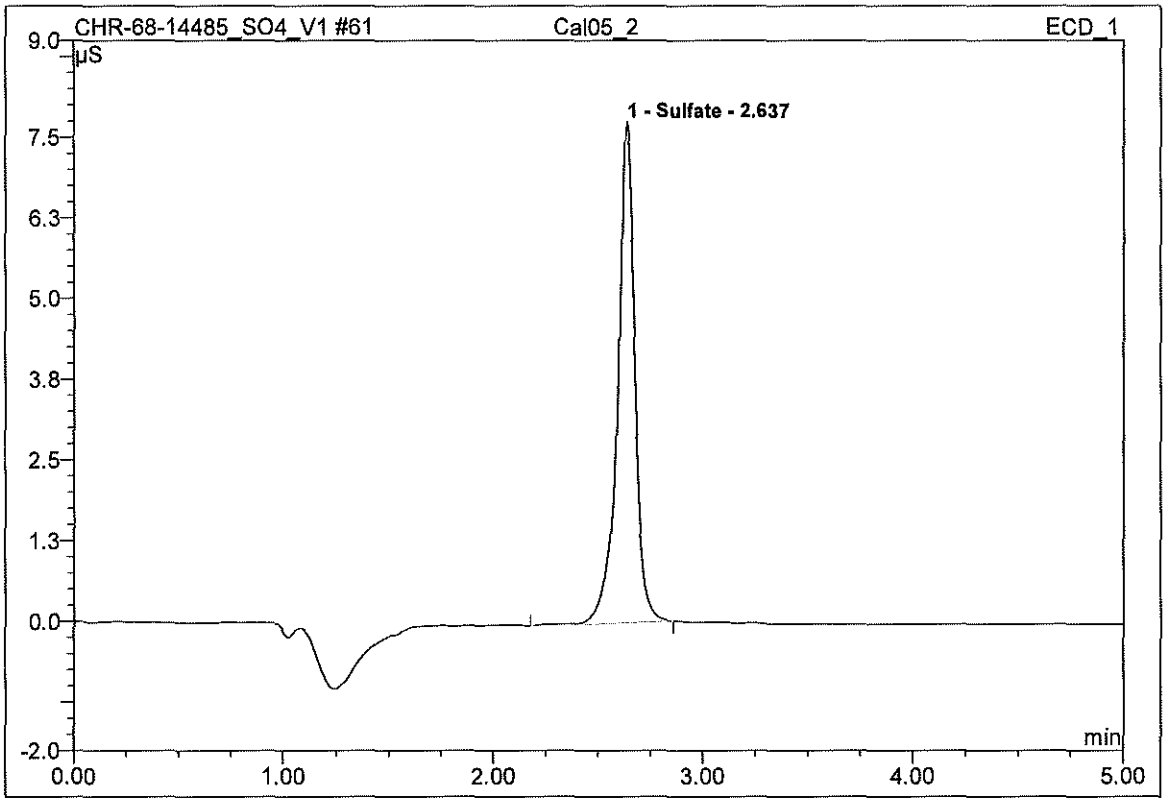


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	7.691	0.734	100.00	n.a.	BMB
Total:			7.691	0.734	100.00	0.000	

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**

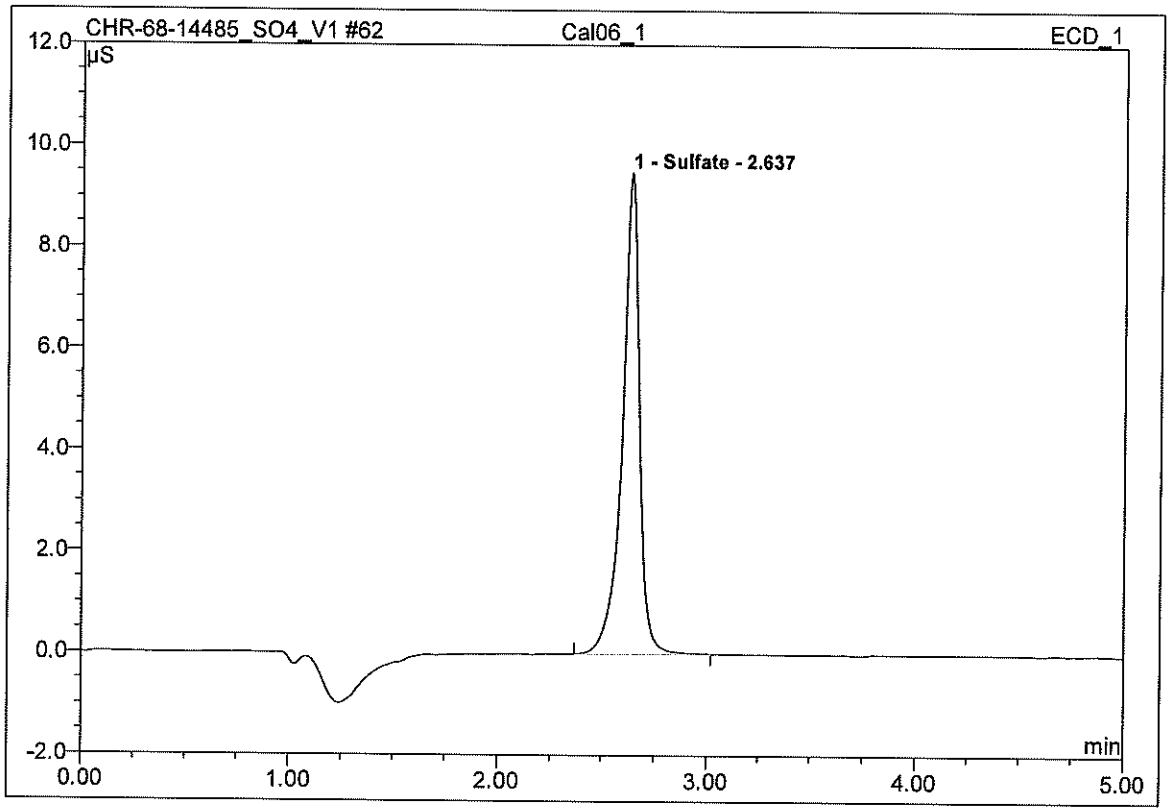


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	7.753	0.739	100.00	n.a.	BMB
Total:			7.753	0.739	100.00	0.000	

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**

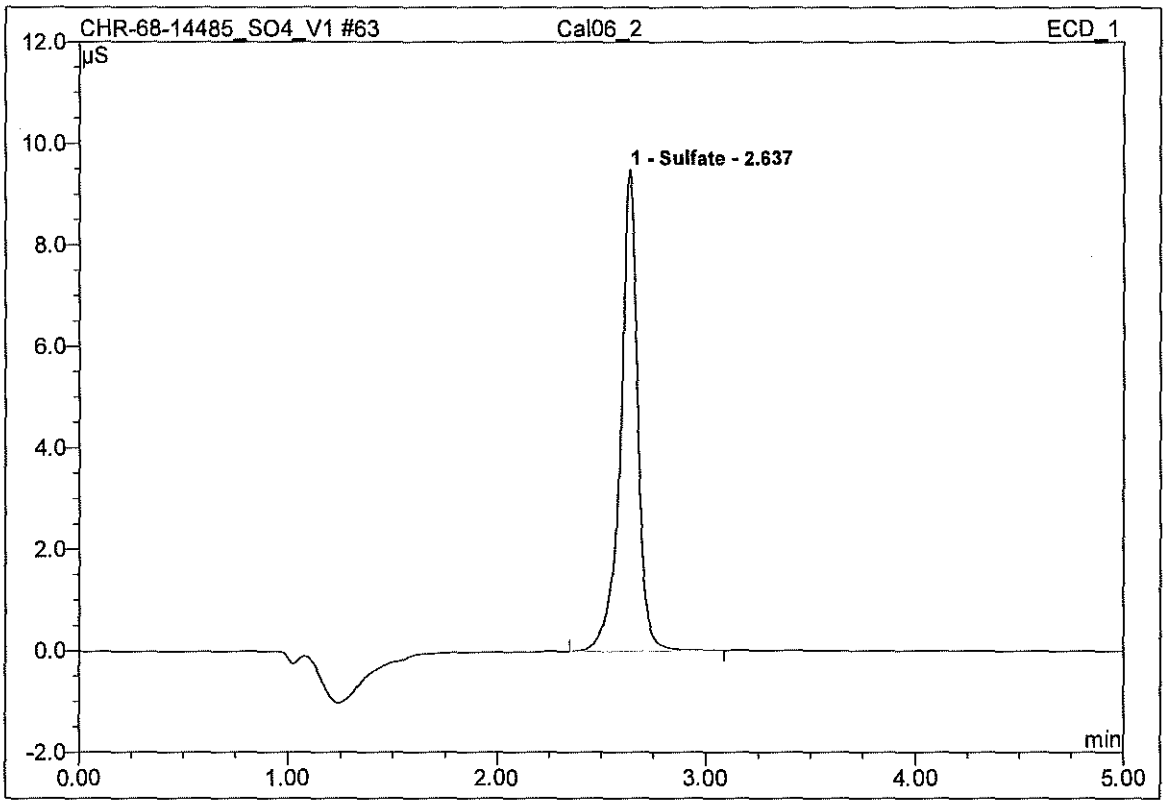


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	9.488	0.901	100.00	n.a.	BMB
Total:			9.488	0.901	100.00	0.000	

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**

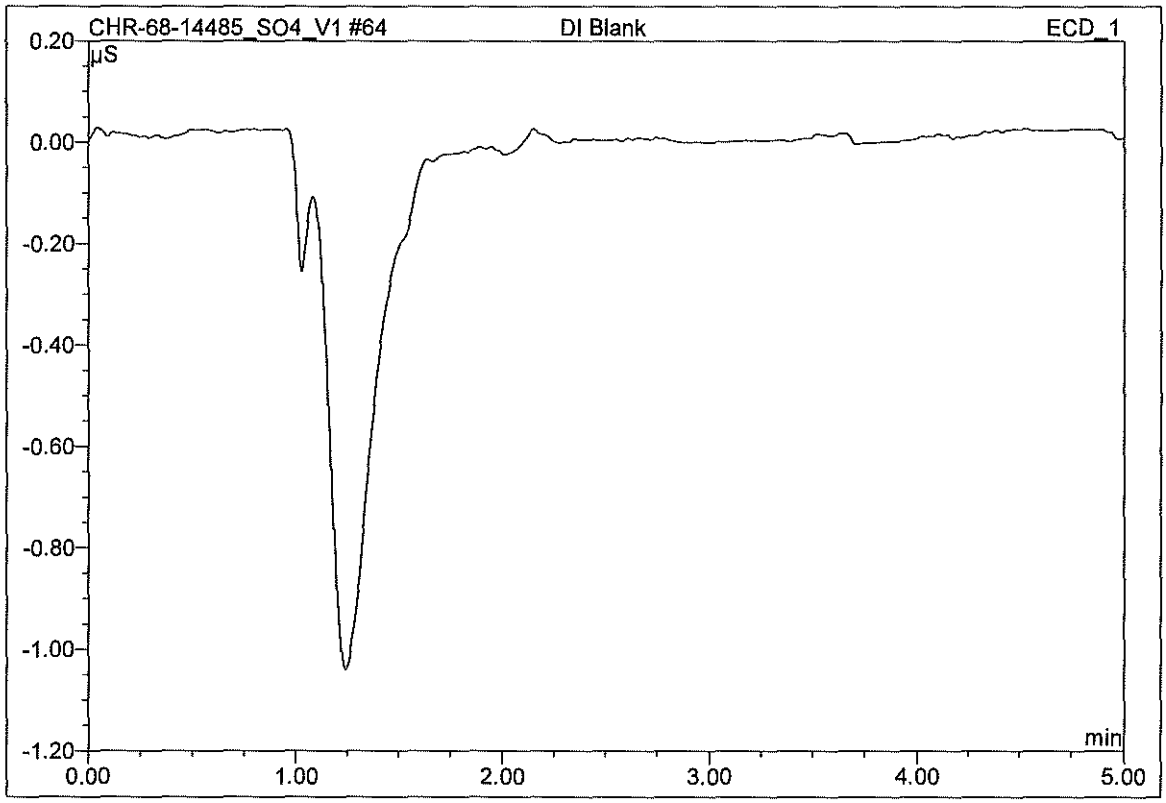


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	9.491	0.905	100.00	n.a.	BMB
Total:			9.491	0.905	100.00	0.000	

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**

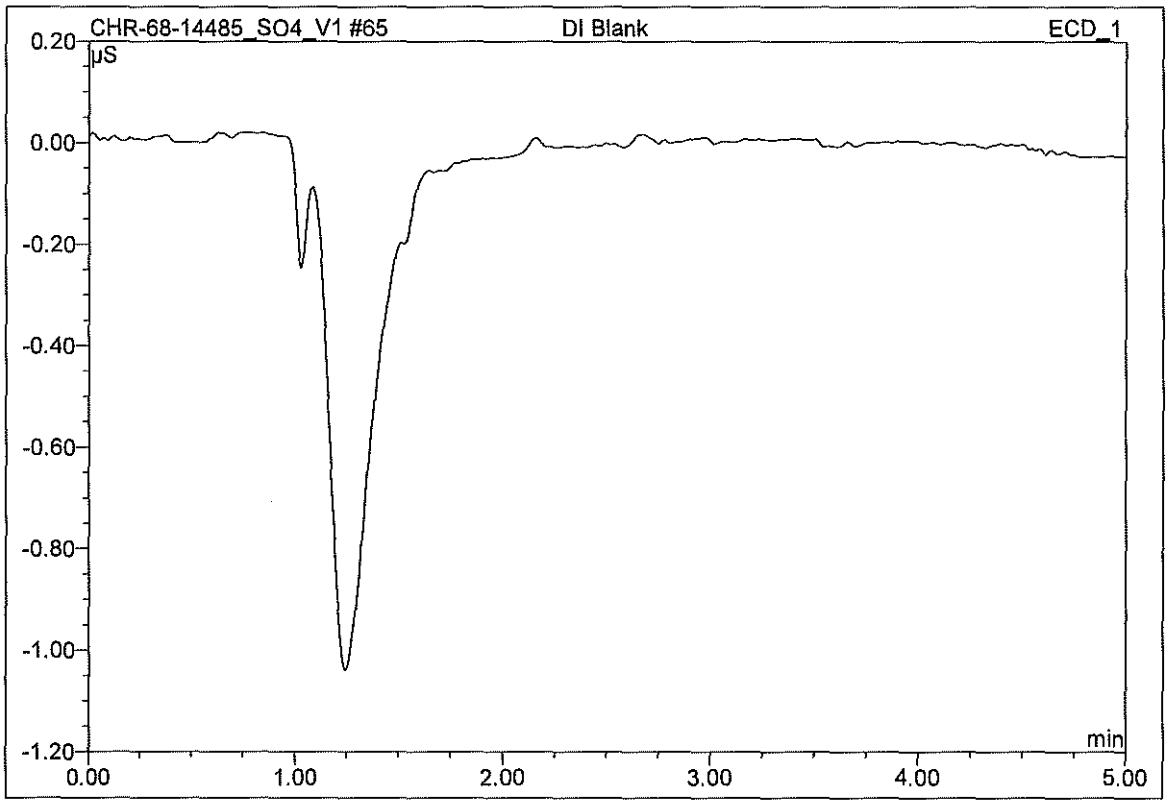


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

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:\Chrome\data\08011110_1\2_Data\14485\CHR-68-14485_SO4_V1.SEQ\ECD_1.CHL\3657.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

ERA
A Waters Company

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

092321K Final Report

Stationary Source Audit Program™

Project # :092321K

ERA
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,

Matthew Seebeck
Quality Officer

cc: Project File Number 092321K

ERA
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

092321K Laboratory Exception Report

A Waters Company

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

EPA ID: **Not Reported**
ERA Customer Number: **C487979**

Not Acceptable Evaluations

There were no Not Acceptable evaluations for this study.

ERA
A Waters Company

Final Report Results For Laboratory
Clean Air Engineering

ERA
A Waters Company

SSAP Final Evaluation Report

Project Number: **092321K**

ERA Customer Number: **C487979**

Laboratory Name: **Clean Air Engineering**

Inorganic Results

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: **Not Reported**
ERA Customer Number: **C487979**

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

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 NH_3, NOx, SO_2, CO, H_2O, O_2 and CO_2. 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; Bremo Bluff Generating Station; Bremo Bluff, Virginia
- Wärtsila 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
- CEPSA; 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
- CTCI 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

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

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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 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

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

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

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

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. 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

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

ERIC M. 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

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. 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

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

SOURCE EVALUATION SOCIETY INCORPORATED 1995 NORTH CAROLINA

CleanAir

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 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

CleanAir

Jennifer L. Wright <jlwright@cleanair.com>

Fwd: SES Exam Results - Joshua Lord

1 message

Josh Lord <jlord@cleanair.com> Mon, Nov 18, 2019 at 2:49 PM
To: Robert Doran <rdoran@cleanair.com>, "Jennifer L. Wright" <jlwright@cleanair.com>

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				

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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**

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

STACK TESTING ACCREDITATION COUNCIL

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:

Matrix	Technology(ies)	Methods
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

5202 Presidents Court, Suite 220 | Frederick, MD 21703-8398 | Phone: 301 644 3248 | Fax: 240 454 9449 | www.A2LA.org

Measurement:

Matrix	Test	Technology(ies)	Methods
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:

Matrix	Technology	Analyte(s)
Air	Gas Chromatography	TRS, Gaseous Organic Compounds, Performance Spec. 9, EPA 18, 106
Air	Ion Chromatography	HCl, CL2, HF, F2, HBr, Br2, SO4, NH3, NO2, NO3, PO4, Li. Ma, K, Mg, Ca
Air	Ion Specific Electrode	NH3
Air	Ohio Lumex (Thermal Atomic Absorption)	Hg

[1]All 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,

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.