Pre-Remedial Design Investigation Data Report

South State Street MGP Site
Bellingham, Washington

for
Puget Sound Energy

June 28, 2023

GeoEngineers
Earth Science + Technology

APPENDICES

GeoEngineers

APPENDIX D
Laboratory Analytical Reports
Part 2 of 2

Analytical Resources, Incorporated
Analytical Chemists and Consultants

18 October 2021

Brian Tracy
GeoEngineers
17425 Union Hill Road Suite 250
Redmond, WA 98052

RE: South State Street PRDI

Please find enclosed sample receipt documentation and analytical results for samples from the project referenced above.

Sample analyses were performed according to ARI's Quality Assurance Plan and any provided project specific Quality Assurance Plan. Each analytical section of this report has been approved and reviewed by an analytical peer, the appropriate Laboratory Supervisor or qualified substitute, and a technical reviewer.

Should you have any questions or problems, please feel free to contact us at your convenience.

Associated Work Order(s)	Associated SDG ID(s)
21I0042	N/A

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed in the enclosed Narrative. ARI, an accredited laboratory, certifies that the report results for which ARI is accredited meets all the requirements of the accrediting body. A list of certified analyses, accreditations, and expiration dates is included in this report.

Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his/her designee, as verified by the following signature.

Analytical Resources, Inc.

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Shelly Fishel, Project Manager

Cert# 100006-012

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: 21I0042	Turn-around Requested: Standard	Page: 1 of 4	
ARI Client Company: GeoEngineers	Phone:	Date: 9/2/21	Ice Present?
Client Contact: Brian Tracy		No. of Coolers:	Cooler Temps: 1.3; 0.4
Client Project Name: SSS - Upland Soil Inv.			
Client Project #: 186-890-03 Tsk 300	Samplers: KRA & BA		

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)
www.arilabs.com

Sample ID	Date	Time	Matrix	No. Containers	cPAHs (8270D)	Total Cyanide for soil (EPA 9014)	TOC in solids (SW9060A)	Total Cu (EPA 6010)	Total Fe (EPA 6010)	TPH Gx + Dx (NWTPH-Gx/ NWTPH-Dx)	Benzene (EPA 8260D)	Naphthalene (EPA 8260D)	Notes/Comments
HSA-59-9-10.5	8/30/21	1155	S	2		X	X	X	X				
HSA-60-9-10.5	8/30/21	1420	S	2		X	X	X	X				
HSA-62-13-14	8/31/21	1100	S	8		X				X	X	X	* Hot sample
Dup-1-083121	8/31/21	1130	S	8		X				X	X	X	* Hot Sample
HA-15-0-1	9/1/21	1240	S	1	X								
HA-15-1-2		1245	S	1	X								
HA-16-0-1		1040	S	1	X								
HA-16-1-2		1045	S	1	X								
HA-17-1-2		0900	S	1	X								
HA-18-1-2	8/31/21	1530	S	1	X								

Comments/Special Instructions	Relinquished by: (Signature)	Received by: (Signature)	Relinquished by: (Signature)	Received by: (Signature)
	Printed Name: Katy Ataturk	Printed Name: Dimitri Lamanna	Printed Name:	Printed Name:
	Company: GEI	Company: ARI	Company:	Company:
	Date & Time: 9/2/21 0800	Date & Time: 09/02/21 1052	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: 21I0042	Turn-around Requested: Stnd.	Page: 2 of 4	
ARI Client Company: GEI	Phone:	Date: 9/2/21	Ice Present?
Client Contact: B. Tracy		No. of Coolers:	Cooler Temps: 1.3; 0.4
Client Project Name: SSS - Upland Soil			
Client Project #: 186-890-03 Task 300	Samplers: KRA & BA		

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Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested: cPAHs								Notes/Comments
HA-19-0-1	8/31/21	1510	S	1	X								
HA-19-1-2	"	1520	"	"	X								
HA-20-0-1	"	1545	"	"	X								
HA-20-1-2	"	1600	"	"	X								
HA-21-1-2	9/1/21	0920	"	"	X								
HA-22-0-1	"	0935	"	"	X								
HA-22-1-2	"	0940	"	"	X								
HA-23-1-2	"	1110	"	"	X								
HA-24-0-1	8/31/21	1115	"	"	X								
HA-24-1-2	"	1120	"	"	X								

Comments/Special Instructions	Relinquished by: (Signature)	Received by: (Signature)	Relinquished by: (Signature)	Received by: (Signature)
	Printed Name: Katy Ataketurk	Printed Name: Dmitri Lomidze	Printed Name:	Printed Name:
	Company: GEI	Company: ARI	Company:	Company:
	Date & Time: 9/2/21 0800	Date & Time: 09/02/21 1052	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: 21I0042	Turn-around Requested: Stnd.	Page: 3 of 4	
ARI Client Company: GEI	Phone:	Date: 9/2/21	Ice Present?
Client Contact: B Tracy		No. of Coolers:	Cooler Temps: 1.3; 0.4
Client Project Name: SSS - Upland Soil			
Client Project #: 186-890-03 Tsk300	Samplers: KRA + BA		

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Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested: SAHs								Notes/Comments
HA-25-0-1	8/31/21	1040	S	1	X								
HA-25-1-2		1050			X								
HA-26-0-1		1135			X								
HA-26-1-2		1145			X								
HA-27-0-1		1220			X								
HA-27-1-2		1225			X								
HA-28-0-1		1255			X								
HA-28-1-2		1300			X								
HA-29-0-1		1345			X								
HA-29-1-2		1350			X								

Comments/Special Instructions	Relinquished by: (Signature)	Received by: (Signature)	Relinquished by: (Signature)	Received by: (Signature)
	Printed Name: Katy Atkinson	Printed Name: Dimitri Lomnadze	Printed Name:	Printed Name:
	Company: GEI	Company: ARI	Company:	Company:
	Date & Time: 9/2/21 0800	Date & Time: 09/02/21 1052	Date & Time:	Date & Time:

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: 21I0042	Turn-around Requested: Stnd	Page: 4 of 4	
ARI Client Company: GEI	Phone:	Date: 9/2/21	Ice Present?
Client Contact: B. Tracy		No. of Coolers:	Cooler Temps:
Client Project Name: SSS - Upland Soil Inv.			
Client Project #: 186-890-03 Tsk 30	Samplers: KRA & BA		

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Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested: cPAHs								Notes/Comments
HA-30-1-2	8/31/21	1415	S	1	X								
HA-31-0-1		1440			X								
HA-31-1-2		1445			X								
HA-32-0-1		1325			X								
HA-32-1-2		1330			X								
HA-33-0-1		1200			X								
HA-33-1-2		1210			X								
HA-34-1-2	↓	1015			X								
Dup-01-1-2	9/1/21	1115			X								
Dup-02-1-2	8/31/21	1400	↓	↓	X								

Comments/Special Instructions	Relinquished by: (Signature)	Received by: (Signature)	Relinquished by: (Signature)	Received by: (Signature)
	Printed Name: Katy Ackerman	Printed Name: Dimitri Lomnadze	Printed Name:	Printed Name:
	Company: GEI	Company: ARI	Company:	Company:
	Date & Time: 9/2/21 0800	Date & Time: 09/02/21 1052	Date & Time:	Date & Time:

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Cooler Receipt Form

ARI Client: Geoengineers | Project Name: SSS-Upland Soil Inv.

COC No(s): ~~NA~~ | Delivered by: Fed-Ex UPS Courier Hand Delivered Other: ____

Assigned ARI Job No: 21I0042 | Tracking No: ____ ~~NA~~

Preliminary Examination Phase:

Were intact, properly signed and dated custody seals attached to the outside of the cooler?	YES	(NO)
Were custody papers included with the cooler?	(YES)	NO
Were custody papers properly filled out (ink, signed, etc.)	(YES)	NO

Temperature of Cooler(s) (°C) (recommended 2.0-6.0 °C for chemistry) 1.3 0.4

Time 1052

If cooler temperature is out of compliance fill out form 00070F | Temp Gun ID#: DOO 5206

Cooler Accepted by: DL Date: 09/02/21 Time: 1052

Complete custody forms and attach all shipping documents

Log-In Phase:

Was a temperature blank included in the cooler?		YES	(NO)
What kind of packing material was used?	Bubble Wrap (Wet Ice) Gel Packs Baggies Foam Block Paper Other: ____		
Was sufficient ice used (if appropriate)?	NA	(YES)	NO
How were bottles sealed in plastic bags?	Individually	Grouped	(Not)
Did all bottles arrive in good condition (unbroken)?		(YES)	NO
Were all bottle labels complete and legible?		(YES)	NO
Did the number of containers listed on COC match with the number of containers received?		(YES)	NO
Did all bottle labels and tags agree with custody papers?		JS (YES)	(NO)
Were all bottles used correct for the requested analyses?		(YES)	NO
Do any of the analyses (bottles) require preservation? (attach preservation sheet, excluding VOCs)	(NA)	YES	NO
Were all VOC vials free of air bubbles?	NA	(YES)	NO
Was sufficient amount of sample sent in each bottle?		(YES)	NO
Date VOC Trip Blank was made at ARI	NA	08/27/2021	

Were the sample(s) split by ARI? (NA) YES Date/Time: ____ Equipment: ____ Split by: ____

Samples Logged by: JS Date: 09/03/2021 Time: 0850 Labels checked by: JS

***** Notify Project Manager of discrepancies or concerns *****

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Additional Notes, Discrepancies, & Resolutions:

Trip Blanks are not listed on the CoC, logged as final sample in workorder

By: JS Date: 09/03/2021

GeoEngineers	Project: South State Street PRDI	
17425 Union Hill Road Suite 250	Project Number: Project #186-890-03 Tsk 300	**Reported:**
Redmond, WA 98052	Project Manager: Brian Tracy	10/18/2021 10:21

ANALYTICAL REPORT FOR SAMPLES

Laboratory ID	Sample ID	Matrix	Date Sampled	Date Received
21I0042-01	HSA-59-9-10.5	Solid	08/30/21 11:55	09/02/21 10:52
21I0042-02	HSA-60-9-10.5	Solid	08/30/21 14:20	09/02/21 10:52
21I0042-03	HSA-62-13-14	Solid	08/31/21 11:00	09/02/21 10:52
21I0042-04	DUP-1-083121	Solid	08/31/21 11:30	09/02/21 10:52
21I0042-05	HA-15-0-1	Solid	09/01/21 12:40	09/02/21 10:52
21I0042-06	HA-15-1-2	Solid	09/01/21 12:45	09/02/21 10:52
21I0042-07	HA-16-0-1	Solid	09/01/21 10:40	09/02/21 10:52
21I0042-08	HA-16-1-2	Solid	09/01/21 10:45	09/02/21 10:52
21I0042-09	HA-17-1-2	Solid	09/01/21 09:00	09/02/21 10:52
21I0042-10	HA-18-1-2	Solid	08/31/21 15:30	09/02/21 10:52
21I0042-11	HA-19-0-1	Solid	08/31/21 15:10	09/02/21 10:52
21I0042-12	HA-19-1-2	Solid	08/31/21 15:20	09/02/21 10:52
21I0042-13	HA-20-0-1	Solid	08/31/21 15:45	09/02/21 10:52
21I0042-14	HA-20-1-2	Solid	08/31/21 16:00	09/02/21 10:52
21I0042-15	HA-21-1-2	Solid	09/01/21 09:20	09/02/21 10:52
21I0042-16	HA-22-0-1	Solid	09/01/21 09:35	09/02/21 10:52
21I0042-17	HA-22-1-2	Solid	09/01/21 09:40	09/02/21 10:52
21I0042-18	HA-23-1-2	Solid	09/01/21 11:10	09/02/21 10:52
21I0042-19	HA-24-0-1	Solid	08/31/21 11:15	09/02/21 10:52
21I0042-20	HA-24-1-2	Solid	08/31/21 11:20	09/02/21 10:52
21I0042-21	HA-25-0-1	Solid	08/31/21 10:40	09/02/21 10:52
21I0042-22	HA-25-1-2	Solid	08/31/21 10:50	09/02/21 10:52
21I0042-23	HA-26-0-1	Solid	08/31/21 11:35	09/02/21 10:52
21I0042-24	HA-26-1-2	Solid	08/31/21 11:45	09/02/21 10:52
21I0042-25	HA-27-0-1	Solid	08/31/21 12:20	09/02/21 10:52
21I0042-26	HA-27-1-2	Solid	08/31/21 12:25	09/02/21 10:52
21I0042-27	HA-28-0-1	Solid	08/31/21 12:55	09/02/21 10:52
21I0042-28	HA-28-1-2	Solid	08/31/21 13:00	09/02/21 10:52
21I0042-29	HA-29-0-1	Solid	08/31/21 13:45	09/02/21 10:52
21I0042-30	HA-29-1-2	Solid	08/31/21 13:50	09/02/21 10:52
21I0042-31	HA-30-1-2	Solid	08/31/21 14:15	09/02/21 10:52
21I0042-32	HA-31-0-1	Solid	08/31/21 14:40	09/02/21 10:52
21I0042-33	HA-31-1-2	Solid	08/31/21 14:45	09/02/21 10:52
21I0042-34	HA-32-0-1	Solid	08/31/21 13:25	09/02/21 10:52
21I0042-35	HA-32-1-2	Solid	08/31/21 13:30	09/02/21 10:52
21I0042-36	HA-33-0-1	Solid	08/31/21 12:00	09/02/21 10:52
21I0042-37	HA-33-1-2	Solid	08/31/21 12:10	09/02/21 10:52
21I0042-38	HA-34-1-2	Solid	08/31/21 10:15	09/02/21 10:52
21I0042-39	DUP-01-1-2	Solid	09/01/21 11:15	09/02/21 10:52
21I0042-40	DUP-02-1-2	Solid	08/31/21 14:00	09/02/21 10:52
21I0042-41	Trip Blanks	Water	08/30/21 11:55	09/02/21 10:52

GeoEngineers	Project: South State Street PRDI	
17425 Union Hill Road Suite 250	Project Number: Project #186-890-03 Tsk 300	**Reported:**
Redmond WA, 98052	Project Manager: Brian Tracy	18-Oct-2021 10:21

Case Narrative

Client: GeoEngineers
Project: South State Street PRDI
Work Order: 21I0042

Sample receipt

Samples as listed on the preceding page were received 02-Sep-2021 10:52 under ARI work order 21I0042. For details regarding sample receipt, please refer to the Cooler Receipt Form.

Gasoline by NWTPH-g (GC/MS)

The sample(s) were analyzed within the recommended holding times.

Initial and continuing calibrations were within method requirements.

Internal standard areas were within limits.

The surrogate percent recoveries were within control limits.

The method blank(s) were clean at the reporting limits.

The blank spike and blank spike duplicate (BS/LCS and BSD/LCSD) spike recoveries and relative percent difference (RPD) were within control limits.

No extra volume provided for matrix QC.

Volatiles - EPA Method SW8260D

The sample(s) were analyzed within the recommended holding times.

Initial and continuing calibrations were within method requirements.

Internal standard areas were within limits.

The surrogate percent recoveries were within control limits.

The method blank(s) were clean at the reporting limits.

The blank spike and blank spike duplicate (BS/LCS and BSD/LCSD) spike recoveries and relative percent difference (RPD) were within control limits.

No extra volume was provided for matrix QC.

Polynuclear Aromatic Hydrocarbons (PAH) - EPA Method SW8270E-SIM

The sample(s) were extracted and analyzed within the recommended holding times.

Initial and continuing calibrations were within method requirements except Dibenzo(a,h)anthracene and Dibenzo(a,h)anthracene-d14 which were out of control high in association with reanalysis of samples 21I0042-38RE1,

GeoEngineers	Project: South State Street PRDI	
17425 Union Hill Road Suite 250	Project Number: Project #186-890-03 Tsk 300	**Reported:**
Redmond WA, 98052	Project Manager: Brian Tracy	18-Oct-2021 10:21

Case Narrative

21I0042-39RE1 and 21I0042-40RE1. All samples which contain analyte have been flagged with a "Q" qualifier.

Internal standard areas were within limits.

The surrogate percent recoveries were within control limits.

The method blank(s) were clean at the reporting limits.

The blank spike (BS/LCS) percent recoveries were within control limits.

Sample specific was performed in association with sample 21I0042-20 in batch BJI0287 and in association with sample 21I0042-32 in batch BJI0296. The matrix spike/matrix spike duplicate (MS/MSD) percent recoveries and relative percent difference (RPD) were within advisory control limits except as flagged. Deviations have been flagged and are attributed to high sample concentration in samples with requested low-level analysis which is spiked with a lower concentration solution and sample homogeniety.

Total Metals - EPA Method 6020B

The sample(s) were digested and analyzed within the recommended holding times.

Initial and continuing calibrations were within method requirements.

The method blank(s) were clean at the reporting limits.

The blank spike (BS/LCS) percent recoveries were within control limits.

Sample specific QC was performed in association with sample 21I0042-01 in batch BJI0584. The duplicate (DUP) relative percent difference (RPD) were within advisory control limits. The matrix spike/matrix spike duplicate (MS/MSD) percent recoveries and relative percent difference (RPD) were within advisory control limits except as follows. Iron deviations are attributed to high sample concentration. Copper was out of control low in matrix spike BJI0584-MS1 and MS/MSD RPD. Deviations have been flagged.

Wet Chemistry

The sample(s) were prepared and analyzed within the recommended holding times.

Initial and continuing calibrations were within method requirements.

The method blank(s) were clean at the reporting limits.

The blank spike (BS/LCS) percent recoveries were within control limits.

The reference material (SRM) percent recoveries were within control limits.

Sample specific QC was performed in association with sample 21I0042-01 in Total Organic Carbon (TOC) batch BJI0215, Total Solids batch BJI0226 and Cyanide batch BJI0275. The duplicate (DUP) relative percent difference (RPD) were within advisory control limits. The matrix spike/matrix spike duplicate (MS/MSD) percent recoveries and relative percent difference (RPD) were within advisory control limits except TOC MS/MSD RPD, Cyanide DUP RPD as well as Cyanide MS and MSD percent recoveries which were out of control low. Deviations have been flagged.

Diesel/Heavy Oil Range Organics - WA-Ecology Method NW-TPHDx

Analytical Report

GeoEngineers	Project: South State Street PRDI	
17425 Union Hill Road Suite 250	Project Number: Project #186-890-03 Tsk 300	**Reported:**
Redmond WA, 98052	Project Manager: Brian Tracy	18-Oct-2021 10:21

Case Narrative

The sample(s) were extracted and analyzed within the recommended holding times.

Initial and continuing calibrations were within method requirements.

The surrogate percent recoveries were within control limits.

The method blank(s) were clean at the reporting limits.

The blank spike (BS/LCS) percent recoveries were within control limit.

Sample specific QC was performed in association with sample 21I0042-04 in batch BJI0334. The matrix spike (MS) percent recoveries and the duplicate (DUP) relative percent difference (RPD) were within advisory control limits except as flagged. NWTPH-Dx was requested at a low concentration level. Deviations have been flagged and are attributed to high concentration of the sample in comparision to the spike concentration.

Analytical Report

GeoEngineers	Project: South State Street PRDI	
17425 Union Hill Road Suite 250	Project Number: Project #186-890-03 Tsk 300	**Reported:**
Redmond WA, 98052	Project Manager: Brian Tracy	18-Oct-2021 10:21

Case Narrative

QUALIFIERS AND NOTES

Qualifier	Definition
U	This analyte is not detected above the reporting limit (RL) or if noted, not detected above the limit of detection (LOD).
Q	Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20% RSD, <20% drift or minimum RRF)
NRS	This surrogate not reported due to chromatographic interference
J	Estimated concentration value detected below the reporting limit.
HC	The natural concentration of the spiked analyte is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible
E	The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL)
D1	Surrogate was not detected due to sample extract dilution
D	The reported value is from a dilution
B	This analyte was detected in the method blank.
*	Flagged value is not within established control limits.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

HSA-62-13-14

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8260D MED

Volatile Organic Compounds (MeOH extraction)

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-03 F	SDG:	21I0042
Sampled:	08/31/21 11:00	Prepared:	09/08/21 08:36	File ID:	NT509082111.D
% Solids:	75.23	Preparation:	EPA 5035 (Methanol Extraction)	Analyzed:	09/08/21 16:28
Batch:	BJI0235	Sequence:	SJI0164	Initial/Final:	7.719 g Wet / 5 mL
Instrument:	NT5	Column:	RTX-VMS	Calibration:	EI00007

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
71-43-2	Benzene	5000	13800	D	982	5950
91-20-3	Naphthalene	5000	1340000	D, E	14700	29800

SURROGATES	ADDED:(ug/L)	(ug/L)	% REC	QC LIMITS	Q
1,2-Dichloroethane-d4	50.000	51.9	104	80 - 149	
Toluene-d8	50.000	50.4	101	77 - 120	
4-Bromofluorobenzene	50.000	49.7	99.4	80 - 120	
1,2-Dichlorobenzene-d4	50.000	50.3	101	80 - 120	

HSA-62-13-14

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8260D MED

Volatile Organic Compounds (MeOH extraction)

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-03RE1 F	SDG:	21I0042
Sampled:	08/31/21 11:00	Prepared:	09/08/21 08:36	File ID:	NT509102104.D
% Solids:	75.23	Preparation:	EPA 5035 (Methanol Extraction)	Analyzed:	09/10/21 11:30
Batch:	BJI0310	Sequence:	SJI0225	Initial/Final:	7.719 g Wet / 5 mL
Instrument:	NT5	Column:	RTX-VMS	Calibration:	EI00007

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
71-43-2	Benzene	25000	12300	J, D	4910	29800
91-20-3	Naphthalene	25000	1260000	D	73300	149000

SURROGATES	ADDED:(ug/L)	(ug/L)	% REC	QC LIMITS	Q
1,2-Dichloroethane-d4	50.000	49.5	99.0	80 - 149	
Toluene-d8	50.000	49.2	98.4	77 - 120	
4-Bromofluorobenzene	50.000	49.0	97.9	80 - 120	
1,2-Dichlorobenzene-d4	50.000	50.3	101	80 - 120	

DUP-1-083121

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8260D MED

Volatile Organic Compounds (MeOH extraction)

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-04 F	SDG:	21I0042
Sampled:	08/31/21 11:30	Prepared:	09/08/21 08:36	File ID:	NT509082112.D
% Solids:	78.49	Preparation:	EPA 5035 (Methanol Extraction)	Analyzed:	09/08/21 16:52
Batch:	BJI0235	Sequence:	SJI0164	Initial/Final:	4.562 g Wet / 5 mL
Instrument:	NT5	Column:	RTX-VMS	Calibration:	EI00007

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
71-43-2	Benzene	10000	29500	D	2760	16700
91-20-3	Naphthalene	10000	3040000	D	41100	83500

SURROGATES	ADDED:(ug/L)	(ug/L)	% REC	QC LIMITS	Q
1,2-Dichloroethane-d4	50.000	51.2	102	80 - 149	
Toluene-d8	50.000	49.7	99.3	77 - 120	
4-Bromofluorobenzene	50.000	49.0	98.0	80 - 120	
1,2-Dichlorobenzene-d4	50.000	50.6	101	80 - 120	

PREPARATION BATCH SUMMARY

EPA 8260D MED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Batch: BJI0235
Batch Matrix: Solid
Preparation: EPA 5035 (Methanol Extraction)

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
HSA-62-13-14	21I0042-03	NT509082111.D	09/08/21 08:36	Check Version
DUP-1-083121	21I0042-04	NT509082112.D	09/08/21 08:36	Check Version
Blank	BJI0235-BLK1	NT509082104B.D	09/08/21 08:36	
LCS	BJI0235-BS1	NT509082102C.D	09/08/21 08:36	
LCS Dup	BJI0235-BSD1	NT509082103B.D	09/08/21 08:36	

PREPARATION BATCH SUMMARY

EPA 8260D MED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Batch: BJI0310
Batch Matrix: Solid
Preparation: EPA 5035 (Methanol Extraction)

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
HSA-62-13-14	21I0042-03RE1	NT509102104.D	09/08/21 08:36	Check Version
Blank	BJI0310-BLK1	NT509102103A.D	09/10/21 07:18	
LCS	BJI0310-BS1	NT509102101B.D	09/10/21 07:18	
LCS Dup	BJI0310-BSD1	NT509102102A.D	09/10/21 07:18	

Form I

METHOD BLANK DATA SHEET

EPA 8260D MED

Blank

Laboratory:	Analytical Resources, Inc.			SDG:	21I0042
Client:	GeoEngineers			Project:	South State Street PRDI
Matrix:	Solid	Laboratory ID:	BJI0235-BLK1	File ID:	NT509082104B.D
Sampled:	N/A	Prepared:	09/08/21 08:36	Analyzed:	09/08/21 11:14
Solids:		Preparation:	EPA 5035 (Methanol Extract	Initial/Final:	5 g / 5 mL
Batch:	BJI0235	Sequence:	SJI0164	Calibration:	EI00007
Instrument:	NT5	Column:	RTX-VMS		

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg wet)	Q	DL	RL
71-43-2	Benzene	50	50.0	U	8.25	50.0
91-20-3	Naphthalene	50	250	U	123	250

SURROGATES	ADDED (ug/L)	CONC. (ug/L)	% REC	QC LIMITS	Q
1,2-Dichloroethane-d4	50.000	50.7	101	80 - 124	
Toluene-d8	50.000	49.8	99.6	80 - 120	
4-Bromofluorobenzene	50.000	49.4	98.8	80 - 120	
1,2-Dichlorobenzene-d4	50.000	50.2	100	80 - 120	

Form I

METHOD BLANK DATA SHEET

EPA 8260D MED

Blank

Laboratory:	Analytical Resources, Inc.			SDG:	21I0042
Client:	GeoEngineers			Project:	South State Street PRDI
Matrix:	Solid	Laboratory ID:	BJI0310-BLK1	File ID:	NT509102103A.D
Sampled:	N/A	Prepared:	09/10/21 07:18	Analyzed:	09/10/21 10:25
Solids:		Preparation:	EPA 5035 (Methanol Extract	Initial/Final:	5 g / 5 mL
Batch:	BJI0310	Sequence:	SJI0225	Calibration:	EI00007
Instrument:	NT5	Column:	RTX-VMS		

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg wet)	Q	DL	RL
71-43-2	Benzene	50	50.0	U	8.25	50.0
91-20-3	Naphthalene	50	250	U	123	250

SURROGATES	ADDED (ug/L)	CONC. (ug/L)	% REC	QC LIMITS	Q
1,2-Dichloroethane-d4	50.000	48.6	97.1	80 - 124	
Toluene-d8	50.000	49.7	99.4	80 - 120	
4-Bromofluorobenzene	50.000	49.4	98.8	80 - 120	
1,2-Dichlorobenzene-d4	50.000	49.9	99.8	80 - 120	

LCS / LCS DUPLICATE RECOVERY

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/08/21 10:14
Batch:	BJI0235	Laboratory ID:	BJI0235-BS1
Preparation:	EPA 5035 (Methanol Extraction)	Sequence Name:	LCS
Initial/Final:	5 g / 5 mL		

COMPOUND	SPIKE ADDED (ug/L)	LCS CONCENTRATION (ug/L)	Q	LCS % REC. #	QC LIMITS REC.
Benzene	2500	2360		94.2	80 - 120
Naphthalene	2500	2420		96.7	63 - 130

* Indicates values outside of QC limits

COMPOUND	SPIKE ADDED (ug/L)	LCSD CONCENTRATION (ug/L)	Q	LCSD % REC. #	% RPD #	QC LIMITS	
						RPD	REC.
Benzene	2500	2410		96.3	2.17	30	80 - 120
Naphthalene	2500	2320		92.9	4.04	30	63 - 130

* Indicates values outside of QC limits

LCS / LCS DUPLICATE RECOVERY

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/10/21 09:36
Batch:	BJI0310	Laboratory ID:	BJI0310-BS1
Preparation:	EPA 5035 (Methanol Extraction)	Sequence Name:	LCS
Initial/Final:	5 g / 5 mL		

COMPOUND	SPIKE ADDED (ug/L)	LCS CONCENTRATION (ug/L)	Q	LCS % REC. #	QC LIMITS REC.
Benzene	2500	2440		97.4	80 - 120
Naphthalene	2500	2420		96.6	63 - 130

* Indicates values outside of QC limits

COMPOUND	SPIKE ADDED (ug/L)	LCSD CONCENTRATION (ug/L)	Q	LCSD % REC. #	% RPD #	QC LIMITS	
						RPD	REC.
Benzene	2500	2280		91.2	6.58	30	80 - 120
Naphthalene	2500	2600		104	7.45	30	63 - 130

* Indicates values outside of QC limits

Analytical Resources, Incorporated
Analytical Chemists and Consultants

MASS SPECTROMETER
INSTRUMENT PERFORMANCE CHECK
EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Lab File ID:	NT509022106.D	Injection Date:	09/02/21
Instrument ID:	NT5	Injection Time:	12:24
Sequence:	SJI0028	Lab Sample ID:	SJI0028-TUN1

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
95	50 - 200% of 174	145	PASS
96	5 - 9% of 95	5.98	PASS
173	Less than 2% of 174	0	PASS
174	50 - 200% of 95	69.1	PASS
175	5 - 9% of 174	8.53	PASS
176	95 - 105% of 174	98.8	PASS
177	5 - 10% of 176	8.27	PASS

Client Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
MS Tune	SJI0028-TUN1	NT509022106.D	09/02/2021	12:24
Cal Standard	SJI0028-CAL3	NT509022109.D	09/02/2021	13:53
Cal Standard	SJI0028-CAL4	NT509022110.D	09/02/2021	14:17
Cal Standard	SJI0028-CAL5	NT509022111.D	09/02/2021	14:42
Cal Standard	SJI0028-CAL6	NT509022112.D	09/02/2021	15:06
Cal Standard	SJI0028-CAL7	NT509022113.D	09/02/2021	15:31
Cal Standard	SJI0028-CAL8	NT509022114.D	09/02/2021	15:55
Cal Standard	SJI0028-CAL2	NT509022116.D	09/02/2021	16:44
Cal Standard	SJI0028-CAL1	NT509022117.D	09/02/2021	17:09
Secondary Cal Check	SJI0028-SCV1	NT509032102.D	09/03/2021	11:27

INITIAL CALIBRATION DATA

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00007	Instrument:	NT5
Calibration Date:	09/02/2021	Column (1):	RTX-VMS

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
		RRF		RRF		RRF		RRF		RRF		RRF
Chloromethane	1	3.163485	2	3.064413	5	2.503672	10	2.552131	50	2.277904	100	2.391666
Vinyl Chloride	1	2.216141	2	2.232214	5	2.235487	10	2.229381	50	2.249761	100	2.298102
Bromomethane	1	1.832347	2	1.573023	5	1.277189	10	1.188446	50	1.015174	100	1.070769
Chloroethane	1	0.9938119	2	0.992961	5	1.085335	10	0.9611212	50	0.917897	100	0.9742123
Trichlorofluoromethane	1	1.911324	2	1.494451	5	1.382861	10	1.370017	50	1.354947	100	1.342524
Acrolein	5	0.2674897	10	0.2972018	25	0.3242832	50	0.3361614	250	0.3278453	500	0.345271
1,1,2-Trichloro-1,2,2-Trifluoroethane			2	1.241294	5	1.126441	10	1.153892	50	1.113492	100	1.134359
Acetone	5	0.7371074	10	0.6721596	25	0.4225563	50	0.4077419	250	0.3796828	500	0.39779
1,1-Dichloroethene	1	1.378754	2	1.334802	5	1.283216	10	1.26669	50	1.171119	100	1.212169
Iodomethane	1	0.6954962	2	0.5728264	5	0.5508057	10	0.6580567	50	0.6690711	100	0.7225874
Methylene Chloride			2	2.583331	5	1.980584	10	1.554021	50	1.324347	100	1.305876
Acrylonitrile			2	0.698338	5	0.6218669	10	0.6250728	50	0.600662	100	0.6216202
Carbon Disulfide	1	4.752207	2	4.658401	5	4.31835	10	4.229727	50	4.136285	100	4.008615
trans-1,2-Dichloroethene	1	1.407247	2	1.303725	5	1.296606	10	1.317701	50	1.242214	100	1.281166
Vinyl Acetate	1	2.180573	2	2.546318	5	3.732356	10	3.810196	50	3.572004	100	3.807149
1,1-Dichloroethane	1	2.845664	2	2.968679	5	2.956963	10	2.950884	50	2.763793	100	2.907729
2-Butanone	5	0.1358484	10	0.1530629	25	0.1388455	50	0.1352731	250	0.1350375	500	0.13814
2,2-Dichloropropane	1	2.038873	2	2.11097	5	1.968277	10	1.975828	50	1.897253	100	1.992225
cis-1,2-Dichloroethene	1	1.526764	2	1.4592	5	1.468105	10	1.435632	50	1.303177	100	1.381105
Chloroform	1	2.195297	2	2.313477	5	2.360395	10	2.344614	50	2.071561	100	2.229591
Bromochloromethane	1	0.7075436	2	0.7466688	5	0.6619268	10	0.661408	50	0.5776097	100	0.6199436
1,1,1-Trichloroethane	1	1.947848	2	1.941858	5	1.934244	10	1.911571	50	1.801306	100	1.886446
1,1-Dichloropropene	1	0.4555132	2	0.4906061	5	0.4859973	10	0.4668704	50	0.437286	100	0.4518715
Carbon tetrachloride	1	0.3262143	2	0.3764435	5	0.3926552	10	0.3777172	50	0.3900802	100	0.4088585
1,2-Dichloroethane	1	0.5187841	2	0.5100158	5	0.484689	10	0.46571	50	0.4364658	100	0.4615867
Benzene	1	1.452147	2	1.366224	5	1.443307	10	1.434622	50	1.345613	100	1.38916
Trichloroethene	1	0.3673825	2	0.3720115	5	0.3317111	10	0.3465099	50	0.3280682	100	0.3326982
1,2-Dichloropropane	1	0.4462608	2	0.4078535	5	0.4475699	10	0.4405395	50	0.4101174	100	0.4372599

INITIAL CALIBRATION DATA

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00007	Instrument:	NT5
Calibration Date:	09/02/2021	Column (1):	RTX-VMS

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
		RRF		RRF		RRF		RRF		RRF		RRF
Bromodichloromethane	1	0.4032235	2	0.4051943	5	0.4374781	10	0.4319337	50	0.404319	100	0.431428
Dibromomethane	1	0.1949062	2	0.1887558	5	0.1762539	10	0.1775799	50	0.1720826	100	0.1829998
2-Chloroethyl vinyl ether					5	4.691807E-02	10	5.385331E-02	50	6.279278E-02	100	8.060174E-02
4-Methyl-2-Pentanone	5	0.1379063	10	0.1500455	25	0.1551206	50	0.1618646	250	0.1612088	500	0.1666727
cis-1,3-Dichloropropene	1	0.5550457	2	0.5559035	5	0.5613425	10	0.5566702	50	0.5296971	100	0.5596809
Toluene	1	0.9451851	2	0.9232558	5	0.9484807	10	0.8940074	50	0.8285714	100	0.8651585
trans-1,3-Dichloropropene	1	0.483644	2	0.5152887	5	0.4636179	10	0.4844716	50	0.452921	100	0.496501
2-Hexanone	5	0.2195915	10	0.2389991	25	0.2196537	50	0.2288929	250	0.2363213	500	0.2415834
1,1,2-Trichloroethane	1	0.2596257	2	0.2660991	5	0.2752137	10	0.2665692	50	0.2546072	100	0.2683223
1,3-Dichloropropane	1	0.3889883	2	0.4492824	5	0.4483029	10	0.4613885	50	0.4322005	100	0.4507541
Tetrachloroethene	1	0.3265591	2	0.3005519	5	0.3060888	10	0.2925369	50	0.2770505	100	0.2826071
Dibromochloromethane	1	0.2168681	2	0.2648013	5	0.2487608	10	0.2507262	50	0.254802	100	0.2698502
1,2-Dibromoethane	1	0.2328968	2	0.2638491	5	0.2617824	10	0.2550713	50	0.2463954	100	0.2617383
Chlorobenzene	1	0.8078086	2	0.8732613	5	0.8392034	10	0.8337321	50	0.7901529	100	0.8126707
Ethylbenzene	1	1.390076	2	1.503295	5	1.537294	10	1.526262	50	1.426986	100	1.454154
1,1,1,2-Tetrachloroethane	1	0.2627473	2	0.276155	5	0.2783981	10	0.2850985	50	0.2699117	100	0.2842248
m,p-Xylene	2	0.5148313	4	0.5572038	10	0.5798235	20	0.5749278	100	0.5368575	200	0.5496794
o-Xylene	1	0.489713	2	0.5482713	5	0.5451086	10	0.556531	50	0.518759	100	0.5330559
Xylenes, total	3	0.5064586	6	0.5542263	15	0.5682518	30	0.5687955	150	0.5308247	300	0.5441382
Styrene	1	0.8382271	2	0.8924244	5	0.8808844	10	0.8977279	50	0.8460741	100	0.8821892
Bromoform	1	0.2691441	2	0.2601393	5	0.2787926	10	0.3006148	50	0.3104218	100	0.3329492
1,1,2,2-Tetrachloroethane	1	0.4784216	2	0.5705782	5	0.5985277	10	0.635348	50	0.6383162	100	0.6642677
1,2,3-Trichloropropane			2	0.1742332	5	0.1820282	10	0.1738209	50	0.179772	100	0.1946015
trans-1,4-Dichloro 2-Butene					5	0.1615236	10	0.1785586	50	0.194254	100	0.2009228
n-Propylbenzene	1	3.315095	2	3.56435	5	3.451213	10	3.463093	50	3.308518	100	3.332836
Bromobenzene	1	0.5741912	2	0.6151175	5	0.6202306	10	0.6405424	50	0.5948156	100	0.6186329
2-Chlorotoluene	1	2.04118	2	2.143519	5	2.063741	10	2.120442	50	1.972982	100	1.98683
4-Chlorotoluene	1	2.019007	2	2.098646	5	2.124256	10	2.108471	50	1.979511	100	2.000626

INITIAL CALIBRATION DATA

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00007	Instrument:	NT5
Calibration Date:	09/02/2021	Column (1):	RTX-VMS

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
		RRF		**RRF**		**RRF**		**RRF**		**RRF**		**RRF**
t-Butylbenzene	1	2.060453	2	2.087083	5	2.130497	10	2.128531	50	2.06063	100	2.090376
1,3,5-Trimethylbenzene	1	2.193576	2	2.339918	5	2.358178	10	2.382518	50	2.271582	100	2.303434
1,2,4-Trimethylbenzene	1	2.212081	2	2.341963	5	2.302107	10	2.318547	50	2.181213	100	2.231987
s-Butylbenzene	1	3.082109	2	3.137951	5	3.09378	10	3.168186	50	3.056159	100	3.079367
4-Isopropyl Toluene	1	2.425282	2	2.594881	5	2.54485	10	2.589838	50	2.515955	100	2.532347
1,3-Dichlorobenzene	1	1.100199	2	1.240295	5	1.195974	10	1.214479	50	1.16405	100	1.181844
1,4-Dichlorobenzene	1	1.215839	2	1.303201	5	1.225266	10	1.224338	50	1.133252	100	1.159384
n-Butylbenzene	1	2.296253	2	2.410546	5	2.265358	10	2.297288	50	2.19694	100	2.221997
1,2-Dichlorobenzene	1	1.228716	2	1.184986	5	1.141334	10	1.136245	50	1.086519	100	1.120559
1,2-Dibromo-3-Chloropropane					5	0.1050528	10	9.906876E-02	50	0.1175481	100	0.1189253
1,2,4-Trichlorobenzene					5	0.6825766	10	0.6551145	50	0.6625623	100	0.6593379
Hexachloro-1,3-Butadiene					5	0.4319446	10	0.3924506	50	0.4031907	100	0.3968763
Naphthalene					5	1.562227	10	1.670926	50	1.767869	100	1.719883
1,2,3-Trichlorobenzene					5	0.612841	10	0.6290446	50	0.63354	100	0.6141262
Dichlorodifluoromethane	1	1.43115	2	1.265506	5	1.40834	10	1.398556	50	1.546803	100	1.56747
Methyl tert-butyl Ether	1	3.463713	2	3.536496	5	3.405922	10	3.450141	50	3.104678	100	3.389455
2-Pentanone	5	0.0386074	10	4.274223E-02	25	4.297652E-02	50	4.403136E-02	250	0.0443386	500	4.537031E-02
Dibromofluoromethane	50	1.589804	50	1.532781	50	1.5057	50	1.4886	50	1.449241	50	1.519527
1,2-Dichloroethane-d4	50	1.583658	50	1.531141	50	1.483415	50	1.477721	50	1.436659	50	1.513306
Toluene-d8	50	1.440943	50	1.424246	50	1.427081	50	1.406901	50	1.412308	50	1.427235
4-Bromofluorobenzene	50	0.3690202	50	0.3680465	50	0.3636868	50	0.3658113	50	0.3620806	50	0.3664115
1,2-Dichlorobenzene-d4	50	1.021446	50	0.9917784	50	0.9850776	50	0.9902831	50	1.007853	50	1.018957

INITIAL CALIBRATION DATA

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00007	Instrument:	NT5
Calibration Date:	09/02/2021	Column (1):	RTX-VMS

Compound	Level 07		Level 08		Level 09		Level 10		Level 11		Level 12	
		RRF		RRF		RRF		RRF		RRF		RRF
Chloromethane	150	2.458441	200	2.615057								
Vinyl Chloride	150	2.25346	200	2.399354								
Bromomethane	150	1.110174	200	1.22099								
Chloroethane	150	0.9472192	200	1.005574								
Trichlorofluoromethane	150	1.27974	200	1.351878								
Acrolein	750	0.3456195	1000	0.3527021								
1,1,2-Trichloro-1,2,2-Trifluor oethane	150	1.125777	200	1.225141								
Acetone	750	0.3781733	1000	0.3818898								
1,1-Dichloroethene	150	1.171776	200	1.280117								
Iodomethane	150	0.7521262	200	0.7744933								
Methylene Chloride	150	1.301399	200	1.361415								
Acrylonitrile	150	0.6165375	200	0.6339003								
Carbon Disulfide	150	4.014334	200	4.358871								
trans-1,2-Dichloroethene	150	1.252985	200	1.359279								
Vinyl Acetate	150	3.757706	200	3.91334								
1,1-Dichloroethane	150	2.864584	200	3.054739								
2-Butanone	750	0.1374332	1000	0.1412191								
2,2-Dichloropropane	150	1.934424	200	2.050303								
cis-1,2-Dichloroethene	150	1.364289	200	1.465071								
Chloroform	150	2.203354	200	2.326672								
Bromochloromethane	150	0.598964	200	0.6151823								
1,1,1-Trichloroethane	150	1.839568	200	1.971684								
1,1-Dichloropropene	150	0.4429986	200	0.4723292								
Carbon tetrachloride	150	0.4066663	200	0.4327294								
1,2-Dichloroethane	150	0.4500461	200	0.4727934								
Benzene	150	1.351795	200	1.411383								
Trichloroethene	150	0.329049	200	0.3535812								
1,2-Dichloropropane	150	0.4353177	200	0.4618027								

INITIAL CALIBRATION DATA

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00007	Instrument:	NT5
Calibration Date:	09/02/2021	Column (1):	RTX-VMS

Compound	Level 07		Level 08		Level 09		Level 10		Level 11		Level 12	
		RRF		RRF		RRF		RRF		RRF		RRF
Bromodichloromethane	150	0.4332543	200	0.4560624								
Dibromomethane	150	0.1806885	200	0.1892012								
2-Chloroethyl vinyl ether	150	9.276009E-02	200	0.1206398								
4-Methyl-2-Pentanone	750	0.1638709	1000	0.1657426								
cis-1,3-Dichloropropene	150	0.5582284	200	0.5893606								
Toluene	150	0.8529614	200	0.9009767								
trans-1,3-Dichloropropene	150	0.4873951	200	0.5119652								
2-Hexanone	750	0.2284778	1000	0.2282838								
1,1,2-Trichloroethane	150	0.2677767	200	0.2797457								
1,3-Dichloropropane	150	0.4392874	200	0.4578603								
Tetrachloroethene	150	0.2757025	200	0.2960981								
Dibromochloromethane	150	0.2672211	200	0.2836675								
1,2-Dibromoethane	150	0.2608586	200	0.2683602								
Chlorobenzene	150	0.7900433	200	0.8284096								
Ethylbenzene	150	1.38746	200	1.433642								
1,1,1,2-Tetrachloroethane	150	0.2761291	200	0.2963478								
m,p-Xylene	300	0.5299569	400	0.5576359								
o-Xylene	150	0.5257603	200	0.5547071								
Xylenes, total	450	0.528558	600	0.5566596								
Styrene	150	0.860624	200	0.9022166								
Bromoform	150	0.3263499	200	0.3428957								
1,1,2,2-Tetrachloroethane	150	0.6300624	200	0.638998								
1,2,3-Trichloropropane	150	0.1826766	200	0.1842817								
trans-1,4-Dichloro 2-Butene	150	0.1941628	200	0.2021827								
n-Propylbenzene	150	3.128801	200	3.247054								
Bromobenzene	150	0.5968039	200	0.6341243								
2-Chlorotoluene	150	1.902347	200	1.99291								
4-Chlorotoluene	150	1.932904	200	2.037351								

INITIAL CALIBRATION DATA
EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00007	Instrument:	NT5
Calibration Date:	09/02/2021	Column (1):	RTX-VMS

Compound	Level 07		Level 08		Level 09		Level 10		Level 11		Level 12	
		RRF		RRF		RRF		RRF		RRF		RRF
t-Butylbenzene	150	1.97588	200	2.102351								
1,3,5-Trimethylbenzene	150	2.191063	200	2.316544								
1,2,4-Trimethylbenzene	150	2.149329	200	2.235477								
s-Butylbenzene	150	2.878012	200	3.027324								
4-Isopropyl Toluene	150	2.386664	200	2.527193								
1,3-Dichlorobenzene	150	1.147161	200	1.216764								
1,4-Dichlorobenzene	150	1.115105	200	1.192492								
n-Butylbenzene	150	2.104683	200	2.229415								
1,2-Dichlorobenzene	150	1.087112	200	1.125392								
1,2-Dibromo-3-Chloropropane	150	0.1117609	200	0.1108491								
1,2,4-Trichlorobenzene	150	0.6593687	200	0.6964949								
Hexachloro-1,3-Butadiene	150	0.3914769	200	0.4104657								
Naphthalene	150	1.697234	200	1.713925								
1,2,3-Trichlorobenzene	150	0.6268767	200	0.6555057								
Dichlorodifluoromethane	150	1.540349	200	1.648022								
Methyl tert-butyl Ether	150	3.374553	200	3.536241								
2-Pentanone	750	4.494084E-02	1000	4.550365E-02								
Dibromofluoromethane	50	1.512636	50	1.532993								
1,2-Dichloroethane-d4	50	1.47635	50	1.487019								
Toluene-d8	50	1.42622	50	1.425442								
4-Bromofluorobenzene	50	0.3613674	50	0.3651718								
1,2-Dichlorobenzene-d4	50	0.9964154	50	0.9866774								

INITIAL CALIBRATION DATA

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00007	Instrument:	NT5
Calibration Date:	09/02/2021	Column (1):	RTX-VMS

COMPOUND	Mean RRF	RRF RSD	Linear COD	Quad COD	Limit Type & Limit	Q
Chloromethane	2.628346	12.1			RSD (15)	
Vinyl Chloride	2.264237	2.6			RSD (15)	
Bromomethane	1.286014	21.7	0.9940		LCOD (0.99)	
Chloroethane	0.9847664	5.0			RSD (15)	
Trichlorofluoromethane	1.435968	14.0			RSD (15)	
Acrolein	0.3245718	8.9			RSD (15)	
1,1,2-Trichloro-1,2,2-Trifluoroethane	1.160057	4.5			RSD (15)	
Acetone	0.4721376	30.8	0.9995		LCOD (0.99)	
1,1-Dichloroethene	1.26233	5.9			RSD (15)	
Iodomethane	0.6744329	11.9			RSD (15)	
Methylene Chloride	1.630139	29.8	0.9987		LCOD (0.99)	
Acrylonitrile	0.6311425	5.0			RSD (15)	
Carbon Disulfide	4.309599	6.4			RSD (15)	
trans-1,2-Dichloroethene	1.307615	4.2			RSD (15)	
Vinyl Acetate	3.414955	19.4	0.9991		LCOD (0.99)	
1,1-Dichloroethane	2.914129	3.1			RSD (15)	
2-Butanone	0.1393575	4.2			RSD (15)	
2,2-Dichloropropane	1.996019	3.4			RSD (15)	
cis-1,2-Dichloroethene	1.425418	5.0			RSD (15)	
Chloroform	2.25562	4.4			RSD (15)	
Bromochloromethane	0.6486559	8.8			RSD (15)	
1,1,1-Trichloroethane	1.904316	3.1			RSD (15)	
1,1-Dichloropropene	0.462934	4.2			RSD (15)	
Carbon tetrachloride	0.3889206	8.0			RSD (15)	
1,2-Dichloroethane	0.4750114	6.0			RSD (15)	
Benzene	1.399281	3.0			RSD (15)	
Trichloroethene	0.3451265	5.1			RSD (15)	
1,2-Dichloropropane	0.4358402	4.2			RSD (15)	
Bromodichloromethane	0.4253617	4.5			RSD (15)	
Dibromomethane	0.1828085	4.2			RSD (15)	
2-Chloroethyl vinyl ether	7.626097E-02	36.2		0.9981	QCOD (0.99)	

INITIAL CALIBRATION DATA

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00007	Instrument:	NT5
Calibration Date:	09/02/2021	Column (1):	RTX-VMS

COMPOUND	Mean RRF	RRF RSD	Linear COD	Quad COD	Limit Type & Limit	Q
4-Methyl-2-Pentanone	0.157804	6.2			RSD (15)	
cis-1,3-Dichloropropene	0.5582411	2.9			RSD (15)	
Toluene	0.8948246	4.9			RSD (15)	
trans-1,3-Dichloropropene	0.4869756	4.4			RSD (15)	
2-Hexanone	0.2302254	3.6			RSD (15)	
1,1,2-Trichloroethane	0.2672449	3.0			RSD (15)	
1,3-Dichloropropane	0.441008	5.2			RSD (15)	
Tetrachloroethene	0.2946494	5.7			RSD (15)	
Dibromochloromethane	0.2570871	7.7			RSD (15)	
1,2-Dibromoethane	0.256369	4.5			RSD (15)	
Chlorobenzene	0.8219102	3.4			RSD (15)	
Ethylbenzene	1.457396	4.0			RSD (15)	
1,1,1,2-Tetrachloroethane	0.2786265	3.7			RSD (15)	
m,p-Xylene	0.5501145	4.0			RSD (15)	
o-Xylene	0.5339883	4.2			RSD (15)	
Xylenes, total	0.5447391	4.0			RSD (15)	
Styrene	0.875046	2.7			RSD (15)	
Bromoform	0.3026634	10.2			RSD (15)	
1,1,2,2-Tetrachloroethane	0.606815	9.8			RSD (15)	
1,2,3-Trichloropropane	0.1816306	3.9			RSD (15)	
trans-1,4-Dichloro 2-Butene	0.1886007	8.3			RSD (15)	
n-Propylbenzene	3.35137	4.1			RSD (15)	
Bromobenzene	0.6118073	3.6			RSD (15)	
2-Chlorotoluene	2.027994	4.0			RSD (15)	
4-Chlorotoluene	2.037596	3.3			RSD (15)	
t-Butylbenzene	2.079475	2.4			RSD (15)	
1,3,5-Trimethylbenzene	2.294602	3.1			RSD (15)	
1,2,4-Trimethylbenzene	2.246588	3.0			RSD (15)	
s-Butylbenzene	3.065361	2.9			RSD (15)	
4-Isopropyl Toluene	2.514626	2.9			RSD (15)	
1,3-Dichlorobenzene	1.182596	3.8			RSD (15)	

INITIAL CALIBRATION DATA

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00007	Instrument:	NT5
Calibration Date:	09/02/2021	Column (1):	RTX-VMS

COMPOUND	Mean RRF	RRF RSD	Linear COD	Quad COD	Limit Type & Limit	Q
1,4-Dichlorobenzene	1.19611	5.0			RSD (15)	
n-Butylbenzene	2.25281	4.0			RSD (15)	
1,2-Dichlorobenzene	1.138858	4.2			RSD (15)	
1,2-Dibromo-3-Chloropropane	0.1105342	6.8			RSD (15)	
1,2,4-Trichlorobenzene	0.6692425	2.5			RSD (15)	
Hexachloro-1,3-Butadiene	0.4044008	3.8			RSD (15)	
Naphthalene	1.688677	4.1			RSD (15)	
1,2,3-Trichlorobenzene	0.6286557	2.5			RSD (15)	
Dichlorodifluoromethane	1.475774	8.3			RSD (15)	
Methyl tert-butyl Ether	3.40765	4.0			RSD (15)	
2-Pentanone	4.356386E-02	5.2			RSD (15)	
Dibromofluoromethane	1.51641	2.7			RSD (15)	
1,2-Dichloroethane-d4	1.498659	2.9			RSD (15)	
Toluene-d8	1.423797	0.7			RSD (15)	
4-Bromofluorobenzene	0.3651995	0.7			RSD (15)	
1,2-Dichlorobenzene-d4	0.999811	1.4			RSD (15)	

SECOND-SOURCE CALIBRATION VERIFICATION

EPA 8260D MED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EI00007
Laboratory ID: SJI0028-SCV1
Sequence: SJI0028
Standard ID: J009432

ANALYTE	EXPECTED (ug/L)	FOUND (ug/L)	% DRIFT	QC LIMIT
Chloromethane	50.000	43.6	-12.7	20.00
Vinyl Chloride	50.000	50.4	0.7	20.00
Bromomethane	50.000	48.3	-3.5	20.00
Chloroethane	50.000	53.8	7.6	20.00
Trichlorofluoromethane	50.000	53.1	6.2	20.00
Acrolein	250.00	256	2.4	20.00
1,1,2-Trichloro-1,2,2-Trifluoroethane	100.00	117	17.5	20.00
Acetone	250.00	359	43.5	20.00
1,1-Dichloroethene	50.000	49.4	-1.1	20.00
Iodomethane	50.000	52.1	4.1	20.00
Methylene Chloride	50.000	49.6	-0.8	20.00
Acrylonitrile	50.000	50.7	1.5	20.00
Carbon Disulfide	50.000	48.7	-2.6	20.00
trans-1,2-Dichloroethene	50.000	52.7	5.4	20.00
Vinyl Acetate	50.000	50.9	1.8	20.00
1,1-Dichloroethane	50.000	55.4	10.9	20.00
2-Butanone	250.00	284	13.7	20.00
2,2-Dichloropropane	50.000	56.0	12.0	20.00
cis-1,2-Dichloroethene	50.000	51.1	2.2	20.00
Chloroform	50.000	52.8	5.5	20.00
Bromochloromethane	50.000	50.9	1.9	20.00
1,1,1-Trichloroethane	50.000	56.0	12.0	20.00
1,1-Dichloropropene	50.000	54.7	9.4	20.00
Carbon tetrachloride	50.000	52.0	4.1	20.00
1,2-Dichloroethane	50.000	48.3	-3.4	20.00
Benzene	50.000	51.0	2.1	20.00
Trichloroethene	50.000	51.9	3.8	20.00
1,2-Dichloropropane	50.000	49.9	-0.3	20.00
Bromodichloromethane	50.000	47.7	-4.6	20.00
Dibromomethane	50.000	48.6	-2.9	20.00
2-Chloroethyl vinyl ether	50.000	74.9	49.7	20.00
4-Methyl-2-Pentanone	250.00	258	3.0	20.00

SECOND-SOURCE CALIBRATION VERIFICATION

EPA 8260D MED

Laboratory: Analytical Resources, Inc. **SDG:** 21I0042

Client: GeoEngineers **Project:** South State Street PRDI

Calibration: EI00007 **Laboratory ID:** SJI0028-SCV1

Sequence: SJI0028 **Standard ID:** J009432

cis-1,3-Dichloropropene	50.000	48.1	-3.7	20.00
Toluene	50.000	50.5	1.0	20.00
trans-1,3-Dichloropropene	50.000	51.8	3.6	20.00
2-Hexanone	250.00	271	8.2	20.00
1,1,2-Trichloroethane	50.000	51.5	3.0	20.00
1,3-Dichloropropane	50.000	50.9	1.7	20.00
Tetrachloroethene	50.000	52.1	4.2	20.00
Dibromochloromethane	50.000	53.2	6.5	20.00
1,2-Dibromoethane	50.000	51.2	2.4	20.00
Chlorobenzene	50.000	52.3	4.6	20.00
Ethylbenzene	50.000	52.5	5.1	20.00
1,1,1,2-Tetrachloroethane	50.000	51.5	3.0	20.00
m,p-Xylene	100.00	107	6.7	20.00
o-Xylene	50.000	53.1	6.2	20.00
Styrene	50.000	52.1	4.1	20.00
Bromoform	50.000	52.3	4.7	20.00
1,1,2,2-Tetrachloroethane	50.000	53.3	6.5	20.00
1,2,3-Trichloropropane	50.000	52.3	4.7	20.00
trans-1,4-Dichloro 2-Butene	50.000	60.3	20.7	20.00
n-Propylbenzene	50.000	55.6	11.3	20.00
Bromobenzene	50.000	55.4	10.9	20.00
Isopropyl Benzene	50.000	0.00		20.00
2-Chlorotoluene	50.000	53.2	6.5	20.00
4-Chlorotoluene	50.000	55.5	10.9	20.00
t-Butylbenzene	50.000	59.9	19.8	20.00
1,3,5-Trimethylbenzene	50.000	55.1	10.1	20.00
1,2,4-Trimethylbenzene	50.000	56.2	12.3	20.00
s-Butylbenzene	50.000	54.0	8.0	20.00
4-Isopropyl Toluene	50.000	56.4	12.7	20.00
1,3-Dichlorobenzene	50.000	56.1	12.1	20.00
1,4-Dichlorobenzene	50.000	55.2	10.4	20.00
n-Butylbenzene	50.000	61.6	23.2	20.00
1,2-Dichlorobenzene	50.000	53.8	7.5	20.00
1,2-Dibromo-3-Chloropropane	50.000	54.9	9.9	20.00
1,2,4-Trichlorobenzene	50.000	67.8	35.7	20.00

SECOND-SOURCE CALIBRATION VERIFICATION

EPA 8260D MED

Laboratory: Analytical Resources, Inc. **SDG:** 21I0042

Client: GeoEngineers **Project:** South State Street PRDI

Calibration: EI00007 **Laboratory ID:** SJI0028-SCV1

Sequence: SJI0028 **Standard ID:** J009432

Hexachloro-1,3-Butadiene	50.000	55.5	11.1	20.00
Naphthalene	50.000	59.6	19.1	20.00
1,2,3-Trichlorobenzene	50.000	64.9	29.7	20.00
Dichlorodifluoromethane	50.000	46.9	-6.3	20.00
Methyl tert-butyl Ether	50.000	53.2	6.5	20.00
2-Pentanone	100.00	149	49.0	20.00
1,2-Dichloroethane-d4	50.000	52.4	4.8	20.00
Toluene-d8	50.000	50.5	1.0	20.00
4-Bromofluorobenzene	50.000	49.6	-0.8	20.00
1,2-Dichlorobenzene-d4	50.000	51.2	2.5	20.00

* Values outside of QC limits

SECOND-SOURCE
CONTINUING CALIBRATION CHECK
EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT5	Calibration:	EI00007
Lab File ID:	NT509032102.D	Calibration Date:	09/02/2021
Sequence:	SJI0028	Injection Date:	09/03/21
Lab Sample ID:	SJI0028-SCV1	Injection Time:	11:27
Sequence Name:	SCV		

		CONC. (ug/L)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Chloromethane	A	50.000	43.6	2.6283460	2.2941800		-12.7	+/-20
Vinyl Chloride	A	50.000	50.4	2.2642370	2.2807040		0.7	+/-20
Bromomethane	A	50.000	48.3	1.2860140	1.1245530		-3.5	+/-20
Chloroethane	A	50.000	53.8	0.9847664	1.0595190		7.6	+/-20
Trichlorofluoromethane	A	50.000	53.1	1.4359680	1.5242820		6.2	+/-20
Acrolein	A	250.00	256	0.3245718	0.3323058		2.4	+/-20
1,1,2-Trichloro-1,2,2-Trifluoroethane	A	100.00	117	1.1600570	1.3625460		17.5	+/-20
Acetone	A	250.00	359	0.4721376	0.5494453		43.5	+/-20
1,1-Dichloroethene	A	50.000	49.4	1.2623300	1.2479980		-1.1	+/-20
Iodomethane	A	50.000	52.1	0.6744329	0.7022964		4.1	+/-20
Methylene Chloride	A	50.000	49.6	1.6301390	1.3257600		-0.8	+/-20
Acrylonitrile	A	50.000	50.7	0.6311425	0.6406035		1.5	+/-20
Carbon Disulfide	A	50.000	48.7	4.3095990	4.1990960		-2.6	+/-20
trans-1,2-Dichloroethene	A	50.000	52.7	1.3076150	1.3776320		5.4	+/-20
Vinyl Acetate	A	50.000	50.9	3.4149550	3.9128010		1.8	+/-20
1,1-Dichloroethane	A	50.000	55.4	2.9141290	3.2313070		10.9	+/-20
2-Butanone	A	250.00	284	0.1393575	0.1584219		13.7	+/-20
2,2-Dichloropropane	A	50.000	56.0	1.9960190	2.2361290		12.0	+/-20
cis-1,2-Dichloroethene	A	50.000	51.1	1.4254180	1.4567940		2.2	+/-20
Chloroform	A	50.000	52.8	2.2556200	2.3804360		5.5	+/-20
Bromochloromethane	A	50.000	50.9	0.6486559	0.6607632		1.9	+/-20
1,1,1-Trichloroethane	A	50.000	56.0	1.9043160	2.1319220		12.0	+/-20
1,1-Dichloropropene	A	50.000	54.7	0.4629340	0.5066609		9.4	+/-20
Carbon tetrachloride	A	50.000	52.0	0.3889206	0.4047653		4.1	+/-20
1,2-Dichloroethane	A	50.000	48.3	0.4750114	0.4587485		-3.4	+/-20
Benzene	A	50.000	51.0	1.3992810	1.4281070		2.1	+/-20
Trichloroethene	A	50.000	51.9	0.3451265	0.3583430		3.8	+/-20
1,2-Dichloropropane	A	50.000	49.9	0.4358402	0.4346434		-0.3	+/-20
Bromodichloromethane	A	50.000	47.7	0.4253617	0.4058421		-4.6	+/-20
Dibromomethane	A	50.000	48.6	0.1828085	0.1775072		-2.9	+/-20
2-Chloroethyl vinyl ether	A	50.000	74.9	0.0762610	0.1139583		49.7	+/-20
4-Methyl-2-Pentanone	A	250.00	258	0.1578040	0.1625854		3.0	+/-20
cis-1,3-Dichloropropene	A	50.000	48.1	0.5582411	0.5375652		-3.7	+/-20
Toluene	A	50.000	50.5	0.8948246	0.9034905		1.0	+/-20

* Values outside of QC limits

SECOND-SOURCE
CONTINUING CALIBRATION CHECK
EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT5	Calibration:	EI00007
Lab File ID:	NT509032102.D	Calibration Date:	09/02/2021
Sequence:	SJI0028	Injection Date:	09/03/21
Lab Sample ID:	SJI0028-SCV1	Injection Time:	11:27
Sequence Name:	SCV		

		CONC. (ug/L)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
trans-1,3-Dichloropropene	A	50.000	51.8	0.4869756	0.5044465		3.6	+/-20
2-Hexanone	A	250.00	271	0.2302254	0.2491098		8.2	+/-20
1,1,2-Trichloroethane	A	50.000	51.5	0.2672449	0.2752728		3.0	+/-20
1,3-Dichloropropane	A	50.000	50.9	0.4410080	0.4486926		1.7	+/-20
Tetrachloroethene	A	50.000	52.1	0.2946494	0.3071288		4.2	+/-20
Dibromochloromethane	A	50.000	53.2	0.2570871	0.2737382		6.5	+/-20
1,2-Dibromoethane	A	50.000	51.2	0.2563690	0.2626429		2.4	+/-20
Chlorobenzene	A	50.000	52.3	0.8219102	0.8593321		4.6	+/-20
Ethylbenzene	A	50.000	52.5	1.4573960	1.5312390		5.1	+/-20
1,1,1,2-Tetrachloroethane	A	50.000	51.5	0.2786265	0.2870840		3.0	+/-20
m,p-Xylene	A	100.00	107	0.5501145	0.5871369		6.7	+/-20
o-Xylene	A	50.000	53.1	0.5339883	0.5671365		6.2	+/-20
Styrene	A	50.000	52.1	0.8750460	0.9110645		4.1	+/-20
Bromoform	A	50.000	52.3	0.3026634	0.3168146		4.7	+/-20
1,1,2,2-Tetrachloroethane	A	50.000	53.3	0.6068150	0.6465250		6.5	+/-20
1,2,3-Trichloropropane	A	50.000	52.3	0.1816306	0.1901532		4.7	+/-20
trans-1,4-Dichloro 2-Butene	A	50.000	60.3	0.1886007	0.2276409		20.7	+/-20
n-Propylbenzene	A	50.000	55.6	3.3513700	3.7286110		11.3	+/-20
Bromobenzene	A	50.000	55.4	0.6118073	0.6784079		10.9	+/-20
Isopropyl Benzene	A	50.000	0.00					+/-20
2-Chlorotoluene	A	50.000	53.2	2.0279940	2.1593440		6.5	+/-20
4-Chlorotoluene	A	50.000	55.5	2.0375960	2.2599930		10.9	+/-20
t-Butylbenzene	A	50.000	59.9	2.0794750	2.4916570		19.8	+/-20
1,3,5-Trimethylbenzene	A	50.000	55.1	2.2946020	2.5266140		10.1	+/-20
1,2,4-Trimethylbenzene	A	50.000	56.2	2.2465880	2.5234150		12.3	+/-20
s-Butylbenzene	A	50.000	54.0	3.0653610	3.3118860		8.0	+/-20
4-Isopropyl Toluene	A	50.000	56.4	2.5146260	2.8347670		12.7	+/-20
1,3-Dichlorobenzene	A	50.000	56.1	1.1825960	1.3259540		12.1	+/-20
1,4-Dichlorobenzene	A	50.000	55.2	1.1961100	1.3208150		10.4	+/-20
n-Butylbenzene	A	50.000	61.6	2.2528100	2.7764060		23.2	+/-20
1,2-Dichlorobenzene	A	50.000	53.8	1.1388580	1.2248200		7.5	+/-20
1,2-Dibromo-3-Chloropropane	A	50.000	54.9	0.1105342	0.1214385		9.9	+/-20
1,2,4-Trichlorobenzene	A	50.000	67.8	0.6692425	0.9078395		35.7	+/-20
Hexachloro-1,3-Butadiene	A	50.000	55.5	0.4044008	0.4492279		11.1	+/-20

* Values outside of QC limits

SECOND-SOURCE
CONTINUING CALIBRATION CHECK
EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT5	Calibration:	EI00007
Lab File ID:	NT509032102.D	Calibration Date:	09/02/2021
Sequence:	SJI0028	Injection Date:	09/03/21
Lab Sample ID:	SJI0028-SCV1	Injection Time:	11:27
Sequence Name:	SCV		

		CONC. (ug/L)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Naphthalene	A	50.000	59.6	1.6886770	2.0115970		19.1	+/-20
1,2,3-Trichlorobenzene	A	50.000	64.9	0.6286557	0.8155168		29.7	+/-20
Dichlorodifluoromethane	A	50.000	46.9	1.4757740	1.3834260		-6.3	+/-20
Methyl tert-butyl Ether	A	50.000	53.2	3.4076500	3.6280370		6.5	+/-20
2-Pentanone	A	100.00	149	0.0435639	0.0649098		49.0	+/-20
Dibromofluoromethane	A	50.000	53.1	1.5164100	1.6094880		6.1	+/-20
1,2-Dichloroethane-d4	A	50.000	52.4	1.4986590	1.5709080		4.8	+/-20
Toluene-d8	A	50.000	50.5	1.4237970	1.4382790		1.0	+/-20
4-Bromofluorobenzene	A	50.000	49.6	0.3651995	0.3622506		-0.8	+/-20
1,2-Dichlorobenzene-d4	A	50.000	51.2	0.9998110	1.0247000		2.5	+/-20

* Values outside of QC limits

CONTINUING CALIBRATION CHECK
EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT5	Calibration:	EI00007
Lab File ID:	NT509082120.D	Calibration Date:	09/02/2021
Sequence:	SJI0164	Injection Date:	09/08/21
Lab Sample ID:	SJI0164-CCV1	Injection Time:	20:05
Sequence Name:	CCV		

		CONC. (ug/L)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Benzene	A	50.000	44.1	1.3992810	1.2347570		-11.8	+/-50
Naphthalene	A	50.000	40.9	1.6886770	1.3824230		-18.1	+/-50
1,2-Dichloroethane-d4	A	50.000	49.5	1.4986590	1.4821880		-1.1	+/-50
Toluene-d8	A	50.000	49.7	1.4237970	1.4153070		-0.6	+/-50
4-Bromofluorobenzene	A	50.000	49.4	0.3651995	0.3604608		-1.3	+/-50
1,2-Dichlorobenzene-d4	A	50.000	49.6	0.9998110	0.9919329		-0.8	+/-50

* Values outside of QC limits

CONTINUING CALIBRATION CHECK
EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT5	Calibration:	EI00007
Lab File ID:	NT509102114.D	Calibration Date:	09/02/2021
Sequence:	SJI0225	Injection Date:	09/10/21
Lab Sample ID:	SJI0225-CCV1	Injection Time:	17:59
Sequence Name:	CCV		

		CONC. (ug/L)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Benzene	A	50.000	39.4	1.3992810	1.1025330		-21.2	+/-50
Naphthalene	A	50.000	43.9	1.6886770	1.4839870		-12.1	+/-50
1,2-Dichloroethane-d4	A	50.000	46.9	1.4986590	1.4049490		-6.3	+/-50
Toluene-d8	A	50.000	49.4	1.4237970	1.4065250		-1.2	+/-50
4-Bromofluorobenzene	A	50.000	49.9	0.3651995	0.3646865		-0.1	+/-50
1,2-Dichlorobenzene-d4	A	50.000	49.5	0.9998110	0.9897044		-1.0	+/-50

* Values outside of QC limits

INITIAL CALIBRATION CHECK

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT5	Calibration:	EI00007
Lab File ID:	NT509082102.D	Calibration Date:	09/02/2021
Sequence:	SJI0164	Injection Date:	09/08/21
Lab Sample ID:	SJI0164-ICV1	Injection Time:	10:14
Sequence Name:	VOA 10		

		CONC. (ug/L)		RESPONSE FACTOR			% DRIFT/DIFF	
COMPOUND	TYPE	STD	ICV	ICAL	ICV	MIN	ICV	LIMIT
Benzene	A	50.000	47.1	1.3992810	1.3185630		-5.8	+/-20
Naphthalene	A	50.000	48.4	1.6886770	1.6333990		-3.3	+/-20
1,2-Dichloroethane-d4	A	50.000	50.0	1.4986590	1.4991020		0.03	+/-20
Toluene-d8	A	50.000	49.4	1.4237970	1.4067600		-1.2	+/-20
4-Bromofluorobenzene	A	50.000	49.0	0.3651995	0.3579530		-2.0	+/-20
1,2-Dichlorobenzene-d4	A	50.000	49.3	0.9998110	0.9852566		-1.5	+/-20

* Values outside of QC limits

INITIAL CALIBRATION CHECK

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT5	Calibration:	EI00007
Lab File ID:	NT509102101.D	Calibration Date:	09/02/2021
Sequence:	SJI0225	Injection Date:	09/10/21
Lab Sample ID:	SJI0225-ICV1	Injection Time:	09:36
Sequence Name:	VOA 10		

		CONC. (ug/L)		RESPONSE FACTOR			% DRIFT/DIFF	
COMPOUND	TYPE	STD	ICV	ICAL	ICV	MIN	ICV	LIMIT
Benzene	A	50.000	48.7	1.3992810	1.3632780		-2.6	+/-20
Naphthalene	A	50.000	48.3	1.6886770	1.6319450		-3.4	+/-20
1,2-Dichloroethane-d4	A	50.000	50.2	1.4986590	1.5055330		0.5	+/-20
Toluene-d8	A	50.000	49.4	1.4237970	1.4057680		-1.3	+/-20
4-Bromofluorobenzene	A	50.000	49.2	0.3651995	0.3592268		-1.6	+/-20
1,2-Dichlorobenzene-d4	A	50.000	49.1	0.9998110	0.9809720		-1.9	+/-20

* Values outside of QC limits

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 8260D MED

Laboratory: Analytical Resources, Inc.
Client: GeoEngineers
Sequence: SJI0028

SDG: 21I0042
Project: South State Street PRDI
Instrument: NT5
Calibration: EI00007

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
MS Tune	SJI0028-TUN1	NT509022106.D	NA	09/02/21 12:24
8260D 5	SJI0028-CAL3	NT509022109.D	NA	09/02/21 13:53
8260D 10	SJI0028-CAL4	NT509022110.D	NA	09/02/21 14:17
8260D 50	SJI0028-CAL5	NT509022111.D	NA	09/02/21 14:42
8260D 100	SJI0028-CAL6	NT509022112.D	NA	09/02/21 15:06
8260D 150	SJI0028-CAL7	NT509022113.D	NA	09/02/21 15:31
8260D 200	SJI0028-CAL8	NT509022114.D	NA	09/02/21 15:55
8260D 2	SJI0028-CAL2	NT509022116.D	NA	09/02/21 16:44
8260D 1	SJI0028-CAL1	NT509022117.D	NA	09/02/21 17:09
SCV	SJI0028-SCV1	NT509032102.D	NA	09/03/21 11:27

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 8260D MED

Laboratory: Analytical Resources, Inc.
Client: GeoEngineers
Sequence: SJI0164

SDG: 21I0042
Project: South State Street PRDI
Instrument: NT5
Calibration: EI00007

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
VOA 10	SJI0164-ICV1	NT509082102.D	NA	09/08/21 10:14
LCS	BJI0235-BS1	NT509082102C.D	Solid	09/08/21 10:14
LCS Dup	BJI0235-BSD1	NT509082103B.D	Solid	09/08/21 10:50
Blank	BJI0235-BLK1	NT509082104B.D	Solid	09/08/21 11:14
HSA-62-13-14	21I0042-03	NT509082111.D	Solid	09/08/21 16:28
DUP-1-083121	21I0042-04	NT509082112.D	Solid	09/08/21 16:52
ZZZZZ	21I0029-01	NT509082117.D	Solid	09/08/21 18:53
CCV	SJI0164-CCV1	NT509082120.D	NA	09/08/21 20:05

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 8260D MED

Laboratory: Analytical Resources, Inc.
Client: GeoEngineers
Sequence: SJI0225

SDG: 21I0042
Project: South State Street PRDI
Instrument: NT5
Calibration: EI00007

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
VOA 10	SJI0225-ICV1	NT509102101.D	NA	09/10/21 09:36
LCS	BJI0310-BS1	NT509102101B.D	Solid	09/10/21 09:36
LCS Dup	BJI0310-BSD1	NT509102102A.D	Solid	09/10/21 10:00
Blank	BJI0310-BLK1	NT509102103A.D	Solid	09/10/21 10:25
HSA-62-13-14	21I0042-03RE1	NT509102104.D	Solid	09/10/21 11:30
CCV	SJI0225-CCV1	NT509102114.D	NA	09/10/21 17:59

SURROGATE RECOVERY SUMMARY

EPA 8260D MED

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0028
Instrument: NT5
Calibration: EI00007
Calibration Date: 09/02/2021

Surrogate Compound	Spike Level ug/L	% Recovery	Recovery Limits	Q
SJI0028-SCV1 (Water)	Lab File ID: NT509032102.D		Analyzed: 09/03/21 11:27	
Dibromofluoromethane	50.000	106	80 - 120	
1,2-Dichloroethane-d4	50.000	105	80 - 120	
Toluene-d8	50.000	101	80 - 120	
4-Bromofluorobenzene	50.000	99.2	80 - 120	
1,2-Dichlorobenzene-d4	50.000	102	80 - 120	

SURROGATE RECOVERY SUMMARY

EPA 8260D MED

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0164
Instrument: NT5
Calibration: EI00007
Calibration Date: 09/02/2021

Surrogate Compound	Spike Level ug/L	% Recovery	Recovery Limits	Q
BJI0235-BS1 (Solid)	Lab File ID: NT509082102C.D		Analyzed: 09/08/21 10:14	
1,2-Dichloroethane-d4	50.000	100	80 - 124	
Toluene-d8	50.000	98.8	80 - 120	
4-Bromofluorobenzene	50.000	98.0	80 - 120	
1,2-Dichlorobenzene-d4	50.000	98.5	80 - 120	
SJI0164-ICV1 (Solid)	Lab File ID: NT509082102.D		Analyzed: 09/08/21 10:14	
1,2-Dichloroethane-d4	50.000	100	80 - 120	
Toluene-d8	50.000	98.8	80 - 120	
4-Bromofluorobenzene	50.000	98.0	80 - 120	
1,2-Dichlorobenzene-d4	50.000	98.5	80 - 120	
BJI0235-BSD1 (Solid)	Lab File ID: NT509082103B.D		Analyzed: 09/08/21 10:50	
1,2-Dichloroethane-d4	50.000	101	80 - 124	
Toluene-d8	50.000	99.4	80 - 120	
4-Bromofluorobenzene	50.000	99.9	80 - 120	
1,2-Dichlorobenzene-d4	50.000	99.0	80 - 120	
BJI0235-BLK1 (Solid)	Lab File ID: NT509082104B.D		Analyzed: 09/08/21 11:14	
1,2-Dichloroethane-d4	50.000	101	80 - 124	
Toluene-d8	50.000	99.6	80 - 120	
4-Bromofluorobenzene	50.000	98.8	80 - 120	
1,2-Dichlorobenzene-d4	50.000	100	80 - 120	
21I0042-03 (Solid)	Lab File ID: NT509082111.D		Analyzed: 09/08/21 16:28	
1,2-Dichloroethane-d4	50.000	104	80 - 149	
Toluene-d8	50.000	101	77 - 120	
4-Bromofluorobenzene	50.000	99.4	80 - 120	
1,2-Dichlorobenzene-d4	50.000	101	80 - 120	
21I0042-04 (Solid)	Lab File ID: NT509082112.D		Analyzed: 09/08/21 16:52	
1,2-Dichloroethane-d4	50.000	102	80 - 149	
Toluene-d8	50.000	99.3	77 - 120	
4-Bromofluorobenzene	50.000	98.0	80 - 120	
1,2-Dichlorobenzene-d4	50.000	101	80 - 120	

SURROGATE RECOVERY SUMMARY

EPA 8260D MED

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0164
Instrument: NT5
Calibration: EI00007
Calibration Date: 09/02/2021

Surrogate Compound	Spike Level ug/L	% Recovery	Recovery Limits	Q
SJI0164-CCV1 (Solid)	Lab File ID: NT509082120.D		Analyzed: 09/08/21 20:05	
1,2-Dichloroethane-d4	50.000	98.9	50 - 150	
Toluene-d8	50.000	99.4	50 - 150	
4-Bromofluorobenzene	50.000	98.7	50 - 150	
1,2-Dichlorobenzene-d4	50.000	99.2	50 - 150	

SURROGATE RECOVERY SUMMARY

EPA 8260D MED

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0225
Instrument: NT5
Calibration: EI00007
Calibration Date: 09/02/2021

Surrogate Compound	Spike Level ug/L	% Recovery	Recovery Limits	Q
BJI0310-BS1 (Solid)	Lab File ID: NT509102101B.D		Analyzed: 09/10/21 09:36	
1,2-Dichloroethane-d4	50.000	100	80 - 124	
Toluene-d8	50.000	98.7	80 - 120	
4-Bromofluorobenzene	50.000	98.4	80 - 120	
1,2-Dichlorobenzene-d4	50.000	98.1	80 - 120	
SJI0225-ICV1 (Solid)	Lab File ID: NT509102101.D		Analyzed: 09/10/21 09:36	
1,2-Dichloroethane-d4	50.000	100	80 - 120	
Toluene-d8	50.000	98.7	80 - 120	
4-Bromofluorobenzene	50.000	98.4	80 - 120	
1,2-Dichlorobenzene-d4	50.000	98.1	80 - 120	
BJI0310-BSD1 (Solid)	Lab File ID: NT509102102A.D		Analyzed: 09/10/21 10:00	
1,2-Dichloroethane-d4	50.000	100	80 - 124	
Toluene-d8	50.000	98.7	80 - 120	
4-Bromofluorobenzene	50.000	100	80 - 120	
1,2-Dichlorobenzene-d4	50.000	101	80 - 120	
BJI0310-BLK1 (Solid)	Lab File ID: NT509102103A.D		Analyzed: 09/10/21 10:25	
1,2-Dichloroethane-d4	50.000	97.1	80 - 124	
Toluene-d8	50.000	99.4	80 - 120	
4-Bromofluorobenzene	50.000	98.8	80 - 120	
1,2-Dichlorobenzene-d4	50.000	99.8	80 - 120	
21I0042-03RE1 (Solid)	Lab File ID: NT509102104.D		Analyzed: 09/10/21 11:30	
1,2-Dichloroethane-d4	50.000	99.0	80 - 149	
Toluene-d8	50.000	98.4	77 - 120	
4-Bromofluorobenzene	50.000	97.9	80 - 120	
1,2-Dichlorobenzene-d4	50.000	101	80 - 120	
SJI0225-CCV1 (Solid)	Lab File ID: NT509102114.D		Analyzed: 09/10/21 17:59	
1,2-Dichloroethane-d4	50.000	93.7	50 - 150	
Toluene-d8	50.000	98.8	50 - 150	
4-Bromofluorobenzene	50.000	99.9	50 - 150	
1,2-Dichlorobenzene-d4	50.000	99.0	50 - 150	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Sequence:	SJI0028	Instrument:	NT5
		Calibration:	EI00007

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
Secondary Cal Check (SJI0028-SCV1)		(Water)		Lab File ID: NT509032102.D				Analyzed: 09/03/21 11:27	
Pentafluorobenzene	236413	4.62	266178	4.626	89	50 - 200	-0.006	+/-0.50	
Chlorobenzene-d5	1091656	7.741	1127354	7.741	97	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	987177	5.089	1041314	5.095	95	50 - 200	-0.006	+/-0.50	
1,4-Dichlorobenzene-d4	536683	9.98	547716	9.98	98	50 - 200	0.000	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8260D MED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0164
Instrument: NT5
Calibration: EI00007

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
LCS (BJI0235-BS1)		(Solid)	Lab File ID: NT509082102C.D				Analyzed: 09/08/21 10:14		
Pentafluorobenzene	240107	4.614	240107	4.614	100	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	1039184	7.741	1039184	7.741	100	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	967128	5.089	967128	5.089	100	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	526202	9.98	526202	9.98	100	50 - 200	0.000	+/-0.50	
Initial Cal Check (SJI0164-ICV1)		(Solid)	Lab File ID: NT509082102.D				Analyzed: 09/08/21 10:14		
Pentafluorobenzene	240107	4.614	240107	4.614	100	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	1039184	7.741	1039184	7.741	100	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	967128	5.089	967128	5.089	100	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	526202	9.98	526202	9.98	100	50 - 200	0.000	+/-0.50	
LCS Dup (BJI0235-BSD1)		(Solid)	Lab File ID: NT509082103B.D				Analyzed: 09/08/21 10:50		
Pentafluorobenzene	235739	4.62	240107	4.614	98	50 - 200	0.006	+/-0.50	
Chlorobenzene-d5	1048180	7.741	1039184	7.741	101	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	963262	5.095	967128	5.089	100	50 - 200	0.006	+/-0.50	
1,4-Dichlorobenzene-d4	517653	9.986	526202	9.98	98	50 - 200	0.006	+/-0.50	
Blank (BJI0235-BLK1)		(Solid)	Lab File ID: NT509082104B.D				Analyzed: 09/08/21 11:14		
Pentafluorobenzene	228860	4.62	240107	4.614	95	50 - 200	0.006	+/-0.50	
Chlorobenzene-d5	1000870	7.741	1039184	7.741	96	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	936236	5.095	967128	5.089	97	50 - 200	0.006	+/-0.50	
1,4-Dichlorobenzene-d4	490279	9.98	526202	9.98	93	50 - 200	0.000	+/-0.50	
HSA-62-13-14 (21I0042-03)		(Solid)	Lab File ID: NT509082111.D				Analyzed: 09/08/21 16:28		
Pentafluorobenzene	226662	4.614	240107	4.614	94	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	994608	7.741	1039184	7.741	96	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	905846	5.089	967128	5.089	94	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	495880	9.98	526202	9.98	94	50 - 200	0.000	+/-0.50	
DUP-1-083121 (21I0042-04)		(Solid)	Lab File ID: NT509082112.D				Analyzed: 09/08/21 16:52		
Pentafluorobenzene	237949	4.626	240107	4.614	99	50 - 200	0.012	+/-0.50	
Chlorobenzene-d5	1033317	7.741	1039184	7.741	99	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	964685	5.095	967128	5.089	100	50 - 200	0.006	+/-0.50	
1,4-Dichlorobenzene-d4	506018	9.98	526202	9.98	96	50 - 200	0.000	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8260D MED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Sequence:	SJI0225	Instrument:	NT5
		Calibration:	EI00007

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
LCS (BJI0310-BS1)		(Solid)	Lab File ID: NT509102101B.D				Analyzed: 09/10/21 09:36		
Pentafluorobenzene	236837	4.62	236837	4.62	100	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	1022059	7.741	1022059	7.741	100	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	956684	5.095	956684	5.095	100	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	496322	9.986	496322	9.986	100	50 - 200	0.000	+/-0.50	
Initial Cal Check (SJI0225-ICV1)		(Solid)	Lab File ID: NT509102101.D				Analyzed: 09/10/21 09:36		
Pentafluorobenzene	236837	4.62	236837	4.62	100	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	1022059	7.741	1022059	7.741	100	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	956684	5.095	956684	5.095	100	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	496322	9.986	496322	9.986	100	50 - 200	0.000	+/-0.50	
LCS Dup (BJI0310-BSD1)		(Solid)	Lab File ID: NT509102102A.D				Analyzed: 09/10/21 10:00		
Pentafluorobenzene	245467	4.62	236837	4.62	104	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	1063329	7.747	1022059	7.741	104	50 - 200	0.006	+/-0.50	
1,4-Difluorobenzene	977323	5.095	956684	5.095	102	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	524549	9.986	496322	9.986	106	50 - 200	0.000	+/-0.50	
Blank (BJI0310-BLK1)		(Solid)	Lab File ID: NT509102103A.D				Analyzed: 09/10/21 10:25		
Pentafluorobenzene	249887	4.626	236837	4.62	106	50 - 200	0.006	+/-0.50	
Chlorobenzene-d5	1048652	7.741	1022059	7.741	103	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	975026	5.095	956684	5.095	102	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	517745	9.986	496322	9.986	104	50 - 200	0.000	+/-0.50	
HSA-62-13-14 (21I0042-03RE1)		(Solid)	Lab File ID: NT509102104.D				Analyzed: 09/10/21 11:30		
Pentafluorobenzene	237637	4.62	236837	4.62	100	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	1008865	7.741	1022059	7.741	99	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	952445	5.089	956684	5.095	100	50 - 200	-0.006	+/-0.50	
1,4-Dichlorobenzene-d4	485639	9.98	496322	9.986	98	50 - 200	-0.006	+/-0.50	

HOLDING TIME SUMMARY

Analysis: EPA 8260D MED

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
HSA-62-13-14 21I0042-03	08/31/21 11:00	09/02/21 10:52	09/08/21 08:36	7	14	09/08/21 16:28	8	14	
HSA-62-13-14 21I0042-03RE1	08/31/21 11:00	09/02/21 10:52	09/08/21 08:36	7	14	09/10/21 11:30	10	14	
DUP-1-083121 21I0042-04	08/31/21 11:30	09/02/21 10:52	09/08/21 08:36	7	14	09/08/21 16:52	8	14	

* Indicates hold time exceedance.

METHOD DETECTION AND REPORTING LIMITS

EPA 8260D MED

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Matrix: Solid Instrument: NT5

Analyte	MDL	RL	Units
Benzene	8.25	50.0	ug/kg
Naphthalene	123	250	ug/kg

METHOD DETECTION AND REPORTING LIMITS

EPA 8260D MED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Water
Instrument: NT5

Analyte	MDL	RL	Units

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Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
021111-01	366047	≤ -10 °C	P/T Methanol	13-Jan-2022	Bromoethane Solution, 2,000 mg/L, 1 ml

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
bromoethane	74-96-4	99.8	1111.1.1P	2014 +/- 20.63	mg/L

H003272
Bromoethane Solution
Solvent / Lot: p&t methanol
Prep: 4/1/2019 by PC
Exp: 1/13/2022
Location: F-40

Certified By: _____
Kara Catron
Manufacture Date 9-Jan-2019

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00. Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

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Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
020620-02	377123	≤ -10 °C	P/T Methanol	15-May-2024	n-Hexane Solution, 1,000 mg/L, 1 mL

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
n-hexane (C6)	110-54-3	98	620.24.1P	1000 +/- 14.42	mg/L

H009538
n-Hexane (C6)
Solvent / Lot: P&T MeOH
Prep: 10/2/2019 by LH
Exp: 5/15/2024

Auquilla Samuel

Certified By: _____

Auquilla Samuel

Manufacture Date 17-May-2019

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00. Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

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Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
122318-01	329610	≤ -10 °C	P/T Methanol	28-Nov-2021	MtBE & Freon 113 Solution, 1000 mg/L, 1 ml

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
methyl t-butyl ether	1634-04-4	99.96	208.24.2P	1003 +/- 10.42	mg/L
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	76-13-1	99.9	270.158.1P	1012 +/- 14.59	mg/L

H009539
MtBE&Freon 113 Solution
Solvent / Lot: p&t methanol
Prep: 10/2/2019 by LH
Exp: 11/28/2021

Certified By: Susan Mathews

Manufacture Date 28-Nov-2017

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

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CERTIFIED REFERENCE MATERIAL

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Reference Material Producer
Certificate #3222.01

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ISO/IEC 17025 Accredited
Testing Laboratory
Certificate #3222.02

FOR LABORATORY USE ONLY-READ SDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 30265 **Lot No.:** A0150481

Description : 2-Chloroethyl vinyl ether Standard

2-Chloroethyl vinyl ether Standard 2,000µg/mL, P&T Methanol, 1mL/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : June 30, 2024 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	2-Chloroethyl vinyl ether	2,000.6 µg/mL	+/- 11.6317	µg/mL	Gravimetric
	CAS # 110-75-8 (Lot MKBS6526V)		+/- 42.8331	µg/mL	Unstressed
	Purity 99%		+/- 44.0783	µg/mL	Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

H012546
2CEVE SS
Solvent / Lot: Methanol
Prep: 12/30/2019 by PC
Exp: 6/30/2024
Location:

Tech Tips:
Degradation of tetrachloroethylene to pentachloroethane may occur if solutions containing 2-chloroethyl vinyl ether are combined with solutions that contain tetrachloroethylene.

Column:
105m x 0.53mm x 3.0µm
Rtx-502.2 (cat.#10910)

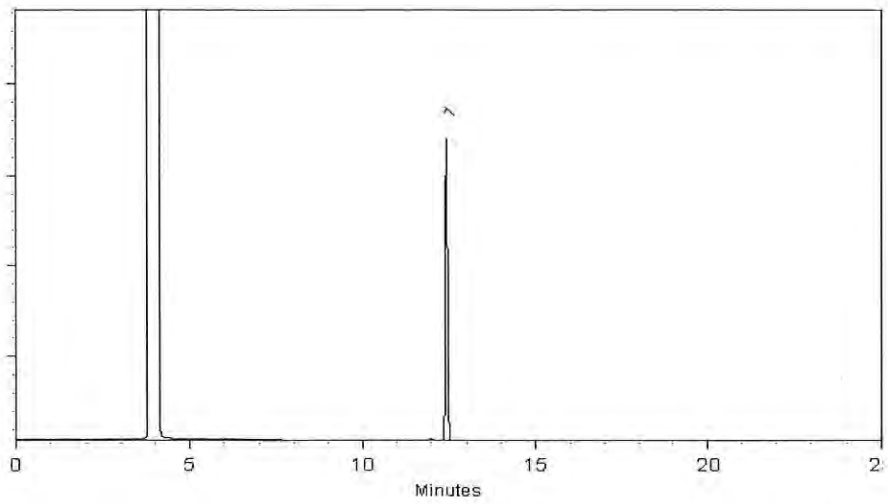
Carrier Gas:
hydrogen-constant pressure 11.0 psi.

Temp. Program:
40°C (hold 2 min.) to 240°C
@ 8°C/min. (hold 5 min.)

Inj. Temp:
200°C

Det. Temp:
250°C

Det. Type:
FID



This chromatogram represents a general set of testing conditions chosen for product acceptance. For optimal results in your lab, conditions should be adjusted for your specific instrument, method, and application.

Walker Workman - Operations Technician I

Date Mixed: 27-Jun-2019 **Balance:** B707717271

Jennifer Pollino - Operations Tech-ARM QC

Date Passed: 01-Jul-2019

Manufactured under Restek's ISO 9001:2015 Registered Quality System Certificate #FM 80397

General Certified Reference Material Notes

Expiration Notes:

- Expiration date valid for unopened ampul stored in compliance with the recommended conditions.
- Uncertainty, concentration, and expiration of the CRM are based on the unopened product being stored according to the recommended condition found in the storage field.

Purity Notes:

- Purity and/or chemical identity are determined by one or more of the following techniques: GC/FID, HPLC, GC/μECD, GC/MS, LC/MS, RI, and/or melting point.
- Compounds with a listed purity of less than 99% have been weight corrected to compensate for impurities and/or salts. A correction factor is used to calculate the amount of compound necessary to achieve the desired concentration of the parent compound in solution.
- Purity of isomeric compounds is reported as the sum of the isomers.
- Purity values are rounded to the nearest whole number.

Certified Uncertainty Value Notes:

- The uncertainties are determined in accordance with ISO 17034 and Guide 35. The certified combined stressed uncertainty value (includes gravimetric uncertainty, homogeneity between-ampul uncertainty, storage stability uncertainty and shipping stability uncertainty and were combined using the following formula:

$$U_{combined\ stressed} = k\sqrt{U^2_{gravimetric} + U^2_{homogeneity} + U^2_{storage\ stability} + U^2_{shipping\ stability}}$$

k is a coverage factor of 2, which gives a level of confidence of approximately 95%.

- It is important to note that the shipping stability uncertainty was obtained under temperature extremes for specific time intervals; therefore, the certified combined stressed uncertainty value should only be applied to the product if it was stored at non-standard temperature conditions up to and including 7 days. Contact Restek Technical Service at www.restek.com/Contact-Us for use recommendations if your shipment was in-transit for more than 7 days at non-standard temperature conditions.
- Apply the certified combined unstressed uncertainty value if the product was received under standard shipping conditions. Apply the certified combined stressed uncertainty value if the product was received under non-standard conditions as specified below.

Label Conditions	Standard Conditions	Non-Standard Conditions
25°C Nominal (Room Temperature)	< 60°C	≥ 60°C up to 7 days
10°C or colder (Refrigerate)	< 40°C	≥ 40°C up to 7 days
0°C or colder (Freezer)	< 25°C	≥ 25°C up to 7 days

- Separate (not combined) uncertainty values for gravimetric uncertainty are also displayed on the certificate, if needed, separate homogeneity between-ampul uncertainty, storage stability uncertainty and shipping stability uncertainty values are available by contacting Restek Technical Service at www.restek.com/Contact-Us.
- The packaged amount is the minimum sample size for which uncertainty is valid. The ampules are over-filled to ensure that the minimum packaged amount can be sufficiently transferred.

Manufacturing Notes:

- Concentration is based upon gravimetric preparation using either a balance whose calibration has been verified daily using NIST traceable weights, and/or dilutions with Class A glassware.

Handling Notes:

- Stability of the unopened product, when stored in compliance with the recommended conditions, is guaranteed through the expiration displayed on the product label and certificate. Contact Restek for additional opened product stability information, with the knowledge/understanding that open product stability is subject to the specific handling and environmental conditions to which the product is exposed. For your convenience Restek supplies deactivated vials with most standards packed in 2mL ampules. Larger volume deactivated vials are available through Restek as a custom ordered item. Additionally, Restek sells DMDCS for the purpose of glassware deactivation as catalog number 31861, which includes complete instructions.
- If any undissolved material is visible inside the ampul, sonicate the unopened ampul until the material is completely dissolved.

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Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
120002-01 -5PAK	400025	≤ -10 Degrees C	P/T Methanol	28-Jan-2023	8260B Surrogate Solution, 2,000 mg/L, 5 x 1 ml

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
4-bromofluorobenzene (BFB)	460-00-4	99.5	135.7.1P	1981 +/- 6.91	mg/L
dibromofluoromethane	1868-53-7	99.6	136.290.1P	1987 +/- 7.2	mg/L
1,2-dichloroethane-d_4	17060-07-0	99.5	138.271.2P	2030 +/- 12.37	mg/L
toluene-d_8	2037-26-5	99.67	137.12.3P	1980 +/- 6.9	mg/L

I001023
8260B Surrogate Solution
Solvent / Lot: Methanol
Prep: 1/31/2020 by PC
Exp: 1/28/2023
Location:

Certified By: Amanda Frazier

Amanda Frazier
Manufacture Date 24-Jan-2020

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

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I009147
2CEVE
Solvent / Lot: Methanol
Prep: 10/5/2020 by PC
Exp: 8/31/2023
Location:

Product Name: 2-Chloroethylvinyl Ether Standard

Product Number: EPA-1016-1

Lot Number: 0006546244

Lot Issue Date: 23-Jul-2020

Expiration Date: 31-Aug-2023

Description:

This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system, and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
2-chloroethylvinyl ether	000110-75-8	RM06940	5020 ± 25 µg/mL

Matrix: methanol (methyl alcohol)

Storage Conditions: Store Frozen (-25° to -10°C).

Traceability:
The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:
This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:
This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:
Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:
Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

Expiration of Certification:
The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:
If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

Sample lot approver:

Monica Bourgeois
QMS Representative

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER
ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026
Page: 1 of 1
www.agilent.com/quality/

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY
ISO 17025 Cert No. AT-1937

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I009654
8260B Calibration Super Mix
Solvent / Lot: P/T Methanol
Prep: 10/14/2020 by PC
Exp: 10/29/2024
Location: F-40

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ISO 17025 Accredited Chemical Testing Lab
Cert. No. 3031.01

Date Received: _____

Certificate of Analysis

Rev 0

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
122150-01	425321	≤ -10 °C	P/T Methanol	29-Oct-2024	8260B Calibration Super Mix, 76-1, 2,000 mg/L, 1 ml (Ampule A) One of Two

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
2-nitropropane	79-46-9	99.4	219.8.1P	1997 ± 40.75	mg/L
acetonitrile	75-05-8	99.9	204.1.2P	2000 ± 35.59	mg/L
acrylonitrile	107-13-1	99	210.1.6P	2002 ± 36.99	mg/L
allyl chloride	107-05-1	98.6	227.1.1P	2013 ± 41.08	mg/L
benzene	71-43-2	99.99	146.1.9P	2001 ± 35.59	mg/L
bromobenzene	108-86-1	99.9	147.8.1.1P	2013 ± 41.08	mg/L
bromochloromethane	74-97-5	99.7	148.1.3P	2005 ± 35.72	mg/L
bromodichloromethane	75-27-4	99.5	149.1.9P	2001 ± 35.65	mg/L
bromoform	75-25-2	99.3	150.7.2P	2002 ± 35.67	mg/L
n-butylbenzene	104-51-8	99.2	151.7.3.2P	2003 ± 35.69	mg/L
sec-butylbenzene	135-98-8	99.5	152.1.2.1P	2011 ± 35.83	mg/L
tert-butylbenzene	98-06-6	99.9	153.29.1P	2010 ± 35.81	mg/L
carbon disulfide	75-15-0	99.99	200.18.2P	2001 ± 35.65	mg/L
carbon tetrachloride	56-23-5	100	154.9.1P	2003 ± 35.69	mg/L
chlorobenzene	108-90-7	99.9	155.29.1P	2001 ± 35.65	mg/L
2-chloroethanol	107-07-3	98.5	217.1.2.1P	2010 ± 41.02	mg/L

Auquilla Samuel

Certified By: _____

Auquilla Samuel

Manufacture Date 31-Oct-2019

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.

This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

Certificate of Analysis

Catalog No.: 122150-01 **Lot No.:** 425321 **Expiration Date:** 29-Oct-2024

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
chloroform	67-66-3	99.8	156.7.1P	2004 ± 35.7	mg/L
chloroprene	126-99-8	99	315.282.8P	2000 ± 35.58	mg/L
2-chlorotoluene	95-49-8	99.5	157.7.1P	2010 ± 35.81	mg/L
4-chlorotoluene	106-43-4	99.9	158.9.3P	2006 ± 35.74	mg/L
cis-1,2-dichloroethylene	156-59-2	99.7	166.286.1P	2004 ± 40.89	mg/L
dibromochloromethane	124-48-1	97.5	159.29.2P	2009 ± 35.74	mg/L
1,2-dibromo-3-chloropropane	96-12-8	98.4	160.7.2.1P	2001 ± 35.65	mg/L
1,2-dibromoethane	106-93-4	99.9	161.9.1P	2001 ± 35.65	mg/L
dibromomethane	74-95-3	99.8	162.1.2P	2001 ± 40.83	mg/L
1,2-dichlorobenzene	95-50-1	99.8	43.7.1P	2000 ± 35.63	mg/L
1,3-dichlorobenzene	541-73-1	99.9	44.7.1P	2011 ± 35.83	mg/L
1,4-dichlorobenzene	106-46-7	99.9	45.29.2P	2001 ± 35.65	mg/L
cis-1,4-dichloro-2-butene	1476-11-5	96.2	209.1.4.1P	2013 ± 35.87	mg/L
trans-1,4-dichloro-2-butene	110-57-6	98	201.1.17P	2002 ± 35.67	mg/L
1,1-dichloroethane	75-34-3	98.27	163.247.1P	2009 ± 35.74	mg/L
1,2-dichloroethane	107-06-2	99.9	164.158.1P	2001 ± 35.65	mg/L
1,1-dichloroethylene	75-35-4	99	165.1.1.1.1P	2002 ± 36.99	mg/L
trans-1,2-dichloroethylene	156-60-5	99.8	167.9.2P	2006 ± 35.74	mg/L
1,2-dichloropropane	78-87-5	99.7	168.8.1.1P	2001 ± 40.83	mg/L
1,3-dichloropropane	142-28-9	99.8	169.7.2.1P	2001 ± 35.65	mg/L
2,2-dichloropropane	594-20-7	99.1	170.7.2P	2000 ± 35.63	mg/L
1,1-dichloropropylene	563-58-6	99	171.158.1P	2000 ± 40.81	mg/L
cis-1,3-dichloropropylene	10061-01-5	99.6	172.7.4.1P	2007 ± 35.76	mg/L
trans-1,3-dichloropropylene	10061-02-6	99	173.7.4.5P	2000 ± 35.63	mg/L

Auquilla Samuel

Certified By: _____

Auquilla Samuel

Manufacture Date 31-Oct-2019

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.

This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00. Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

Certificate of Analysis

Catalog No.: 122150-01 **Lot No.:** 425321 **Expiration Date:** 29-Oct-2024

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration
1,4-dioxane	123-91-1	100	223.1.3P	2003 ± 40.87 mg/L
ethyl ether	60-29-7	99.9	226.1.3P	2002 ± 35.61 mg/L
ethyl methacrylate	97-63-2	99.1	216.1.1P	2007 ± 40.96 mg/L
ethylbenzene	100-41-4	99.9	174.8.2P	2001 ± 40.83 mg/L
hexachlorobutadiene	87-68-3	98	47.158.1.2P	2009 ± 41 mg/L
iodomethane	74-88-4	99.9	203.1.3.1P	2003 ± 40.87 mg/L
isobutyl alcohol	78-83-1	100	220.7.2P	2001 ± 35.65 mg/L
isopropylbenzene	98-82-8	98.9	176.9.1P	2004 ± 40.89 mg/L
4-isopropyltoluene	99-87-6	99.7	177.9.2P	2003 ± 40.87 mg/L
methyl acrylonitrile	126-98-7	99.5	212.3.1P	2000 ± 36.96 mg/L
methyl methacrylate	80-62-6	98.5	231.8.1.1P	2012 ± 41.06 mg/L
methyl acrylate	96-33-3	99.9	349.1.1P	2004 ± 40.9 mg/L
methylene chloride	75-09-2	99.99	178.271.1P	2002 ± 35.61 mg/L
naphthalene	91-20-3	99.8	26.9.1P	2001 ± 35.65 mg/L
nitrobenzene	98-95-3	99.9	94.29.2P	2003 ± 35.63 mg/L
pentachloroethane	76-01-7	98.8	52.3.5P	2004 ± 37.03 mg/L
propionitrile	107-12-0	99.9	218.7.1P	2001 ± 35.65 mg/L
n-propylbenzene	103-65-1	99.7	179.7.2P	2005 ± 35.72 mg/L
styrene	100-42-5	99.5	180.286.1P	2010 ± 41.02 mg/L
1,1,1,2-tetrachloroethane	630-20-6	99.8	181.7.2.7P	2004 ± 35.7 mg/L
1,1,2,2-tetrachloroethane	79-34-5	99.4	182.8.2P	2001 ± 40.83 mg/L
tetrachloroethylene	127-18-4	100	183.1.2P	2006 ± 35.68 mg/L
tetrahydrofuran (THF)	109-99-9	99.9	299.18.1P	2003 ± 40.87 mg/L
toluene	108-88-3	100	184.48.1P	2001 ± 35.65 mg/L

Auquilla Samuel

Certified By: _____

Auquilla Samuel

Manufacture Date 31-Oct-2019

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.

This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00. Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

Certificate of Analysis

Catalog No.: 122150-01 **Lot No.:** 425321 **Expiration Date:** 29-Oct-2024

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration
1,2,3-trichlorobenzene	87-61-6	99	185.1.1.6P	2016 ± 37.25 mg/L
1,2,4-trichlorobenzene	120-82-1	99.6	54.29.1P	2005 ± 35.72 mg/L
1,1,1-trichloroethane	71-55-6	99	187.1.1P	2004 ± 40.89 mg/L
1,1,2-trichloroethane	79-00-5	99.6	195.7.1.6P	2004 ± 35.7 mg/L
trichloroethylene	79-01-6	100	188.1.1P	2015 ± 41.12 mg/L
1,2,3-trichloropropane	96-18-4	99.5	189.1.3P	2005 ± 35.72 mg/L
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	76-13-1	99	270.158.2P	2003 ± 40.88 mg/L
1,2,4-trimethylbenzene	95-63-6	99.1	190.1.3P	2008 ± 40.98 mg/L
1,3,5-trimethylbenzene	108-67-8	99.7	191.9.2.1P	2002 ± 40.85 mg/L
m-xylene	108-38-3	99.7	193.7.1.2P	2001 ± 35.65 mg/L
o-xylene	95-47-6	99.2	192.29.2P	2003 ± 35.69 mg/L
p-xylene	106-42-3	99.9	194.7.1P	2003 ± 35.69 mg/L

Auquilla Samuel

Certified By: _____

Auquilla Samuel

Manufacture Date 31-Oct-2019

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.

This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00. Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

Certificate of Analysis

Catalog No.: 122150-01 **Lot No.:** 425321 **Expiration Date:** 29-Oct-2024

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration

Auquilla Samuel

Certified By: _____

Auquilla Samuel

Manufacture Date 31-Oct-2019

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00. Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

ACCREDITED
Reference Materials Producer
Cert #2495.01

SPEXertificate®
Certificate of Reference Material

ilac-MRA ACCREDITED
Chemical Testing
Cert #2495.02

Catalog Number: S-2986 **Lot No.** EN191002016

Description: 2-Pentanone

Matrix: Methanol (Purge & Trap Grade)

Ship Date: December 2, 2020
Expiration Date: December 2, 2022

This **SPEXOrganics®** Certified Reference Material, CRM, is intended primarily for use as a calibration standard or quality control standard for organic chromatography instrumentation such as GC, GC-MS, LC, and LC-MS. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Compounds:

Compound	CAS #	Labeled	Purity	Certified†	Uncertainty
2-Pentanone	107-87-9	1000 µg/mL	99%	990 µg/mL	± 35 µg/mL

I011378
2-Pentonone 1000
Solvent / Lot: MeOH
Prep: 12/10/2020 by PC
Exp: 12/2/2022
Location: VOA F-40

* - Isomer ratios (when applicable) are an uncertified parameter.

Final Solution Verification:

Final solution integrity verified by Gas Chromatography/Mass Spectrometry. The mass spectrum of each compound was confirmed against the NIST mass spectral database.

† Certified concentration based on gravimetric weights and corrected for the purity of the compound(s) used to prepare the standard. Analytical balance calibration is verified daily with C1 weight set #23-190006 which is registered with Atlantic Scale, and traceable to NIST and NJ Division of Weights and Measures.

This CRM is guaranteed stable and accurate to within the uncertainty listed for the certified value. This includes uncertainty components due to preparation, homogeneity, short term and long term stability. During the stated period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution. For further information, contact the Sales Support Department at crmsales@spexcsp.com.

Date of Certification: December 2, 2020

Certifying Officer: Shannon Mace
Shannon Macieira, Operations Manager

Report of Certification

Catalog Number: S-2986 **Lot No.** EN1910020I6

Description: 2-Pentanone

Matrix: Methanol (Purge & Trap Grade) **Ship Date:** December 2, 2020

Expiration Date: December 2, 2022

This Certified Reference Material (CRM) has been prepared and certified under an ISO 9001 (certified by DQS) and ISO 17025 (accredited by A2LA), and ISO 17034 (accredited by A2LA) quality system consistent with the following standards:

- ISO 9001: Quality management systems - Requirements
- ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories
- ISO 17034: General requirements for the competence of reference material producers
- ISO Guide 30: Reference Materials - Selected terms and definitions
- ISO Guide 31: Reference Materials - Contents of certificates and lables
- ISO Guide 35: Reference Materials - General and Statistical principals for certification
- Guide to the Expression of Uncertainty in Measurement, 2008
- EURACHEM/CITAC Guide: Qualifying Uncertainty in Analytical Measurement - Third Edition
- NIST Technical Note 1297

Storage Requirements:

To ensure the stability of the product once it arrives in your laboratory, please store this product in ambient conditions (18°C to 27°C). Note: Shipping conditions may differ from storage conditions. The EXPIRATION DATE is calculated from the SHIPPED DATE using our stability data and is applicable only if the product is stored under the laboratory specified conditions.

Instructions for Use:

Let material come to room temperature before use. Check for precipitate and if necessary sonicate for one minute. If compounds do not dissolve after one minute then sonicate further until the product is dissolved. A clear appearance is acceptable. The minimum recommended amount that should be removed from this vial is 5µL with a 25µL gas tight syringe. All solutions should be thoroughly mixed, by shaking, prior to use. All surfaces that come in contact with the solution must be thoroughly cleaned prior to use. Dilutions should be performed only with Class A volumetric glassware.

Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For assistance, please contact sales support at crmsales@spexcsp.com.

Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, and analytical instrumentation have been qualified prior to use. The highest purity solvents and Class A / calibrated volumetrics have been used in all preparations.

Homogeneity:

The homogeneity of this CRM has been confirmed by procedures consistent with ISO 17025, ISO 17034, and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed to prove homogeneity in accordance with our internal procedure 4300-HOMOGEN-1A. This is consistent with the intended use of this CRM. The Degree of Homogeneity, as expressed as maximum between-bottle variation, is 1.2%

Statistical Estimator and Confidence Limits:

The Certified value 'X' as listed on the reverse of this document is at the 95% level of confidence and can be expressed as:

- X = x ± U where X=certified value, U=expanded uncertainty, x=property value
- U = $k u_c$ where k=2 is the coverage factor at the 95% confidence level
- u_c = combined standard uncertainty obtained by combining the individual compound standard uncertainty components u_i, where $u_c=\sqrt{\Sigma u_i^2}$

Legal Notice:

SPEX CertiPrep Certified Reference Materials are not for any cosmetic, drug, or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep of any kind whatsoever, whether based on breech of warranty, alleged negligence, or otherwise, with respect to this Reference Material shall be greater than the purchase price. In no event shall SPEX CertiPrep be liable for any loss of profits or any incidental, special, or consequential damages.

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Cert. No. 3031.01

Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
120076-01	414391	≤ -10 ºC	P/T Methanol	16-Jan-2024	8260 Internal Standard Solution, 2,000 mg/L, 1 mL

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
chlorobenzene-d_5	3114-55-4	99.41	12[illegible]9.3[illegible]	1999 ± 6.93	mg/L
1,4-dichlorobenzene-d4	3855-82-1	100	3.12.6.1	2004 ± 7.23	mg/L
1,4-difluorobenzene	540-36-3	99.[illegible]	129.[illegible]8.1P	2002 ± 21.19	mg/L
pentafluorobenzene	363-72-4	99.9	131.7.1P	2001 ± 7.22	mg/L

Certified By: Kayla Coleman

Kayla Coleman
Manufacture Date 17-Jan-2019

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00. Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

Agilent

Certificate of Analysis

Product Name: Custom Standard

Product Number: CUS-1756

Lot Number: 0006580093

Lot Issue Date: 30-Dec-2020

Expiration Date: 31-Jan-2023

Description:
This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
acrylonitrile	000107-13-1	RM16463	5020 ± 25 µg/mL
bromoethane	000074-96-4	RM00936	5023 ± 25 µg/mL
carbon disulfide	000075-15-0	RM08158	5019 ± 25 µg/mL
iodomethane	000074-88-4	RM14171	5023 ± 25 µg/mL
1,1,2-trichlorotrifluoroethane	000076-13-1	RM04848	5025 ± 25 µg/mL
trans-1,4-dichloro-2-butene	000110-57-6	RM13971	5019 ± 25 µg/mL

Matrix: methanol (methyl alcohol)

Storage Conditions: Store Frozen (-25° to -10°C).

Traceability:
The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:
This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:
This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:
Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:
Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

J000092
Custom Mix
Solvent / Lot: Methanol
Prep: 1/5/2021 by PC
Exp: 1/31/2023
Location:

ANAB ACCREDITED ISO17034 REFERENCE MATERIAL PRODUCER
ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026
Page: 1 of 2
www.agilent.com/quality/
CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY
ISO 17025 Cert No. AT-1937

Certificate of Analysis

Product Number: CUS-1756 **Lot Number:** 0006580093

Expiration of Certification:
The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:
If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

Sample lot approver:

Monica Bourgeois
QMS Representative

ANAB ACCREDITED ISO17034 REFERENCE MATERIAL PRODUCER
ISO 17034 Cert
No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026
Page: 2 of 2
www.agilent.com/quality/
CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY
ISO 17025 Cert
No. AT-1937

Agilent

Certificate of Analysis

Product Name: Methyl tert-Butyl Ether Standard

Product Number: STS-440-1 **Lot Issue Date:** 19-Aug-2020

Lot Number: 0006555762 **Expiration Date:** 31-Aug-2022

Description:
This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system, and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
tert-butylmethyl ether	001634-04-4	RM06568	2006 ± 10 µg/mL

Matrix: methanol (methyl alcohol)

Storage Conditions: Store Frozen (-25° to -10°C).

Traceability:
The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:
This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:
This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:
Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:
Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

Expiration of Certification:
The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:
If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

J000094
MTBE Solution
Solvent / Lot: Methanol
Prep: 1/5/2021 by PC
Exp: 8/31/2022
Location: VOA F-40

Sample lot approver:
Monica Bourgeois
QMS Representative

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER
ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026
Page: 1 of 1
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CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY
ISO 17025 Cert No. AT-1937

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CERTIFIED REFERENCE MATERIAL

Certificate of Analysis

ACCREDITED
ISO 17034 Accredited
Reference Material Producer
Certificate #3222.01

ACCREDITED
ISO/IEC 17025 Accredited
Testing Laboratory
Certificate #3222.02

FOR LABORATORY USE ONLY-READ SDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 30006 **Lot No.:** A0159420

Description : VOA Calibration Mix #1

VOA Calibration Mix #1 5,000µg/mL, P&T Methanol/Water(90:10), 1mL/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : June 30, 2023 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Acetone	5,006.4 µg/mL	+/- 29.1076	µg/mL	Gravimetric
	CAS # 67-64-1 (Lot MKCK2598)		+/- 302.0583	µg/mL	Unstressed
	Purity 99%		+/- 302.7754	µg/mL	Stressed
2	2-Butanone (MEK)	5,001.8 µg/mL	+/- 29.0809	µg/mL	Gravimetric
	CAS # 78-93-3 (Lot SHBK9603)		+/- 301.7808	µg/mL	Unstressed
	Purity 99%		+/- 302.4972	µg/mL	Stressed
3	4-Methyl-2-pentanone (MIBK)	5,001.5 µg/mL	+/- 29.0792	µg/mL	Gravimetric
	CAS # 108-10-1 (Lot SHBK5017)		+/- 301.7627	µg/mL	Unstressed
	Purity 99%		+/- 302.4791	µg/mL	Stressed
4	2-Hexanone	5,001.6 µg/mL	+/- 29.0797	µg/mL	Gravimetric
	CAS # 591-78-6 (Lot MKCL1599)		+/- 301.7687	µg/mL	Unstressed
	Purity 99%		+/- 302.4851	µg/mL	Stressed

Solvent: P&T Methanol/Water (90:10)
CAS # 67-56-1/7732-18-5
Purity 99%

J000706
Ketones Stock
Solvent / Lot: 90:10 Methanol:Water
Prep: 1/20/2021 by PC
Exp: 6/30/2023
Location: VOA F-40

Column:
105m x 0.53mm x 3.0µm
Rtx-502.2 (cat.#10910)

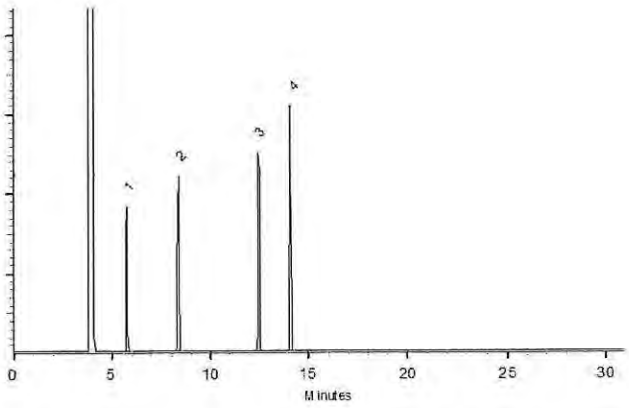
Carrier Gas:
hydrogen-constant pressure 11.0 psi.

Temp. Program:
40°C (hold 2 min.) to 240°C
@ 8°C/min. (hold 5 min.)

Inj. Temp:
200°C

Det. Temp:
250°C

Det. Type:
FID



This chromatogram represents a general set of testing conditions chosen for product acceptance. For optimal results in your lab, conditions should be adjusted for your specific instrument, method, and application.

Cathleen Soltis - Mix Technician

Date Mixed: 30-Mar-2020 **Balance:** B251644995

Fang-Yun Lo - QC Analyst

Date Passed: 01-Apr-2020

Manufactured under Restek's ISO 9001:2015
Registered Quality System
Certificate #FM 80397

Reference Materials Producer
Cert #2495.01

SPEXertificate®
Certificate of Reference Material

Chemical Testing
Cert #2495.02

Catalog Number: S-3800 **Lot No.** CP201130003

Description: Vinyl acetate

Matrix: Methanol (Purge & Trap Grade)

Ship Date: January 14, 2021
Expiration Date: January 14, 2022

This **SPEXOrganics®** Certified Reference Material, CRM, is intended primarily for use as a calibration standard or quality control standard for organic chromatography instrumentation such as GC, GC-MS, LC, and LC-MS. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Compounds:

Compound	CAS #	Labeled	Purity	Certified†	Uncertainty
Vinyl acetate	108-05-4	1000 µg/mL	99%	988 µg/mL	± 35 µg/mL

J000707
Vinyl Acetate 1000
Solvent / Lot: MeOH
Prep: 1/20/2021 by PC
Exp: 1/14/2022
Location: VOA F-40

* - Isomer ratios (when applicable) are an uncertified parameter.

Final Solution Verification:

Final solution integrity verified by Gas Chromatography/Mass Spectrometry. The mass spectrum of each compound was confirmed against the NIST mass spectral database.

† Certified concentration based on gravimetric weights and corrected for the purity of the compound(s) used to prepare the standard. Analytical balance calibration is verified daily with C1 weight set #23-190006 which is registered with Atlantic Scale, and traceable to NIST and NJ Division of Weights and Measures.

This CRM is guaranteed stable and accurate to within the uncertainty listed for the certified value. This includes uncertainty components due to preparation, homogeneity, short term and long term stability. During the stated period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution. For further information, contact the Sales Support Department at crmsales@spexcsp.com.

Date of Certification: January 14, 2021

Certifying Officer: Shannon Mac

Shannon Macieira, Operations Manager

Report of Certification

Catalog Number: S-3800 **Lot No.** CP201130003

Description: Vinyl acetate

Matrix: Methanol (Purge & Trap Grade)

Ship Date: January 14, 2021

Expiration Date: January 14, 2022

This Certified Reference Material (CRM) has been prepared and certified under an ISO 9001 (certified by DQS) and ISO 17025 (accredited by A2LA), and ISO 17034 (accredited by A2LA) quality system consistent with the following standards:

- ISO 9001: Quality management systems - Requirements
- ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories
- ISO 17034: General requirements for the competence of reference material producers
- ISO Guide 30: Reference Materials - Selected terms and definitions
- ISO Guide 31: Reference Materials - Contents of certificates and lables
- ISO Guide 35: Refernece Materials - General and Statistical principals for certification
- Guide to the Expression of Uncertainty in Measurement, 2008
- EURACHEM/CITAC Guide: Qualifying Uncertainty in Analytical Measurement - Third Edition
- NIST Technical Note 1297

Storage Requirements:

To ensure the stability of the product once it arrives in your laboratory, please store this product in a freezer (-35°C to -10°C). Note: Shipping conditions may differ from storage conditions. The EXPIRATION DATE is calculated from the SHIPPED DATE using our stability data and is applicable only if the product is stored under the laboratory specified conditions.

Instructions for Use:

Let material come to room temperature before use. Check for precipitate and if necessary sonicate for one minute. If compounds do not dissolve after one minute then sonicate further until the product is dissolved. A clear appearance is acceptable. The minimum recommended amount that should be removed from this vial is 5µL with a 25µL gas tight syringe. All solutions should be thoroughly mixed, by shaking, prior to use. All surfaces that come in contact with the solution must be thoroughly cleaned prior to use. Dilutions should be performed only with Class A volumetric glassware.

Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For assistance, please contact sales support at crmsales@spexcsp.com.

Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, and analytical instrumentation have been qualified prior to use. The highest purity solvents and Class A / calibrated volumetrics have been used in all preparations.

Homogeneity:

The homogeneity of this CRM has been confirmed by procedures consistent with ISO 17025, ISO 17034, and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed to prove homogeneity in accordance with our internal procedure 4300-HOMOGEN-1A. This is consistent with the intended use of this CRM. The Degree of Homogeneity, as expressed as maximum between-bo ttle variation, is 1.2%

Statistical Estimator and Confidence Limits:

The Certified value 'X' as listed on the reverse of this document is at the 95% level of confidence and can be expressed as:

- $X = x \pm U$ where X=certified value, U=expanded uncertainty, x=property value
- $U = ku_c$ where k=2 is the coverage factor at the 95% confidence level
- u_c = combined standard uncertainty obtained by combining the individual compound standard uncertainty components u_i, where $u_c=\sqrt{\sum u_i^2}$

Legal Notice:

SPEX CertiPrep Certified Reference Materials are not for any cosmetic, drug, or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep of any kind whatsoever, whether based on breech of warranty, alleged negligence, or otherwise, with respect to this Reference Material shall be greater than the purchase price. In no event shall SPEX CertiPrep be liable for any loss of profits or any incidental, special, or consequential damages.

SPEX CertiPrep®
Your Science is Our Passion.®

203 Norcross Ave. Metuchen, NJ 08840
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Phone: 1-732-549-7144 • Fax 1-732-603-9647

Absolute Standards, Inc.
800-368-1131
www.absolutestandards.com

Certified Reference Material CRM

ANAB ISO 17034 Accredited
AR-1539 Certificate Number
https://Absolutestandards.com

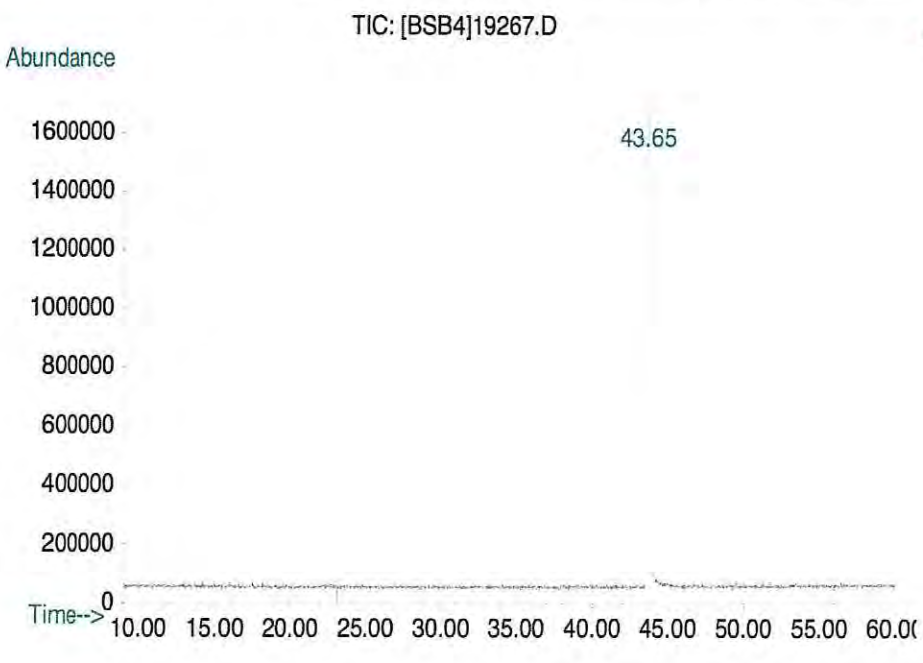
CERTIFIED WEIGHT REPORT

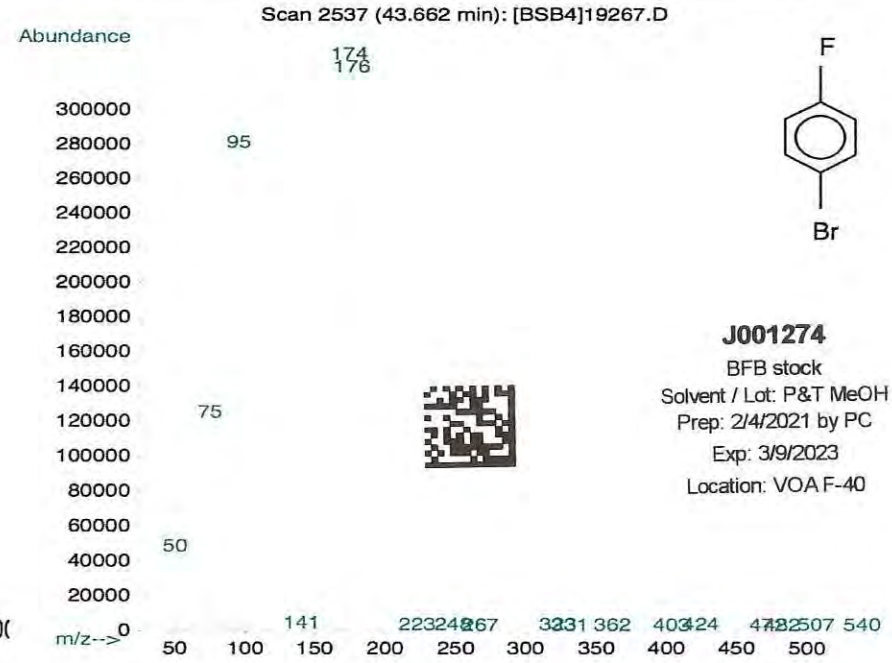
Part Number:	**19267**	**Solvent(s):**	**Lot#**
Lot Number:	030918	Methanol	DS435
Description:	p-Bromofluorobenzene		
	EPA Method 502/524 Surrogate Standard #2		
Expiration Date:	030923		
Recommended Storage:	Refrigerate (4 °C)		
Nominal Concentration (µg/mL):	2000		
NIST Test ID#:	2506734D	5E-05 Balance Uncertainty	
Weight(s) shown below were combined and diluted to (mL):	100.0	0.001 Flask Uncertainty	

		030918
Formulated By:	Jason Criscio	DATE
		030918
Reviewed By:	Pedro L. Rentas	DATE

Compound	RM#	Lot Number	Nominal Conc (µg/mL)	Purity (%)	Uncertainty Purity	Target Weight(g)	Actual Weight(g)	Actual Conc (µg/mL)	Expanded Uncertainty (+/-) (µg/mL)	SDS Information (Solvent Safety Info. On Attached pg.) CAS#	OSHA PEL (TWA)	LD50
1. p-Bromofluorobenzene	48	01127COV	2000	99	0.2	0.20204	0.20234	2002.9	8.2	460-00-4	N/A	orl-rat 2700mg/kg

Method: GC6MSD-1: **Detector:** Mass Selective Detector. **Column:** Vocol (60m X 0.25mm ID X 1.5µm film thickness). **Oven Profile:** Temp. 1 = 35°C (Time1=10min.), Temp. 2 = 200°C (Time2=8.75 min.), Rate = 4°C/min., Injector Temp.= 200°C, Detector Temp. = 220°C. **Analyst:** Candice Warren.





J001274
BFB stock
Solvent / Lot: P&T MeOH
Prep: 2/4/2021 by PC
Exp: 3/9/2023
Location: VOA F-40

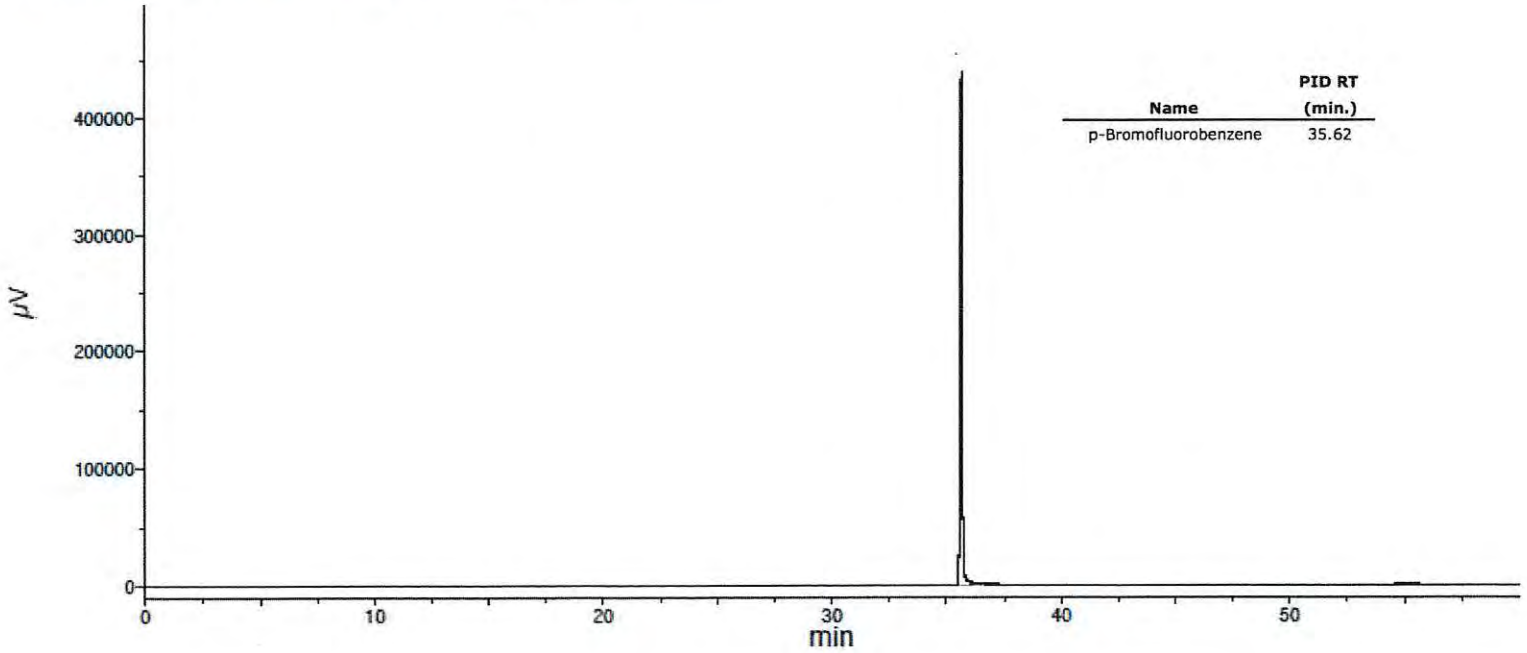
- **The certified value is the concentration calculated from gravimetric and volumetric measurements unless otherwise stated.**
- **Standards are prepared gravimetrically using balances that are calibrated with weights traceable to NIST (see above).**
- **Standards are certifed (+/-) 0.5% of the stated value, unless otherwise stated.**
- **All Standards, after opening ampule, should be stored with caps tight and under appropriate laboratory conditions.**
- **Uncertainty Reference: Taylor, B.N. and Kuyat, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Result," NIST Technical Note 1297, U.S. Government Printing Office, Washington, DC, (1994).**

Run 37, "P19267 L030918 [2000µg/mL in MeOH]"

Run Length: 60.00 min, 36000 points at 10 points/second.
Created: Mon, Mar 12, 2018 at 10:30:10 AM.
Sampled: Sequence "030818-GC1", Method "GC1-M7".
Analyzed using Method "GC1-M7".

Comments

GC1-M7 Analysis by Candice Warren
Column ID SPB-Vocol 105 meter X 0.53mm X 3.0µm film thickness
Flow rates: Total flow=150mL/min., Helium (carrier)=10mL/min.,
Helium(make-up)=40mL/min., Hydogen(make-up)=100mL/min.
Oven Profile: Temp. 1=35°C (Time 1=10 min.), Temp 2=200°C (Time 2=8.75 min.),
Rate = 4°C/min., Total run time=60 min. Injector temp.=200°C, FID Temp.=200°C.
ELCD Signal = Edaq Channel 1 PID Signal = Edaq Channel 2
Standard injection = 0.5µL, Range=4 Purge Valve = 8 min.



o2si smart solutions®

7290B Investment Drive North Charleston, South Carolina 29417
Phone: 866.272.0932 Fax: 866.509.5146 www.o2si.com

ACCREDITED

ISO 17025 Accredited Chemical Testing Lab
Cert. No. 3031.01

Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
120016-01	434093	≤ -10 °C	P/T Methanol	9-Feb-2026	Method 8260 Gases, 2,000 mg/L, 1 mL

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
bromomethane	74-83-9	99.5	139.158.1.1P	2009 ± 4.5	mg/L
chloroethane	75-00-3	99.94	141.2.2P	2005 ± 4.03	mg/L
chloromethane	74-87-3	99	140.158.2.2P	1997 ± 20.36	mg/L
dichlorodifluoromethane	75-71-8	99	142.158.5P	1993 ± 20.32	mg/L
trichlorofluoromethane	75-69-4	99	144.1.3P	2000 ± 12.17	mg/L
vinyl chloride	75-01-4	99	143.158.5.1P	1987 ± 20.26	mg/L

J002342
CLP VOA Gases Stock
Solvent / Lot: MeOH
Prep: 3/2/2021 by PC
Exp: 2/9/2026
Location: VOA F-40

Certified By: _____
Erica Lawson
Manufacture Date 10-Feb-2021

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.
The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

CERTIFIED WEIGHT REPORT

Part Number: 92579
Lot Number: 092519
Description: 2-Pentanone

Expiration Date: 092524
Recommended Storage: Refrigerate (4 °C)
Nominal Concentration (µg/mL): 2000
NIST Test ID#: 6UTB

Weight(s) shown below were combined and diluted to (mL): 30.0

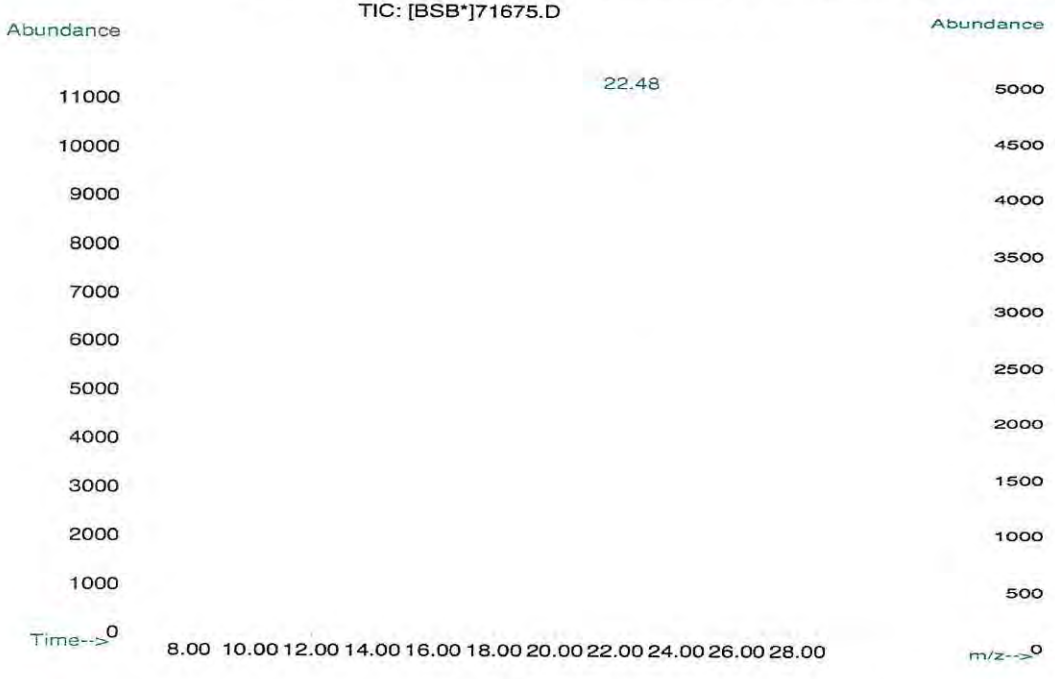
Solvent(s):	Lot#	
Methanol	DV182-US	(90%)
Water	091619	(10%)

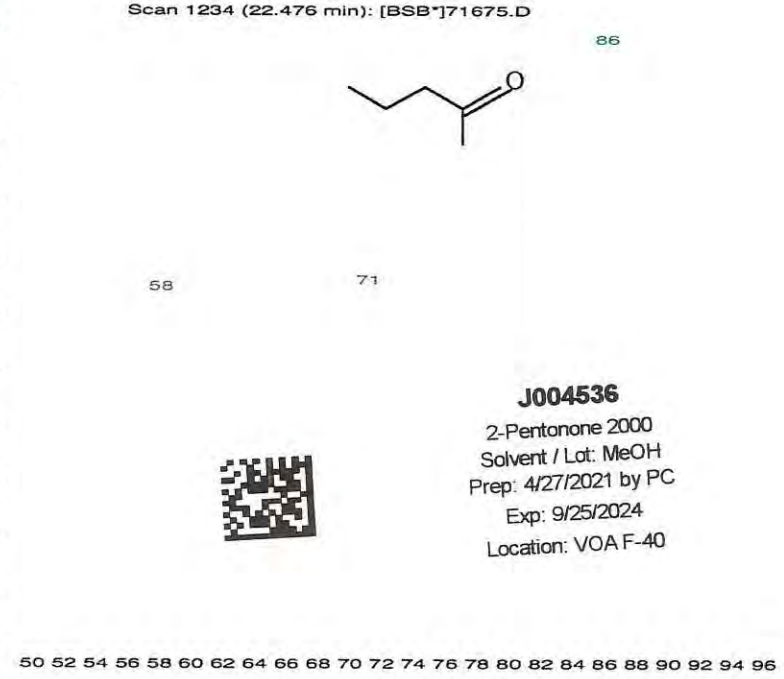
5E-05 Balance Uncertainty
0.002 Flask Uncertainty

Formulated By:	Prashant Chauhan	092519 DATE
Reviewed By:	Pedro L. Rentas	092519 DATE

Compound	RM#	Lot Number	Nominal Conc (µg/mL)	Purity (%)	Uncertainty Purity	Target Weight(g)	Actual Weight(g)	Actual Conc (µg/mL)	Expanded Uncertainty (+/-) µg/mL	SDS Information (Solvent Safety Info. On Attached pg.) CAS#	OSHA PEL (TWA)	LD50
1. 2-Pentanone	1675	ER 07040KN	2000	99	0.2	0.06057	0.06070	2004.4	8.8	107-87-9	N/A	N/A

Method GC6MSD-1: Column: Vocol (60m X 0.25mm ID X 1.5µm film thickness). Temp. 1 = 35°C (10min.), Temp. 2 = 200°C (8.75 min.), Rate = 4°C/min., Injector Temp. = 200°C, Detector Temp. = 220°C. Solvent Delay: 7 minutes. Analysis performed by Candice Warren.





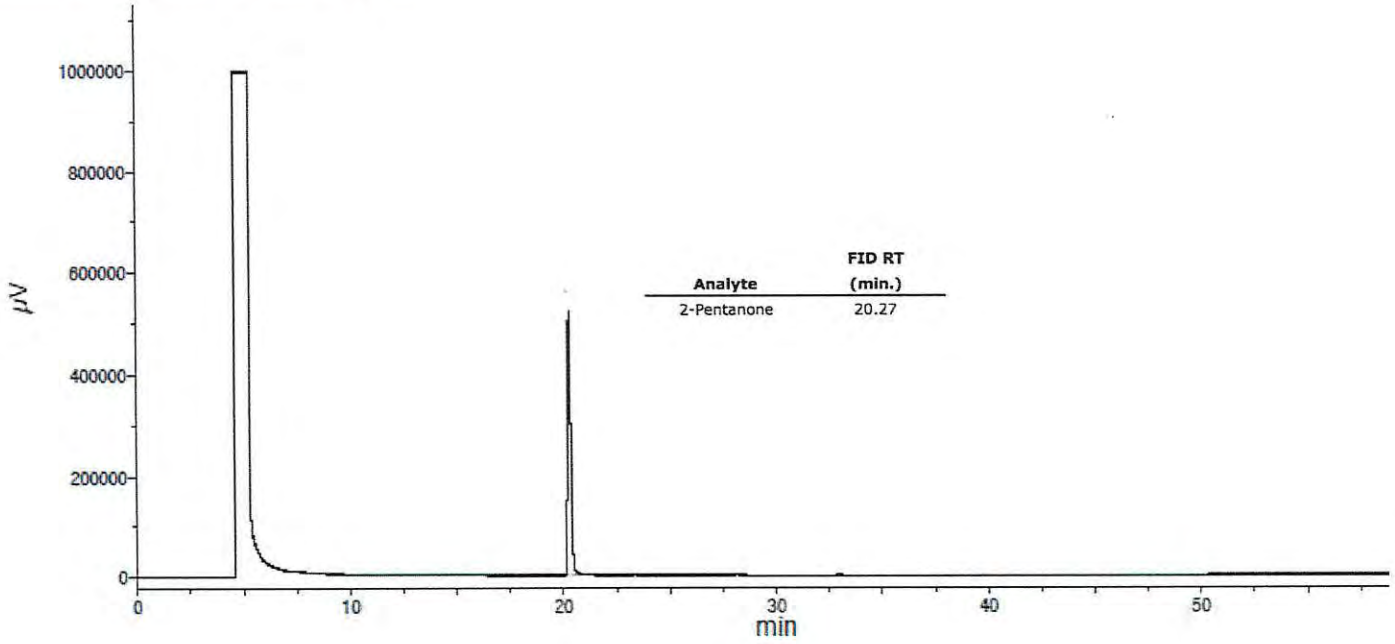
J004536
2-Pentonone 2000
Solvent / Lot: MeOH
Prep: 4/27/2021 by PC
Exp: 9/25/2024
Location: VOA F-40

- The certified value is the concentration calculated from gravimetric and volumetric measurements unless otherwise stated.
- Standards are prepared gravimetrically using balances that are calibrated with weights traceable to NIST (see above).
- Standards are certifed (+/-) 0.5% of the stated value, unless otherwise stated.
- All Standards, after opening ampule, should be stored with caps tight and under appropriate laboratory conditions.
- Uncertainty Reference: Taylor, B.N. and Kuyat, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Result," NIST Technical Note 1297, U.S. Government Printing Office, Washington, DC, (1994).

Run 37, "P92579 L092519 [2000µg/mL in M:W(9:1)]"

Run Length: 60.00 min, 36000 points at 10 points/second.
Created: Thu, Oct 3, 2019 at 8:40:03 PM.
Sampled: Sequence "100119-GC13M1", Method "GC13-M1".
Analyzed using Method "GC13-M1".

Comments
GC13-M1 Analysis by Candice Warren
Column ID SPB-Vocol 105 meter X 0.53mm X 3.0µm film thickness
Flow rates: Total flow=290mL/min., Helium (carrier)=10mL/min.,
Helium(make-up)=10mL/min., Hydogen(make-up)=40mL/min., Air(make-up)=230mL/min.
Oven Profile: Temp. 1=35˚C (Time 1=10 min.), Temp 2=200˚C (Time 2=8.75 min.),
Rate = 4˚C/min., Total run time=60 min. Injector temp.=200˚C, FID Temp.=200˚C.
FID Signal = Edaq Channel 1
Standard injection = 0.5µL, Range=2



Agilent

Certificate of Analysis

Product Name: VOC Standard

Product Number: DWM-588-1 **Lot Issue Date:** 04-Feb-2021

Lot Number: 0006587927 **Expiration Date:** 31-Mar-2024

Description:
This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
bromochloromethane	000074-97-5	RM00009	2010 ± 10 µg/mL
bromodichloromethane	000075-27-4	RM17386	2006 ± 10 µg/mL
bromoform	000075-25-2	RM07516	2009 ± 10 µg/mL
carbon tetrachloride	000056-23-5	RM07576	2003 ± 10 µg/mL
chloroform	000067-66-3	RM15321	2009 ± 10 µg/mL
dibromochloromethane	000124-48-1	RM14843-01	2006 ± 10 µg/mL
dibromomethane	000074-95-3	RM12878	2004 ± 10 µg/mL
methylene chloride	000075-09-2	RM09575	2010 ± 10 µg/mL
trichlorofluoromethane	000075-69-4	RM00017	2010 ± 10 µg/mL
1,2-dibromoethane	000106-93-4	RM00018	2007 ± 10 µg/mL
1,1-dichloroethane	000075-34-3	RM16217	2009 ± 10 µg/mL
1,2-dichloroethane	000107-06-2	RM04655	2010 ± 10 µg/mL
1,1-dichloroethene	000075-35-4	RM14486	2009 ± 10 µg/mL
cis-1,2-dichloroethene	000156-59-2	RM15008	2009 ± 10 µg/mL
trans-1,2-dichloroethene	000156-60-5	RM07565	2006 ± 10 µg/mL
1,1,1,2-tetrachloroethane	000630-20-6	RM12632	2009 ± 10 µg/mL
1,1,2,2-tetrachloroethane	000079-34-5	NT00390	2008 ± 10 µg/mL

J005404
VOC mixture
Solvent / Lot: Methanol
Prep: 5/21/2021 by PC
Exp: 3/31/2024
Location:

ANAB ACCREDITED ISO17034 REFERENCE MATERIAL PRODUCER
ISO 17034 Cert
No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026
Page: 1 of 4
www.agilent.com/quality/
CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY
ISO 17025 Cert
No. AT-1937

Certificate of Analysis

Product Number: DWM-588-1 **Lot Number:** 0006587927

tetrachloroethene	000127-18-4	RM06491	2008 ± 10 µg/mL
1,1,1-trichloroethane	000071-55-6	RM15126	2009 ± 10 µg/mL
1,1,2-trichloroethane	000079-00-5	RM01175	2007 ± 10 µg/mL
trichloroethene	000079-01-6	RM00029	2010 ± 10 µg/mL
1,2-dibromo-3-chloropropane	000096-12-8	RM12895	2006 ± 10 µg/mL
1,2-dichloropropane	000078-87-5	RM12821	2008 ± 10 µg/mL
1,3-dichloropropane	000142-28-9	RM02080	2008 ± 10 µg/mL
2,2-dichloropropane	000594-20-7	RM12927	2006 ± 10 µg/mL
1,1-dichloropropene	000563-58-6	RM17865	2010 ± 10 µg/mL
cis-1,3-dichloropropene	010061-01-5	RM12891	2008 ± 10 µg/mL
trans-1,3-dichloropropene	010061-02-6	RM12254	2006 ± 10 µg/mL
hexachlorobutadiene	000087-68-3	RM09157	2001 ± 10 µg/mL
1,2,3-trichloropropane	000096-18-4	RM13082	2007 ± 10 µg/mL
naphthalene	000091-20-3	NT00970	2007 ± 10 µg/mL
benzene	000071-43-2	RM12931	2007 ± 10 µg/mL
n-butylbenzene	000104-51-8	RM03651	2010 ± 10 µg/mL
sec-butylbenzene	000135-98-8	RM10905	2008 ± 10 µg/mL
tert-butylbenzene	000098-06-6	RM14040	2008 ± 10 µg/mL
ethylbenzene	000100-41-4	RM16356	2007 ± 10 µg/mL
isopropylbenzene	000098-82-8	RM00835	2008 ± 10 µg/mL
4-isopropyltoluene	000099-87-6	RM09747	2008 ± 10 µg/mL
n-propylbenzene	000103-65-1	RM13956	2008 ± 10 µg/mL

Agilent

Certificate of Analysis

Product Number: DWM-588-1 **Lot Number:** 0006587927

styrene	000100-42-5	RM13393	2006 ± 10 µg/mL
toluene	000108-88-3	RM06650	2009 ± 10 µg/mL
1,2,4-trimethylbenzene	000095-63-6	RM06731	2009 ± 10 µg/mL
1,3,5-trimethylbenzene	000108-67-8	RM12905	2007 ± 10 µg/mL
o-xylene	000095-47-6	RM15639	2003 ± 10 µg/mL
m-xylene	000108-38-3	RM15919	2008 ± 10 µg/mL
p-xylene	000106-42-3	RM09445	2009 ± 10 µg/mL
1,4-dichlorobenzene	000106-46-7	RM12826	2006 ± 10 µg/mL
bromobenzene	000108-86-1	RM10227	2007 ± 10 µg/mL
chlorobenzene	000108-90-7	RM01874	2010 ± 10 µg/mL
2-chlorotoluene	000095-49-8	RM13774	2007 ± 10 µg/mL
4-chlorotoluene	000106-43-4	RM11750	2005 ± 10 µg/mL
1,2-dichlorobenzene	000095-50-1	RM16249	2008 ± 10 µg/mL
1,3-dichlorobenzene	000541-73-1	NT00356	2008 ± 10 µg/mL
1,2,3-trichlorobenzene	000087-61-6	RM10193	2008 ± 10 µg/mL
1,2,4-trichlorobenzene	000120-82-1	RM09454	2006 ± 10 µg/mL
bromomethane	000074-83-9	RM00064	2008 ± 10 µg/mL
chloroethane	000075-00-3	RM00065	2007 ± 10 µg/mL
chloromethane	000074-87-3	RM12571	2008 ± 10 µg/mL
dichlorodifluoromethane	000075-71-8	RM05289	2010 ± 10 µg/mL
vinyl chloride	000075-01-4	RM05458	2010 ± 10 µg/mL

Matrix: methanol (methyl alcohol)

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER

ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026

www.agilent.com/quality/

CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

ISO 17025 Cert No. AT-1937

Certificate of Analysis

Product Number: DWM-588-1 **Lot Number:** 0006587927

Storage Conditions: Store Frozen (-25° to -10°C).

Traceability:
The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:
This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:
This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:
Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:
Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

Expiration of Certification:
The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:
If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

Sample lot approver:

Monica Bourgeois
QMS Representative

ANAB ACCREDITED ISO17034 REFERENCE MATERIAL PRODUCER
ISO 17034 Cert
No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026

www.agilent.com/quality/
CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY
ISO 17025 Cert
No. AT-1937

RESTEK®
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CERTIFIED REFERENCE MATERIAL

Certificate of Analysis

ACCREDITED
ISO 17034 Accredited
Reference Material Producer
Certificate #3222.01

ACCREDITED
ISO/IEC 17025 Accredited
Testing Laboratory
Certificate #3222.02

FOR LABORATORY USE ONLY-READ SDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 30216 **Lot No.:** A0170990

Description : Vinyl Acetate Standard

Vinyl Acetate Standard 2000 µg/mL, P&T Methanol, 1mL/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : October 31, 2022 **Storage:** -20°C or colder

Handling: This product is photosensitive. **Ship:** On Ice

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)	
1	Vinyl acetate	2,006.0 µg/mL	+/- 11.7723 µg/mL	Gravimetric
	CAS # 108-05-4 (Lot RD200601)		+/- 121.0414 µg/mL	Unstressed
	Purity 99%		+/- 121.3288 µg/mL	Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

J005912
Vinyl Acetate
Solvent / Lot: p&t methanol
Prep: 6/4/2021 by PC
Exp: 10/31/2022
Location: VOA F-40

Tech Tips:
Vinyl acetate is a volatile organic ester included in the target lists of several US EPA and other methods . Under acidic conditions, esters react with alcohols to form new esters (transesterification). Methanol-based mixes containing halogenated compounds are slightly acidic, so it is important to minimize exposure of vinyl acetate to mixes of halogenated compounds in methanol. For this reason, we offer vinyl acetate in individual solution, and suggest that it be introduced into the working level calibration solution immediately before use. This will minimize problems and ensure more consistent results.

Column:
105m x 0.53mm x 3.0µm
Rtx-502.2 (cat.#10910)

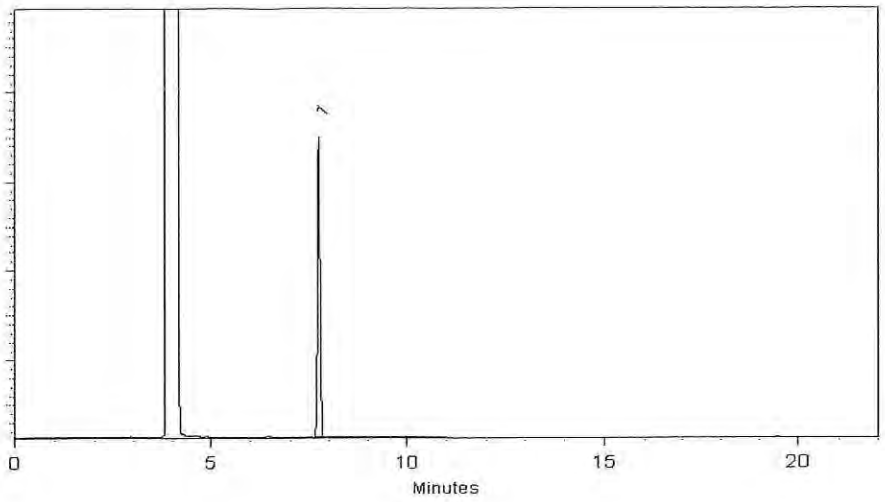
Carrier Gas:
hydrogen-constant pressure 11.0 psi.

Temp. Program:
40°C (hold 2 min.) to 240°C
@ 8°C/min. (hold 5 min.)

Inj. Temp:
200°C

Det. Temp:
250°C

Det. Type:
FID



This chromatogram represents a general set of testing conditions chosen for product acceptance. For optimal results in your lab, conditions should be adjusted for your specific instrument, method, and application.

Russ Bookhamer - Operations Technician I

Date Mixed: 05-Apr-2021 **Balance:** 1128342314

Alexis Shelow - Operations Tech I

Date Passed: 09-Apr-2021

Manufactured under Restek's ISO 9001:2015
Registered Quality System
Certificate #FM 80397

Agilent

Certificate of Analysis

Product Name: 1,2-Dichlorobenzene-d4 Standard

Product Number: STS-210-1 **Lot Issue Date:** 11-Aug-2020

Lot Number: 0006552847 **Expiration Date:** 30-Sep-2024

Description:

This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system, and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
1,2-dichlorobenzene-d4	002199-69-1	RM11038	2002 ± 10 µg/mL

Matrix: methanol (methyl alcohol)

Storage Conditions: Store Frozen (-25° to -10°C).

Traceability:

The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:

This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:

This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:

Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:

Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

Expiration of Certification:

The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:

If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

J007623

d4 1,2 Dichlorobenzene Stock
Solvent / Lot: Methanol
Prep: 7/23/2021 by PC
Exp: 9/30/2024
Location: VOA F-40

Sample lot approver:

Monica Bourgeois
QMS Representative

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER

ISO 17034 Cert
No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026

Page: 1 of 1

www.agilent.com/quality/

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

ISO 17025 Cert
No. AT-1937

o2si smart solutions®
7290B Investment Drive North Charleston, South Carolina 29417
Phone: 866.272.0932 Fax: 866.509.5146 www.o2si.com

ACCREDITED
ISO 17025 Accredited Chemical Testing Lab
Cert. No. 3031.01

Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
121020-02	425069	≤ 6 °C	P/T Methanol	1-Oct-2025	Ketones Solution, 5000 mg/L, 1 mL

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
acetone	67-64-1	99.6	196.271.4P	5024 ± 52.27	mg/L
2-butanone (MEK)	78-93-3	99.9	197.18.1P	5018 ± 72.37	mg/L
2-hexanone	591-78-6	99.7	199.7.2.1P	5002 ± 52.22	mg/L
4-methyl-2-pentanone (MIBK)	108-10-1	99.6	198.1.3P	5015 ± 72.32	mg/L

J008079
Ketones SS Stock
Solvent / Lot: P/T Methanol
Prep: 8/5/2021 by PC
Exp: 10/1/2025
Location: VOA F-40

Certified By: Melissa Workoff

Melissa Workoff
Manufacture Date 2-Oct-2020

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

Agilent

Certificate of Analysis

Product Name: Acrolein Standard

Product Number: AM-170-1 **Lot Issue Date:** 26-Jul-2021

Lot Number: 0006622911 **Expiration Date:** 30-Nov-2021

Description:
This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
acrolein	000107-02-8	RM18390	100.1 ± 0.5 µg/mL

Matrix: methanol (methyl alcohol)

Storage Conditions: Store Frozen (-25° to -10°C).

Traceability:
The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:
This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:
This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:
Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:
Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

Expiration of Certification:
The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:
If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

J009008
Acrolein SCV
Solvent / Lot: MeOH
Prep: 8/23/2021 by LH
Exp: 11/30/2021

Sample lot approver:

Monica Bourgeois
QMS Representative

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER
ISO 17034 Cert
No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026
Page: 1 of 1
www.agilent.com/quality/
CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY
ISO 17025 Cert
No. AT-1937

RESTEK®
110 Benner Circle
Bellefonte, PA 16823-8812
Tel: (800)356-1688
Fax: (814)353-1309

www.restek.com

CERTIFIED REFERENCE MATERIAL

Certificate of Analysis

ACCREDITED
ISO 17034 Accredited
Reference Material Producer
Certificate #3222.01

ACCREDITED
ISO/IEC 17025 Accredited
Testing Laboratory
Certificate #3222.02

FOR LABORATORY USE ONLY-READ SDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 30645 **Lot No.:** A0173747

Description : Acrolein Standard

Acrolein Standard 5000 µg/mL, P&T Methanol 1mL/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : September 30, 2021 **Storage:** 0°C or colder

Handling: This product is photosensitive. **Ship:** On Ice

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Acrolein	5,026.7 µg/mL	+/- 29.4993	µg/mL	Gravimetric
	CAS # 107-02-8 (Lot RD210416)		+/- 100.4390	µg/mL	Unstressed
	Purity 99%		+/- 225.2970	µg/mL	Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

J009159
Acrolein
Solvent / Lot: MeOH
Prep: 8/25/2021 by PC
Exp: 9/30/2021
Location: VOA F-40

Column:
105m x 0.53mm x 3.0µm
Rtx-502.2 (cat.#10910)

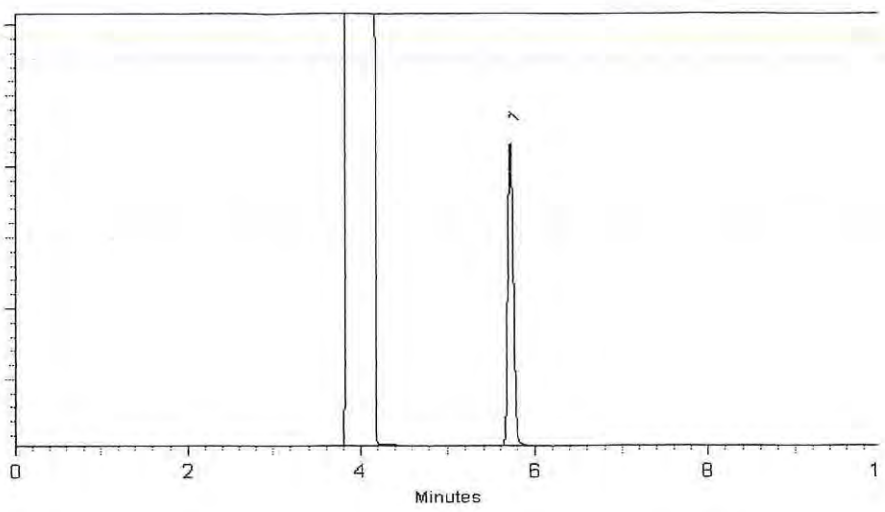
Carrier Gas:
hydrogen-constant pressure 11.0 psi.

Temp. Program:
40°C (hold 2 min.) to 240°C
@ 8°C/min. (hold 5 min.)

Inj. Temp:
200°C

Det. Temp:
250°C

Det. Type:
FID



This chromatogram represents a general set of testing conditions chosen for product acceptance. For optimal results in your lab, conditions should be adjusted for your specific instrument, method, and application.

Tom Suckar - Mix Technician

Date Mixed: 23-Jun-2021 **Balance:** B707717271

Alexis Shelow - Operations Tech I

Date Passed: 29-Jun-2021

Manufactured under Restek's ISO 9001:2015 Registered Quality System Certificate #FM 80397

HSA-62-13-14

Form I

ORGANIC ANALYSIS DATA SHEET

NWTPHg

Gasoline Range Organics (GC/MS)

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-03 G	SDG:	21I0042
Sampled:	08/31/21 11:00	Prepared:	09/09/21 15:35	File ID:	V309092123G.D
% Solids:	75.23	Preparation:	EPA 5035 (Methanol Extraction)	Analyzed:	09/09/21 20:38
Batch:	BJI0272	Sequence:	SJI0231	Initial/Final:	4.877 g Wet / 5 mL
Instrument:	NT3	Column:	RTX-VMS	Calibration:	EI00046

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
GRO	Gasoline Range Organics (Tol-Nap)	5000	5650000	D	423000	846000

SURROGATES	ADDED:(ug/L)	(ug/L)	% REC	QC LIMITS	Q
Toluene-d8	5.0000	4.95	99.1	80 - 120	
4-Bromofluorobenzene	5.0000	5.00	100	78 - 123	

Analytical Resources, Incorporated
Analytical Chemists and Consultants

DUP-1-083121

Form I

ORGANIC ANALYSIS DATA SHEET

NWTPHg

Gasoline Range Organics (GC/MS)

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-04 H	SDG:	21I0042
Sampled:	08/31/21 11:30	Prepared:	09/09/21 15:35	File ID:	V309092124G.D
% Solids:	78.49	Preparation:	EPA 5035 (Methanol Extraction)	Analyzed:	09/09/21 21:03
Batch:	BJI0272	Sequence:	SJI0231	Initial/Final:	4.066 g Wet / 5 mL
Instrument:	NT3	Column:	RTX-VMS	Calibration:	EI00046

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
GRO	Gasoline Range Organics (Tol-Nap)	5000	5160000	D	460000	920000

SURROGATES	ADDED:(ug/L)	(ug/L)	% REC	QC LIMITS	Q
Toluene-d8	5.0000	4.95	99.1	80 - 120	
4-Bromofluorobenzene	5.0000	4.73	94.6	78 - 123	

Trip Blanks

Form I

ORGANIC ANALYSIS DATA SHEET

NWTPHg

Gasoline Range Organics (GC/MS)

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Water	Laboratory ID:	21I0042-41 B	SDG:	21I0042
Sampled:	08/30/21 11:55	Prepared:	09/09/21 14:44	File ID:	V309092111G.D
% Solids:		Preparation:	EPA 5030C (Purge and Trap)	Analyzed:	09/09/21 15:12
Batch:	BJI0271	Sequence:	SJI0231	Initial/Final:	10 mL / 10 ml
Instrument:	NT3	Column:	RTX-VMS	Calibration:	EI00046

CAS NO.	COMPOUND	DILUTION	(ug/L)	Q	DL	RL
GRO	Gasoline Range Organics (Tol-Nap)	1	100	U	13.6	100

SURROGATES	ADDED:(ug/L)	(ug/L)	% REC	QC LIMITS	Q
Toluene-d8	5.0000	5.00	100	80 - 120	
4-Bromofluorobenzene	5.0000	4.95	98.9	80 - 120	

PREPARATION BATCH SUMMARY

NWTPHg

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Batch: BJI0271 Batch Matrix: Water Preparation: EPA 5030C (Purge and Trap)

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
Trip Blanks	21I0042-41	V309092111G.D	09/09/21 14:44	
Blank	BJI0271-BLK1	V309092110G.D	09/09/21 08:44	
LCS	BJI0271-BS1	V309092105GLCS.D	09/09/21 08:44	
LCS Dup	BJI0271-BSD1	V309092107G.D	09/09/21 08:44	

PREPARATION BATCH SUMMARY

NWTPHg

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Batch: BJI0272 Batch Matrix: Solid Preparation: EPA 5035 (Methanol Extraction)

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
HSA-62-13-14	21I0042-03	V309092123G.D	09/09/21 15:35	
DUP-1-083121	21I0042-04	V309092124G.D	09/09/21 15:35	
Blank	BJI0272-BLK1	V309092110GA.D	09/09/21 08:35	
LCS	BJI0272-BS1	V309092105GLCSA.D	09/09/21 08:35	
LCS Dup	BJI0272-BSD1	V309092107GA.D	09/09/21 08:35	

Form I

METHOD BLANK DATA SHEET

NWTPHg

Blank

Laboratory:	Analytical Resources, Inc.			SDG:	21I0042
Client:	GeoEngineers			Project:	South State Street PRDI
Matrix:	Water	Laboratory ID:	BJI0271-BLK1	File ID:	V309092110G.D
Sampled:	N/A	Prepared:	09/09/21 08:44	Analyzed:	09/09/21 14:13
Solids:		Preparation:	EPA 5030C (Purge and Trap)	Initial/Final:	10 mL / 10 ml
Batch:	BJI0271	Sequence:	SJI0231	Calibration:	EI00046
Instrument:	NT3	Column:	RTX-VMS		

CAS NO.	COMPOUND	DILUTION	CONC. (ug/L)	Q	DL	RL
GRO	Gasoline Range Organics (Tol-Nap)	1	100	U	13.6	100

SURROGATES	ADDED (ug/L)	CONC. (ug/L)	% REC	QC LIMITS	Q
Toluene-d8	5.0000	5.08	102	80 - 120	
4-Bromofluorobenzene	5.0000	4.87	97.3	80 - 120	

Form I

METHOD BLANK DATA SHEET

NWTPHg

Blank

Laboratory:	Analytical Resources, Inc.			SDG:	21I0042
Client:	GeoEngineers			Project:	South State Street PRDI
Matrix:	Solid	Laboratory ID:	BJI0272-BLK1	File ID:	V309092110GA.D
Sampled:	N/A	Prepared:	09/09/21 08:35	Analyzed:	09/09/21 14:13
Solids:		Preparation:	EPA 5035 (Methanol Extract	Initial/Final:	5 g / 5 mL
Batch:	BJI0272	Sequence:	SJI0231	Calibration:	EI00046
Instrument:	NT3	Column:	RTX-VMS		

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg wet)	Q	DL	RL
GRO	Gasoline Range Organics (Tol-Nap)	50	5000	U	2500	5000

SURROGATES	ADDED (ug/L)	CONC. (ug/L)	% REC	QC LIMITS	Q
Toluene-d8	5.0000	5.08	102	80 - 120	
4-Bromofluorobenzene	5.0000	4.87	97.3	78 - 123	

LCS / LCS DUPLICATE RECOVERY

NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Water	Analyzed:	09/09/21 12:07
Batch:	BJI0271	Laboratory ID:	BJI0271-BS1
Preparation:	EPA 5030C (Purge and Trap)	Sequence Name:	LCS
Initial/Final:	10 mL / 10 ml		

COMPOUND	SPIKE ADDED (ug/L)	LCS CONCENTRATION (ug/L)	Q	LCS % REC. #	QC LIMITS REC.
Gasoline Range Organics (Tol-Nap)	1000	1110		111	72 - 128

* Indicates values outside of QC limits

COMPOUND	SPIKE ADDED (ug/L)	LCSD CONCENTRATION (ug/L)	Q	LCSD % REC. #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Gasoline Range Organics (Tol-Nap)	1000	1050		105	5.98	30	72 - 128

* Indicates values outside of QC limits

LCS / LCS DUPLICATE RECOVERY

NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/09/21 12:07
Batch:	BJI0272	Laboratory ID:	BJI0272-BS1
Preparation:	EPA 5035 (Methanol Extraction)	Sequence Name:	LCS
Initial/Final:	5 g / 5 mL		

COMPOUND	SPIKE ADDED (ug/kg wet)	LCS CONCENTRATION (ug/kg wet)	Q	LCS % REC. #	QC LIMITS REC.
Gasoline Range Organics (Tol-Nap)	50000	55500		111	70 - 121

* Indicates values outside of QC limits

COMPOUND	SPIKE ADDED (ug/kg wet)	LCSD CONCENTRATION (ug/kg wet)	Q	LCSD % REC. #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Gasoline Range Organics (Tol-Nap)	50000	52300		105	5.98	30	70 - 121

* Indicates values outside of QC limits

Analytical Resources, Incorporated
Analytical Chemists and Consultants

MASS SPECTROMETER
INSTRUMENT PERFORMANCE CHECK
NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Lab File ID:	V308272103G.D	Injection Date:	08/27/21
Instrument ID:	NT3	Injection Time:	08:59
Sequence:	SJH0422	Lab Sample ID:	SJH0422-TUN1

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
95	50 - 200% of 174	130	PASS
96	5 - 9% of 95	6.76	PASS
173	Less than 2% of 174	0.632	PASS
174	50 - 200% of 95	76.7	PASS
175	5 - 9% of 174	7.77	PASS
176	95 - 105% of 174	98.1	PASS
177	5 - 10% of 176	5.78	PASS

Client Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
Cal Standard	SJH0422-CAL9	V308272116G.D	08/27/2021	14:50
Cal Standard	SJH0422-CALA	V308272117G.D	08/27/2021	15:15
Cal Standard	SJH0422-CALB	V308272118G.D	08/27/2021	15:40
Cal Standard	SJH0422-CALC	V308272119G.D	08/27/2021	16:05
Cal Standard	SJH0422-CALD	V308272120G.D	08/27/2021	16:30
Cal Standard	SJH0422-CALE	V308272121G.D	08/27/2021	16:56
Initial Cal Blank	SJH0422-ICB1	V308272122G.D	08/27/2021	17:21
Secondary Cal Check	SJH0422-SCV1	V308272123G.D	08/27/2021	17:46

INITIAL CALIBRATION DATA

NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00006	Instrument:	NT3
Calibration Date:	09/02/2021	Column (1):	RTX-VMS

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
		RRF		**RRF**		**RRF**		**RRF**		**RRF**		**RRF**
Toluene-d8	5	1.26304	5	1.287477	5	1.224142	5	1.240047	5	1.268936	5	1.26037
4-Bromofluorobenzene	5	0.4298449	5	0.4285543	5	0.4239711	5	0.4261065	5	0.4073753	5	0.4252224

INITIAL CALIBRATION DATA

NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00006	Instrument:	NT3
Calibration Date:	09/02/2021	Column (1):	RTX-VMS

Compound	Level 07		Level 08		Level 09		Level 10		Level 11		Level 12	
		RRF		RRF		RRF		RRF		RRF		RRF
Gasoline Range Organics (Tol-Nap)					100	48057.32	250	43985.08	500	42470.2	1000	49343.3
Toluene-d8	5	1.26119	5	1.233454								
4-Bromofluorobenzene	5	0.4226947	5	0.4078637								

INITIAL CALIBRATION DATA

NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00006	Instrument:	NT3
Calibration Date:	09/02/2021	Column (1):	RTX-VMS

Compound	Level 13		Level 14		Level 15		Level 16		Level 17		Level 18	
		RRF		RRF		RRF		RRF		RRF		RRF
Gasoline Range Organics (Tol-Nap)	2500	52133.44	5000	45536.62								

INITIAL CALIBRATION DATA

NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00006	Instrument:	NT3
Calibration Date:	09/02/2021	Column (1):	RTX-VMS

COMPOUND	Mean RRF	RRF RSD	Linear COD	Quad COD	Limit Type & Limit	Q
Gasoline Range Organics (Tol-Nap)	46920.99	7.7			RSD (15)	
Toluene-d8	1.254832	1.7			RSD (15)	
4-Bromofluorobenzene	0.4214541	2.1			RSD (15)	

INITIAL CALIBRATION DATA

NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00046	Instrument:	NT3
Calibration Date:	09/08/2021	Column (1):	RTX-VMS

Comments: New ICAL for IS basis and changing surrogate response after instrument maintenance. Gasoline calibration from 8/27 still meets.

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
		RRF		**RRF**		**RRF**		**RRF**		**RRF**		**RRF**
Toluene-d8	5	1.162766	5	1.136253	5	1.167996	5	1.164757	5	1.138768	5	1.145011
4-Bromofluorobenzene	5	0.3860509	5	0.4044195	5	0.4034493	5	0.3976827	5	0.3933258	5	0.3869949

INITIAL CALIBRATION DATA

NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00046	Instrument:	NT3
Calibration Date:	09/08/2021	Column (1):	RTX-VMS

Comments: New ICAL for IS basis and changing surrogate response after instrument maintenance. Gasoline calibration from 8/27 still meets.

Compound	Level 07		Level 08		Level 09		Level 10		Level 11		Level 12	
		RRF		RRF		RRF		RRF		RRF		RRF
Gasoline Range Organics (Tol-Nap)					100	48057.32	250	43985.08	500	42470.2	1000	49343.3
Toluene-d8	5	1.142947	5	1.172883								
4-Bromofluorobenzene	5	0.4011844	5	0.3988782								

INITIAL CALIBRATION DATA

NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00046	Instrument:	NT3
Calibration Date:	09/08/2021	Column (1):	RTX-VMS

Comments: New ICAL for IS basis and changing surrogate response after instrument maintenance. Gasoline calibration from 8/27 still meets.

Compound	Level 13		Level 14		Level 15		Level 16		Level 17		Level 18	
		RRF		RRF		RRF		RRF		RRF		RRF
Gasoline Range Organics (Tol-Nap)	2500	52133.44	5000	45536.62								

INITIAL CALIBRATION DATA

NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00046	Instrument:	NT3
Calibration Date:	09/08/2021	Column (1):	RTX-VMS
Comments:	New ICAL for IS basis and changing surrogate response after instrument maintenance. Gasoline calibration from 8/27 still meets.		

COMPOUND	Mean RRF	RRF RSD	Linear COD	Quad COD	Limit Type & Limit	Q
Gasoline Range Organics (Tol-Nap)	46920.99	7.7			RSD (15)	
Toluene-d8	1.153923	1.3			RSD (15)	
4-Bromofluorobenzene	0.3964982	1.8			RSD (15)	

SECOND-SOURCE CALIBRATION VERIFICATION

NWTPHg

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EI00006
Laboratory ID: SJH0422-SCV1
Sequence: SJH0422
Standard ID: J009399

ANALYTE	EXPECTED (ug/L)	FOUND (ug/L)	% DRIFT	QC LIMIT
Gasoline Range Organics (Tol-Nap)	1000.0	968	-3.2	20.00
Toluene-d8	5.0000	4.89	-2.2	
4-Bromofluorobenzene	5.0000	5.09	1.7	

* Values outside of QC limits

CONTINUING CALIBRATION CHECK
NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT3	Calibration:	EI00046
Lab File ID:	V309092126G.D	Calibration Date:	09/08/2021
Sequence:	SJI0231	Injection Date:	09/09/21
Lab Sample ID:	SJI0231-CCV1	Injection Time:	21:55
Sequence Name:	CCV		

		CONC. (ug/L)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Gasoline Range Organics (Tol-Nap)	A	1000.0	1060	46920.99	49702.59		5.9	+/-20
Toluene-d8	A	5.0000	5.04	1.1539230	1.1628020		0.8	
4-Bromofluorobenzene	A	5.0000	4.98	0.3964982	0.3949372		-0.4	

* Values outside of QC limits

INITIAL CALIBRATION CHECK

NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT3	Calibration:	EI00046
Lab File ID:	V309092105G.D	Calibration Date:	09/08/2021
Sequence:	SJI0231	Injection Date:	09/09/21
Lab Sample ID:	SJI0231-ICV1	Injection Time:	12:07
Sequence Name:	ICV		

		CONC. (ug/L)		RESPONSE FACTOR			% DRIFT/DIFF	
COMPOUND	TYPE	STD	ICV	ICAL	ICV	MIN	ICV	LIMIT
Gasoline Range Organics (Tol-Nap)	A	1000.0	1110	46920.9900	52092.8100		11.0	+/-20
Toluene-d8	A	5.0000	4.97	1.1539230	1.1469560		-0.6	
4-Bromofluorobenzene	A	5.0000	4.99	0.3964982	0.3955263		-0.2	

* Values outside of QC limits

ANALYSIS BATCH (SEQUENCE) SUMMARY

NWTPHg

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJH0422
Instrument: NT3
Calibration: EI00006

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Gas 0.1	SJH0422-CAL9	V308272116G.D	NA	08/27/21 14:50
Gas 0.25	SJH0422-CALA	V308272117G.D	NA	08/27/21 15:15
Gas 0.5	SJH0422-CALB	V308272118G.D	NA	08/27/21 15:40
Gas 1	SJH0422-CALC	V308272119G.D	NA	08/27/21 16:05
Gas 2.5	SJH0422-CALD	V308272120G.D	NA	08/27/21 16:30
Gas 5	SJH0422-CALE	V308272121G.D	NA	08/27/21 16:56
Initial Cal Blank	SJH0422-ICB1	V308272122G.D	NA	08/27/21 17:21
Gas SCV 1	SJH0422-SCV1	V308272123G.D	NA	08/27/21 17:46

Analytical Resources, Incorporated
Analytical Chemists and Consultants

ANALYSIS BATCH (SEQUENCE) SUMMARY

NWTPHg

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Sequence:	SJI0229	Instrument:	NT3
		Calibration:	EI00046

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
MS Tune	SJI0229-TUN1	V309082108G.D	NA	09/08/21 12:24

ANALYSIS BATCH (SEQUENCE) SUMMARY

NWTPHg

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0231
Instrument: NT3
Calibration: EI00046

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
BFB	SJI0231-TUN1	V309092104G.D	NA	09/09/21 11:22
ICV	SJI0231-ICV1	V309092105G.D	NA	09/09/21 12:07
LCS	BJI0271-BS1	V309092105GLCS.D	Water	09/09/21 12:07
LCS	BJI0272-BS1	V309092105GLCSA.D	Solid	09/09/21 12:07
LCS Dup	BJI0271-BSD1	V309092107G.D	Water	09/09/21 12:58
LCS Dup	BJI0272-BSD1	V309092107GA.D	Solid	09/09/21 12:58
Blank	BJI0271-BLK1	V309092110G.D	Water	09/09/21 14:13
Blank	BJI0272-BLK1	V309092110GA.D	Solid	09/09/21 14:13
Trip Blanks	21I0042-41	V309092111G.D	Water	09/09/21 15:12
HSA-62-13-14	21I0042-03	V309092123G.D	Solid	09/09/21 20:38
DUP-1-083121	21I0042-04	V309092124G.D	Solid	09/09/21 21:03
CCV	SJI0231-CCV1	V309092126G.D	NA	09/09/21 21:55

SURROGATE RECOVERY SUMMARY

NWTPHg

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0231
Instrument: NT3
Calibration: EI00046
Calibration Date: 09/08/2021

Surrogate Compound	Spike Level ug/L	% Recovery	Recovery Limits	Q
BJI0271-BS1 (Water)	Lab File ID: V309092105GLCS.D		Analyzed: 09/09/21 12:07	
Toluene-d8	5.0000	99.4	80 - 120	
4-Bromofluorobenzene	5.0000	99.8	80 - 120	
BJI0272-BS1 (Solid)	Lab File ID: V309092105GLCSA.D		Analyzed: 09/09/21 12:07	
Toluene-d8	5.0000	99.4	80 - 120	
4-Bromofluorobenzene	5.0000	99.8	78 - 123	
SJI0231-ICV1 (Water)	Lab File ID: V309092105G.D		Analyzed: 09/09/21 12:07	
Toluene-d8	5.0000	99.4	0 - 200	
4-Bromofluorobenzene	5.0000	99.8	0 - 200	
BJI0271-BSD1 (Water)	Lab File ID: V309092107G.D		Analyzed: 09/09/21 12:58	
Toluene-d8	5.0000	96.3	80 - 120	
4-Bromofluorobenzene	5.0000	102	80 - 120	
BJI0272-BSD1 (Solid)	Lab File ID: V309092107GA.D		Analyzed: 09/09/21 12:58	
Toluene-d8	5.0000	96.3	80 - 120	
4-Bromofluorobenzene	5.0000	102	78 - 123	
BJI0271-BLK1 (Water)	Lab File ID: V309092110G.D		Analyzed: 09/09/21 14:13	
Toluene-d8	5.0000	102	80 - 120	
4-Bromofluorobenzene	5.0000	97.3	80 - 120	
BJI0272-BLK1 (Solid)	Lab File ID: V309092110GA.D		Analyzed: 09/09/21 14:13	
Toluene-d8	5.0000	102	80 - 120	
4-Bromofluorobenzene	5.0000	97.3	78 - 123	
21I0042-41 (Water)	Lab File ID: V309092111G.D		Analyzed: 09/09/21 15:12	
Toluene-d8	5.0000	100	80 - 120	
4-Bromofluorobenzene	5.0000	98.9	80 - 120	
21I0042-03 (Solid)	Lab File ID: V309092123G.D		Analyzed: 09/09/21 20:38	
Toluene-d8	5.0000	99.1	80 - 120	
4-Bromofluorobenzene	5.0000	100	78 - 123	
21I0042-04 (Solid)	Lab File ID: V309092124G.D		Analyzed: 09/09/21 21:03	
Toluene-d8	5.0000	99.1	80 - 120	
4-Bromofluorobenzene	5.0000	94.6	78 - 123	

SURROGATE RECOVERY SUMMARY

NWTPHg

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0231
Instrument: NT3
Calibration: EI00046
Calibration Date: 09/08/2021

Surrogate Compound	Spike Level ug/L	% Recovery	Recovery Limits	Q
SJI0231-CCV1 (Water)	Lab File ID: V309092126G.D		Analyzed: 09/09/21 21:55	
Toluene-d8	5.0000	101	0 - 200	
4-Bromofluorobenzene	5.0000	99.6	0 - 200	

INTERNAL STANDARD AREA AND RT SUMMARY

NWTPHg

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0231
Instrument: NT3
Calibration: EI00046

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
LCS (BJI0271-BS1)		(Water)	Lab File ID: V309092105GLCS.D				Analyzed: 09/09/21 12:07		
Pentafluorobenzene	272787	5.139	272787	5.139	100	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	405839	7.573	405839	7.573	100	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	451318	5.522	451318	5.522	100	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	230538	9.258	230538	9.258	100	50 - 200	0.000	+/-0.50	
LCS (BJI0272-BS1)		(Solid)	Lab File ID: V309092105GLCSA.D				Analyzed: 09/09/21 12:07		
Pentafluorobenzene	272787	5.139	272787	5.139	100	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	405839	7.573	405839	7.573	100	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	451318	5.522	451318	5.522	100	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	230538	9.258	230538	9.258	100	50 - 200	0.000	+/-0.50	
Initial Cal Check (SJI0231-ICV1)		(Water)	Lab File ID: V309092105G.D				Analyzed: 09/09/21 12:07		
Pentafluorobenzene	272787	5.139	272787	5.139	100	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	405839	7.573	405839	7.573	100	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	451318	5.522	451318	5.522	100	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	230538	9.258	230538	9.258	100	50 - 200	0.000	+/-0.50	
LCS Dup (BJI0271-BSD1)		(Water)	Lab File ID: V309092107G.D				Analyzed: 09/09/21 12:58		
Pentafluorobenzene	283496	5.139	272787	5.139	104	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	416520	7.574	405839	7.573	103	50 - 200	0.001	+/-0.50	
1,4-Difluorobenzene	464894	5.522	451318	5.522	103	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	239525	9.259	230538	9.258	104	50 - 200	0.001	+/-0.50	
LCS Dup (BJI0272-BSD1)		(Solid)	Lab File ID: V309092107GA.D				Analyzed: 09/09/21 12:58		
Pentafluorobenzene	283496	5.139	272787	5.139	104	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	416520	7.574	405839	7.573	103	50 - 200	0.001	+/-0.50	
1,4-Difluorobenzene	464894	5.522	451318	5.522	103	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	239525	9.259	230538	9.258	104	50 - 200	0.001	+/-0.50	
Blank (BJI0271-BLK1)		(Water)	Lab File ID: V309092110G.D				Analyzed: 09/09/21 14:13		
Pentafluorobenzene	275932	5.139	272787	5.139	101	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	399977	7.573	405839	7.573	99	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	434789	5.521	451318	5.522	96	50 - 200	-0.001	+/-0.50	
1,4-Dichlorobenzene-d4	226468	9.258	230538	9.258	98	50 - 200	0.000	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

NWTPHg

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0231
Instrument: NT3
Calibration: EI00046

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
Blank (BJI0272-BLK1)		(Solid)		Lab File ID: V309092110GA.D				Analyzed: 09/09/21 14:13	
Pentafluorobenzene	275932	5.139	272787	5.139	101	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	399977	7.573	405839	7.573	99	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	434789	5.521	451318	5.522	96	50 - 200	-0.001	+/-0.50	
1,4-Dichlorobenzene-d4	226468	9.258	230538	9.258	98	50 - 200	0.000	+/-0.50	
Trip Blanks (21I0042-41)		(Water)		Lab File ID: V309092111G.D				Analyzed: 09/09/21 15:12	
Pentafluorobenzene	278620	5.139	272787	5.139	102	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	412874	7.578	405839	7.573	102	50 - 200	0.005	+/-0.50	
1,4-Difluorobenzene	440422	5.521	451318	5.522	98	50 - 200	-0.001	+/-0.50	
1,4-Dichlorobenzene-d4	225344	9.258	230538	9.258	98	50 - 200	0.000	+/-0.50	
HSA-62-13-14 (21I0042-03)		(Solid)		Lab File ID: V309092123G.D				Analyzed: 09/09/21 20:38	
Pentafluorobenzene	267666	5.138	272787	5.139	98	50 - 200	-0.001	+/-0.50	
Chlorobenzene-d5	399598	7.573	405839	7.573	98	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	427653	5.526	451318	5.522	95	50 - 200	0.004	+/-0.50	
1,4-Dichlorobenzene-d4	229997	9.258	230538	9.258	100	50 - 200	0.000	+/-0.50	
DUP-1-083121 (21I0042-04)		(Solid)		Lab File ID: V309092124G.D				Analyzed: 09/09/21 21:03	
Pentafluorobenzene	294875	5.134	272787	5.139	108	50 - 200	-0.005	+/-0.50	
Chlorobenzene-d5	418070	7.573	405839	7.573	103	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	453698	5.522	451318	5.522	101	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	237370	9.258	230538	9.258	103	50 - 200	0.000	+/-0.50	

HOLDING TIME SUMMARY

Analysis: NWTPHg

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
HSA-62-13-14 21I0042-03	08/31/21 11:00	09/02/21 10:52	09/09/21 15:35	9	14	09/09/21 20:38	9	14	
DUP-1-083121 21I0042-04	08/31/21 11:30	09/02/21 10:52	09/09/21 15:35	9	14	09/09/21 21:03	9	14	
Trip Blanks 21I0042-41	08/30/21 11:55	09/02/21 10:52	09/09/21 14:44	10	14	09/09/21 15:12	10	14	

* Indicates hold time exceedance.

METHOD DETECTION AND REPORTING LIMITS

NWTPHg

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Solid
Instrument: NT3

Analyte	MDL	RL	Units
Gasoline Range Organics (Tol-Nap)	2500	5000	ug/kg

METHOD DETECTION AND REPORTING LIMITS

NWTPHg

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Water
Instrument: NT3

Analyte	MDL	RL	Units
Gasoline Range Organics (Tol-Nap)	13.6	100	ug/L

o2si smart solutions®

Quality System Audited & Registered by NSF-ISR to ISO 9001:2008

2030 Savage Road
Charleston, South Carolina 29407
Phone: 866.272.0932
Fax: 866.509.5146
www.o2si.com

ACCREDITED

ISO 17025 Accredited Chemical Testing Lab
Cert. No. 3031.01

Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
120002-01 -5PAK	354941	≤ -10 Degrees C	P/T Methanol	1-Sep-2021	8260B Surrogate Solution, 2,000 mg/L, 5 x 1 ml

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
4-bromofluorobenzene (BFB)	460-00-4	99.5	135.7.1P	2036 +/- 7.1	mg/L
dibromofluoromethane	1868-53-7	99.4	136.282.7P	2025 +/- 7.34	mg/L
1,2-dichloroethane-d_4	17060-07-0	99.5	138.271.2P	2023 +/- 12.33	mg/L
toluene-d_8	2037-26-5	99.9	137.120.3.2P	2018 +/- 7.31	mg/L

G008020

8260B Surrogate Solution
Solvent / Lot: Methanol
Prep: 9/5/2018 by PC
Exp: 9/1/2021
Location:

Certified By: _____

Kara Catron
Manufacture Date 28-Aug-2018

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.
The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

ACCREDITED
Reference Materials Producer
Cert #2495.01

SPEXertificate®
Certificate of Reference Material

ilac-MRA ACCREDITED
Chemical Testing
Cert #2495.02

Catalog Number: GAS-20 **Lot No.** TS180521004

Description: BTEX Characterized Gasoline Standard

Matrix: Methanol (Purge & Trap Grade)

Ship Date: July 22, 2020
Expiration Date: July 22, 2023

This **SPEXOrganics®** Certified Reference Material, CRM, is intended primarily for use as a calibration standard or quality control standard for organic chromatography instrumentation such as GC, GC-MS, LC, and LC-MS. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Compounds:

Compound	CAS #	Labeled	Purity	Certified†	Uncertainty
Regular Unleaded Gas-87octane	86290-81-5	20 mg/mL	100%	20.0 mg/mL	± 0.72 mg/mL

I006737
Gas 20 Primary
Solvent / Lot: Methanol
Prep: 8/3/2020 by PC
Exp: 7/22/2023
Location: VOA F-40

* - Isomer ratios (when applicable) are an uncertified parameter.

Final Solution Verification:

Final solution integrity verified by Gas Chromatography/Mass Spectrometry. The mass spectrum of each compound was confirmed against the NIST mass spectral database.

† Certified concentration based on gravimetric weights and corrected for the purity of the compound(s) used to prepare the standard. Analytical balance calibration is verified daily with C1 weight set #23-190006 which is registered with Atlantic Scale, and traceable to NIST and NJ Division of Weights and Measures.

This CRM is guaranteed stable and accurate to within the uncertainty listed for the certified value. This includes uncertainty components due to preparation, homogeneity, short term and long term stability. During the stated period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution. For further information, contact the Sales Support Department at crmsales@spexcsp.com.

Date of Certification: July 22, 2020

Certifying Officer: Shannon Mace
Shannon Macieira, Operations Manager

Report of Certification

Catalog Number: GAS-20 **Lot No.** TS180521004

Description: BTEX Characterized Gasoline Standard

Matrix: Methanol (Purge & Trap Grade)

Ship Date: July 22, 2020

Expiration Date: July 22, 2023

This Certified Reference Material (CRM) has been prepared and certified under an ISO 9001 (certified by DQS) and ISO 17025 (accredited by A2LA), and ISO 17034 (accredited by A2LA) quality system consistent with the following standards:

- ISO 9001: Quality management systems - Requirements
- ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories
- ISO 17034: General requirements for the competence of reference material producers
- ISO Guide 30: Reference Materials - Selected terms and definitions
- ISO Guide 31: Reference Materials - Contents of certificates and lables
- ISO Guide 35: Refernece Materials - General and Statistical principals for certification
- Guide to the Expression of Uncertainty in Measurement, 2008
- EURACHEM/CITAC Guide: Qualifying Uncertainty in Analytical Measurement - Third Edition
- NIST Technical Note 1297

Storage Requirements:

To ensure the stability of the product once it arrives in your laboratory, please store this product in ambient conditions (18°C to 27°C). Note: Shipping conditions may differ from storage conditions. The EXPIRATION DATE is calculated from the SHIPPED DATE using our stability data and is applicable only if the product is stored under the laboratory specified conditions.

Instructions for Use:

Let material come to room temperature before use. Check for precipitate and if necessary sonicate for one minute. If compounds do not dissolve after one minute then sonicate further until the product is dissolved. A clear appearance is acceptable. The minimum recommended amount that should be removed from this vial is 5µL with a 25µL gas tight syringe. All solutions should be thoroughly mixed, by shaking, prior to use. All surfaces that come in contact with the solution must be thoroughly cleaned prior to use. Dilutions should be performed only with Class A volumetric glassware.

Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For assistance, please contact sales support at crmsales@spexcsp.com.

Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, and analytical instrumentation have been qualified prior to use. The highest purity solvents and Class A / calibrated volumetrics have been used in all preparations.

Homogeneity:

The homogeneity of this CRM has been confirmed by procedures consistent with ISO 17025, ISO 17034, and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed to prove homogeneity in accordance with our internal procedure 4300-HOMOGEN-1A. This is consistent with the intended use of this CRM. The Degree of Homogeneity, as expressed as maximum between-bo ttle variation, is 1.2%

Statistical Estimator and Confidence Limits:

The Certified value 'X' as listed on the reverse of this document is at the 95% level of confidence and can be expressed as:

- $X = x \pm U$ where X=certified value, U=expanded uncertainty, x=property value
- $U = ku_c$ where k=2 is the coverage factor at the 95% confidence level
- u_c = combined standard uncertainty obtained by combining the individual compound standard uncertainty components u_i where $u_c=\sqrt{\sum u_i^2}$

Legal Notice:

SPEX CertiPrep Certified Reference Materials are not for any cosmetic, drug, or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep of any kind whatsoever, whether based on breech of warranty, alleged negligence, or otherwise, with respect to this Reference Material shall be greater than the purchase price. In no event shall SPEX CertiPrep be liable for any loss of profits or any incidental, special, or consequential damages.

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Absolute Standards, Inc.
800-368-1131
www.absolutestandards.com

Certified Reference Material CRM

ANAB ISO 17034 Accredited
AR-1539 Certificate Number
https://Absolutestandards.com

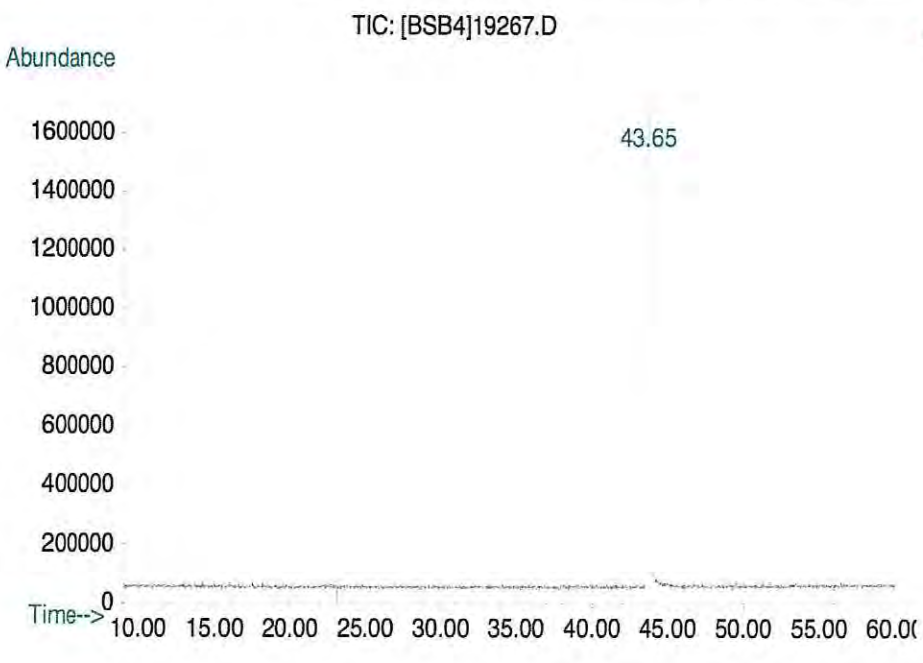
CERTIFIED WEIGHT REPORT

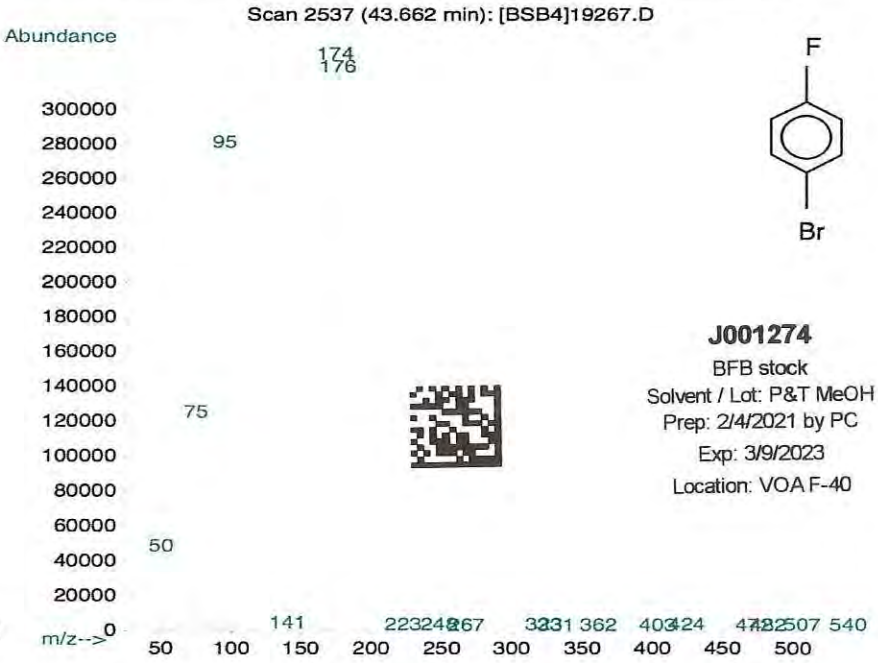
Part Number:	**19267**	**Solvent(s):**	**Lot#**
Lot Number:	030918	Methanol	DS435
Description:	p-Bromofluorobenzene		
	EPA Method 502/524 Surrogate Standard #2		
Expiration Date:	030923		
Recommended Storage:	Refrigerate (4 °C)		
Nominal Concentration (µg/mL):	2000		
NIST Test ID#:	2506734D	5E-05 Balance Uncertainty	
Weight(s) shown below were combined and diluted to (mL):	100.0	0.001 Flask Uncertainty	

	030918
Formulated By: Jason Criscio	DATE
	030918
Reviewed By: Pedro L. Rentas	DATE

Compound	RM#	Lot Number	Nominal Conc (µg/mL)	Purity (%)	Uncertainty Purity	Target Weight(g)	Actual Weight(g)	Actual Conc (µg/mL)	Expanded Uncertainty (+/-) (µg/mL)	SDS Information (Solvent Safety Info. On Attached pg.) CAS#	OSHA PEL (TWA)	LD50
1. p-Bromofluorobenzene	48	01127COV	2000	99	0.2	0.20204	0.20234	2002.9	8.2	460-00-4	N/A	orl-rat 2700mg/kg

Method: GC6MSD-1: **Detector:** Mass Selective Detector. **Column:** Vocol (60m X 0.25mm ID X 1.5µm film thickness). **Oven Profile:** Temp. 1 = 35°C (Time1=10min.), Temp. 2 = 200°C (Time2=8.75 min.), Rate = 4°C/min., Injector Temp.= 200°C, Detector Temp. = 220°C. **Analyst:** Candice Warren.





J001274
BFB stock
Solvent / Lot: P&T MeOH
Prep: 2/4/2021 by PC
Exp: 3/9/2023
Location: VOA F-40

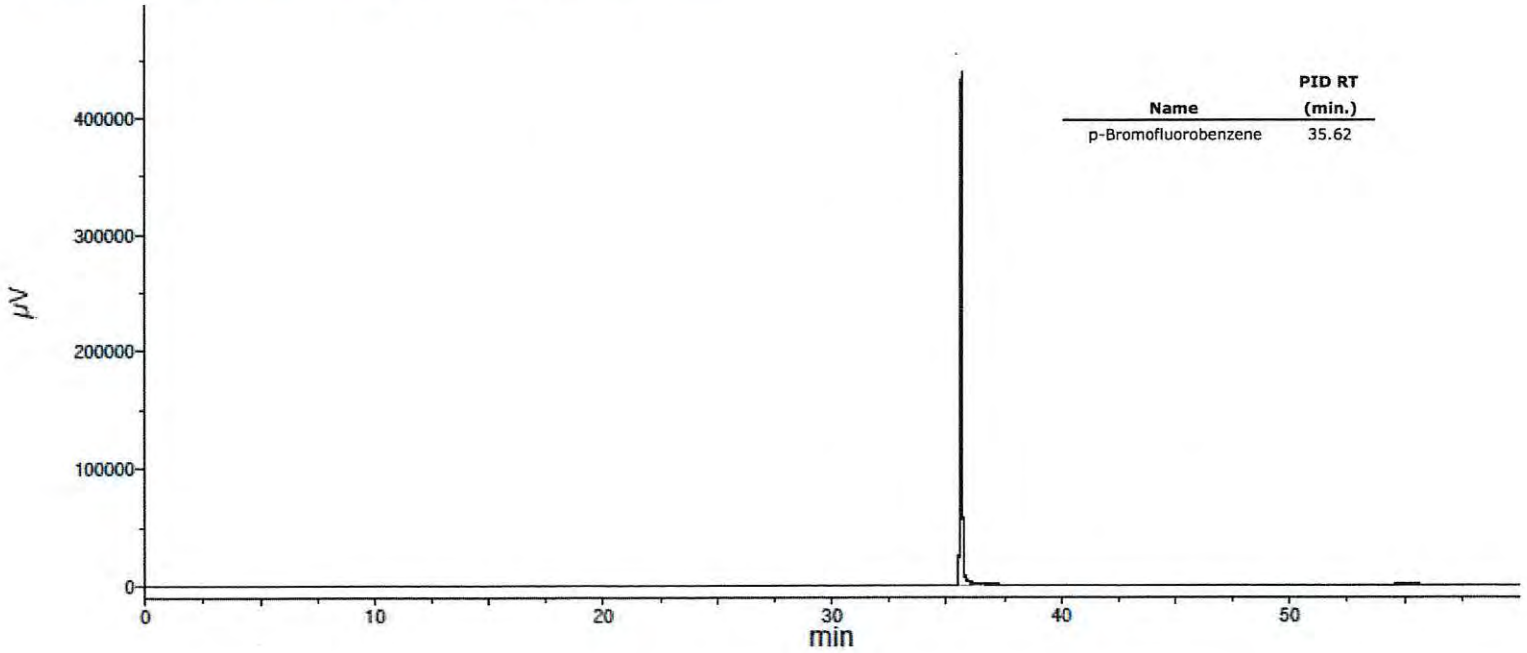
- **The certified value is the concentration calculated from gravimetric and volumetric measurements unless otherwise stated.**
- **Standards are prepared gravimetrically using balances that are calibrated with weights traceable to NIST (see above).**
- **Standards are certifed (+/-) 0.5% of the stated value, unless otherwise stated.**
- **All Standards, after opening ampule, should be stored with caps tight and under appropriate laboratory conditions.**
- **Uncertainty Reference: Taylor, B.N. and Kuyat, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Result," NIST Technical Note 1297, U.S. Government Printing Office, Washington, DC, (1994).**

Run 37, "P19267 L030918 [2000µg/mL in MeOH]"

Run Length: 60.00 min, 36000 points at 10 points/second.
Created: Mon, Mar 12, 2018 at 10:30:10 AM.
Sampled: Sequence "030818-GC1", Method "GC1-M7".
Analyzed using Method "GC1-M7".

Comments

GC1-M7 Analysis by Candice Warren
Column ID SPB-Vocol 105 meter X 0.53mm X 3.0µm film thickness
Flow rates: Total flow=150mL/min., Helium (carrier)=10mL/min.,
Helium(make-up)=40mL/min., Hydogen(make-up)=100mL/min.
Oven Profile: Temp. 1=35°C (Time 1=10 min.), Temp 2=200°C (Time 2=8.75 min.),
Rate = 4°C/min., Total run time=60 min. Injector temp.=200°C, FID Temp.=200°C.
ELCD Signal = Edaq Channel 1 PID Signal = Edaq Channel 2
Standard injection = 0.5µL, Range=4 Purge Valve = 8 min.



CERTIFIED WEIGHT REPORT

Part Number: 51047
Lot Number: 060420
Description: Unleaded Gasoline 87 Octane - ETOH

Solvent(s): **Lot#**
Methanol DX932-US

Expiration Date: 060425
Recommended Storage: Refrigerate (4 °C)
Nominal Concentration (µg/mL): 20000
NIST Test ID#: 23060

Weight(s) shown below were combined and diluted to (mL): 50.0 0.007 Flask Uncertainty

5E-05 Balance Uncertainty

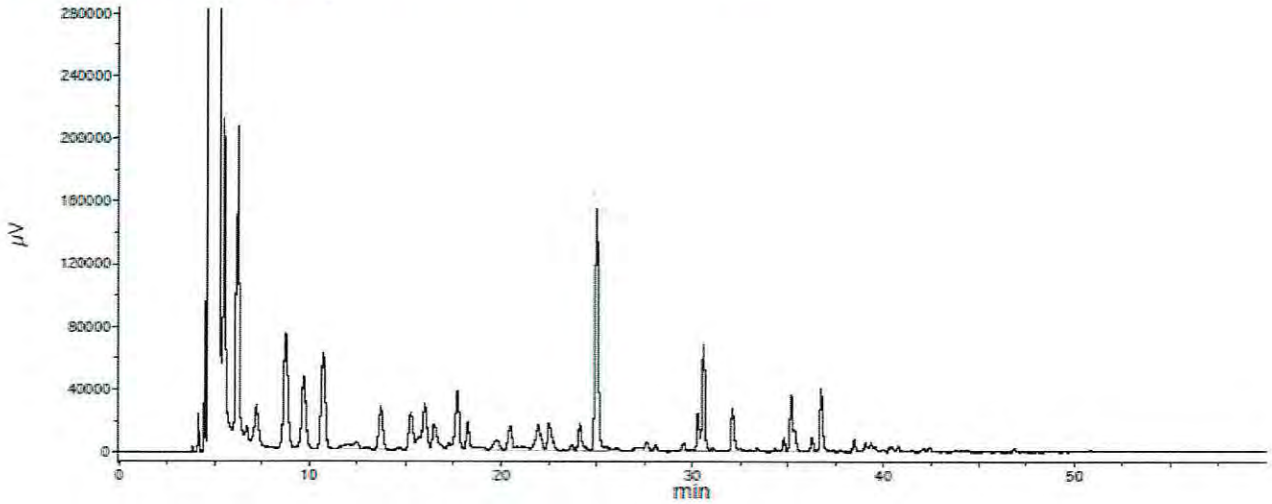
Prashant Chauhan	Formulated By:	060420 DATE
Pedro L. Rentas	Reviewed By:	060420 DATE

Note: Technical Grade Purity

Compound	RM#	Lot Number	Nominal Conc (µg/mL)	Purity (%)	Uncertainty Purity	Target Weight(g)	Actual Weight(g)	Actual Conc (µg/mL)	Expanded Uncertainty (+/-) (µg/mL)	SDS Information (Solvent Safety Info. On Attached pg.) CAS#	OSHA PEL (TWA)	LD50
1. Unleaded Gasoline 87 Octane - ETOH	2700	010908	20000	99	0.2	1.01005	1.01055	20009.8	81.0	86290-81-5	N/A	N/A

- The certified value is the concentration calculated from gravimetric and volumetric measurements unless otherwise stated.
- Standards are prepared gravimetrically using balances that are calibrated with weights traceable to NIST (see above).
- Standards are certifed (+/-) 0.5% of the stated value, unless otherwise stated.
- All Standards, after opening ampule, should be stored with caps tight and under appropriate laboratory conditions.
- Uncertainty Reference: Taylor, B.N. and Kuyat, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Result," NIST Technical Note 1297, U.S. Government Printing Office, Washington, DC, (1994).

Comments
GC13-M1 Analysis by Candice Warren
Column ID SPB-Vocol 105 meter X 0.53mm X 3.0µm film thickness
Flow rates: Total flow=290mL/min., Helium (carrier)=10mL/min.,
Helium(make-up)=10mL/min., Hydogen(make-up)=40mL/min., Air(make-up)=230mL/min.
Oven Profile: Temp. 1=35°C (Time 1=10 min.), Temp 2=200°C (Time 2=8.75 min.),
Rate = 4°C/min., Total run time=60 min. Injector temp.=200°C, FID Temp.=200°C.
FID Signal = Edaq Channel 1
Standard injection = 0.5µL, Range=4



J004282
Gas 20 Secondary AS
Solvent / Lot: Methanol
Prep: 4/21/2021 by LH
Exp: 6/4/2025

o2si smart solutions®

7290B Investment Drive North Charleston, South Carolina 29417
Phone: 866.272.0932 Fax: 866.509.5146 www.o2si.com

ACCREDITED

ISO 17025 Accredited Chemical Testing Lab
Cert. No. 3031.01

Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
020246-S5	398454	≤ -10 Degrees C	P/T Methanol	1-Oct-2023	Gasoline (Unleaded) Solution in P/T Methanol, 50,000 mg/L, 1 ml

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration
gasoline, unleaded, regular	8006-61-9	100	246.109.3P	50030 ± 180.39 mg/L

J004740
Gas 50 O2SI
Solvent / Lot: Methanol
Prep: 5/3/2021 by PC
Exp: 10/23/2023
Location: VOA F-40

Certified By: Kayla Coleman

Kayla Coleman
Manufacture Date 2-Oct-2018

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

Certificate of Analysis

Catalog No.: 020246-S5 **Lot No.:** 398454 **Expiration Date:** 1-Oct-2023

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration

Certified By: Kayla Coleman

Kayla Coleman
Manufacture Date 2-Oct-2018

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

Agilent

Certificate of Analysis

Product Name: 1,2-Dichlorobenzene-d4 Standard

Product Number: STS-210-1 **Lot Issue Date:** 11-Aug-2020

Lot Number: 0006552847 **Expiration Date:** 30-Sep-2024

Description:

This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system, and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
1,2-dichlorobenzene-d4	002199-69-1	RM11038	2002 ± 10 µg/mL

Matrix: methanol (methyl alcohol)

Storage Conditions: Store Frozen (-25° to -10°C).

Traceability:

The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:

This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:

This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:

Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:

Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

Expiration of Certification:

The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:

If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

J007623

d4 1,2 Dichlorobenzene Stock
Solvent / Lot: Methanol
Prep: 7/23/2021 by PC
Exp: 9/30/2024
Location: VOA F-40

Sample lot approver:

Monica Bourgeois
QMS Representative

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER

ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026

Page: 1 of 1

www.agilent.com/quality/

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

ISO 17025 Cert No. AT-1937

o2si smart solutions®
7290B Investment Drive North Charleston, South Carolina 29417
Phone: 866.272.0932 Fax: 866.509.5146 www.o2si.com

ACCREDITED
ISO 17025 Accredited Chemical Testing Lab
Cert. No. 3031.01

Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
120002-01-5PAK	456477	≤ -10 °C	P/T Methanol	22-Jul-2026	8260B Surrogate Solution, 2,000 mg/L, 5 x 1 ml

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
4-bromofluorobenzene (BFB)	460-00-4	99.5	135.7.1P	1982 ± 25.4	mg/L
dibromofluoromethane	1868-53-7	99	136.290.3P	2008 ± 28.96	mg/L
1,2-dichloroethane-d4	17060-07-0	99.8	138.120.2P	1992 ± 25.6	mg/L
toluene-d_8	2037-26-5	100	137.12.4P	2003 ± 25.74	mg/L

J008077
8260B Surrogate Solution
Solvent / Lot: Methanol
Prep: 8/5/2021 by PC
Exp: 7/22/2026
Location:

Certified By: _____
Jared Ball
Manufacture Date 23-Jul-2021

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.
The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

Trip Blanks

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8260D

Volatile Organic Compounds

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Water	Laboratory ID:	21I0042-41 B	SDG:	21I0042
Sampled:	08/30/21 11:55	Prepared:	09/09/21 14:44	File ID:	V309092111.D
% Solids:		Preparation:	EPA 5030C (Purge and Trap)	Analyzed:	09/09/21 15:12
Batch:	BJI0271	Sequence:	SJI0166	Initial/Final:	10 mL / 10 ml
Instrument:	NT3	Column:	RTX-VMS	Calibration:	EI00035

CAS NO.	COMPOUND	DILUTION	(ug/L)	Q	DL	RL
71-43-2	Benzene	1	0.20	U	0.05	0.20
91-20-3	Naphthalene	1	0.50	U	0.27	0.50

SURROGATES	ADDED:(ug/L)	(ug/L)	% REC	QC LIMITS	Q
1,2-Dichloroethane-d4	5.0000	5.49	110	80 - 129	
Toluene-d8	5.0000	5.00	100	80 - 120	
4-Bromofluorobenzene	5.0000	4.95	98.9	80 - 120	
1,2-Dichlorobenzene-d4	5.0000	5.07	101	80 - 120	

PREPARATION BATCH SUMMARY

EPA 8260D

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Batch: BJI0271 Batch Matrix: Water Preparation: EPA 5030C (Purge and Trap)

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
Trip Blanks	21I0042-41	V309092111.D	09/09/21 14:44	Check Version
Blank	BJI0271-BLK2	V309092110.D	09/09/21 08:44	
LCS	BJI0271-BS2	V309092106LCS.D	09/09/21 08:44	
LCS Dup	BJI0271-BSD2	V309092108.D	09/09/21 08:44	

Form I

METHOD BLANK DATA SHEET

EPA 8260D

Blank

Laboratory:	Analytical Resources, Inc.			SDG:	21I0042
Client:	GeoEngineers			Project:	South State Street PRDI
Matrix:	Water	Laboratory ID:	BJI0271-BLK2	File ID:	V309092110.D
Sampled:	N/A	Prepared:	09/09/21 08:44	Analyzed:	09/09/21 14:13
Solids:		Preparation:	EPA 5030C (Purge and Trap)	Initial/Final:	10 mL / 10 ml
Batch:	BJI0271	Sequence:	SJI0166	Calibration:	EI00035
Instrument:	NT3	Column:	RTX-VMS		

CAS NO.	COMPOUND	DILUTION	CONC. (ug/L)	Q	DL	RL
71-43-2	Benzene	1	0.20	U	0.05	0.20
91-20-3	Naphthalene	1	0.50	U	0.27	0.50

SURROGATES	ADDED (ug/L)	CONC. (ug/L)	% REC	QC LIMITS	Q
1,2-Dichloroethane-d4	5.0000	5.34	107	80 - 129	
Toluene-d8	5.0000	5.08	102	80 - 120	
4-Bromofluorobenzene	5.0000	4.87	97.3	80 - 120	
1,2-Dichlorobenzene-d4	5.0000	4.91	98.2	80 - 120	

LCS / LCS DUPLICATE RECOVERY

EPA 8260D

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Water	Analyzed:	09/09/21 12:32
Batch:	BJI0271	Laboratory ID:	BJI0271-BS2
Preparation:	EPA 5030C (Purge and Trap)	Sequence Name:	LCS
Initial/Final:	10 mL / 10 ml		

COMPOUND	SPIKE ADDED (ug/L)	LCS CONCENTRATION (ug/L)	Q	LCS % REC. #	QC LIMITS REC.
Benzene	10.0	10.2		102	80 - 120
Naphthalene	10.0	10.2		102	50 - 134

* Indicates values outside of QC limits

COMPOUND	SPIKE ADDED (ug/L)	LCSD CONCENTRATION (ug/L)	Q	LCSD % REC. #	% RPD #	QC LIMITS	
						RPD	REC.
Benzene	10.0	10.5		105	3.02	30	80 - 120
Naphthalene	10.0	10.5		105	2.69	30	50 - 134

* Indicates values outside of QC limits

Analytical Resources, Incorporated
Analytical Chemists and Consultants

MASS SPECTROMETER
INSTRUMENT PERFORMANCE CHECK
EPA 8260D

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Lab File ID:	V309082108.D	Injection Date:	09/08/21
Instrument ID:	NT3	Injection Time:	12:24
Sequence:	SJI0159	Lab Sample ID:	SJI0159-TUN1

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
95	50 - 200% of 174	121	PASS
96	5 - 9% of 95	6.33	PASS
173	Less than 2% of 174	0.588	PASS
174	50 - 200% of 95	82.4	PASS
175	5 - 9% of 174	6.94	PASS
176	95 - 105% of 174	98.7	PASS
177	5 - 10% of 176	6.45	PASS

Client Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
MS Tune	SJI0159-TUN1	V309082108.D	09/08/2021	12:24
Cal Standard	SJI0159-CAL1	V309082109.D	09/08/2021	12:49
Cal Standard	SJI0159-CAL2	V309082110.D	09/08/2021	13:15
Cal Standard	SJI0159-CAL3	V309082111.D	09/08/2021	13:40
Cal Standard	SJI0159-CAL4	V309082112.D	09/08/2021	14:05
Cal Standard	SJI0159-CAL5	V309082113.D	09/08/2021	14:30
Initial Cal Check	SJI0159-ICV1	V309082113A.D	09/08/2021	14:30
Cal Standard	SJI0159-CAL6	V309082114.D	09/08/2021	14:55
Cal Standard	SJI0159-CAL7	V309082115.D	09/08/2021	15:21
Cal Standard	SJI0159-CAL8	V309082116.D	09/08/2021	15:46
Initial Cal Blank	SJI0159-ICB1	V309082117.D	09/08/2021	16:11
Secondary Cal Check	SJI0159-SCV1	V309082118.D	09/08/2021	16:36
LCS	BJI0246-BS1	V309082119.D	09/08/2021	17:02
LCS Dup	BJI0246-BSD1	V309082120.D	09/08/2021	17:27
Blank	BJI0246-BLK1	V309082122.D	09/08/2021	18:17
ZZZZZ	21H0389-01	V309082127.D	09/08/2021	20:30
ZZZZZ	21H0389-02	V309082128.D	09/08/2021	20:56
ZZZZZ	21I0068-01	V309082129.D	09/08/2021	21:21
ZZZZZ	21I0068-02	V309082130.D	09/08/2021	21:47
ZZZZZ	21I0068-03	V309082131.D	09/08/2021	22:12
ZZZZZ	21I0068-04	V309082132.D	09/08/2021	22:38
ZZZZZ	21I0068-05	V309082133.D	09/08/2021	23:03
ZZZZZ	21I0068-06	V309082134.D	09/08/2021	23:29
ZZZZZ	21I0085-01	V309082135.D	09/08/2021	23:54
ZZZZZ	21I0085-02	V309082136.D	09/09/2021	0:20
ZZZZZ	21I0085-03	V309082137.D	09/09/2021	0:46

INITIAL CALIBRATION DATA

EPA 8260D

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00035	Instrument:	NT3
Calibration Date:	09/08/2021	Column (1):	RTX-VMS

Comments: Chloroethane and trichlorofluoromethane dropped 80 point.

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
		RRF		**RRF**		**RRF**		**RRF**		**RRF**		**RRF**
Benzene	0.2	1.952204	0.5	1.577283	1	1.522961	2	1.621937	10	1.476239	20	1.458348
Naphthalene			0.5	2.060709	1	1.931233	2	2.177222	10	2.018937	20	2.040539
1,2-Dichloroethane-d4	5	0.2682915	5	0.2821216	5	0.2643037	5	0.2779456	5	0.2791007	5	0.2907785
Toluene-d8	5	1.162766	5	1.136253	5	1.167996	5	1.164757	5	1.138768	5	1.145011
4-Bromofluorobenzene	5	0.3860509	5	0.4044195	5	0.4034493	5	0.3976827	5	0.3933258	5	0.3869949
1,2-Dichlorobenzene-d4	5	0.8573311	5	0.8900645	5	0.886898	5	0.874658	5	0.8777888	5	0.8523164

INITIAL CALIBRATION DATA

EPA 8260D

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00035	Instrument:	NT3
Calibration Date:	09/08/2021	Column (1):	RTX-VMS

Comments: Chloroethane and trichlorofluoromethane dropped 80 point.

Compound	Level 07		Level 08		Level 09		Level 10		Level 11		Level 12	
		RRF		RRF		RRF		RRF		RRF		RRF
Benzene	40	1.499628	80	1.37824								
Naphthalene	40	2.099768	80	1.901987								
1,2-Dichloroethane-d4	5	0.2700401	5	0.2696373								
Toluene-d8	5	1.142947	5	1.172883								
4-Bromofluorobenzene	5	0.4011844	5	0.3988782								
1,2-Dichlorobenzene-d4	5	0.8585442	5	0.8757535								

INITIAL CALIBRATION DATA

EPA 8260D

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00035	Instrument:	NT3
Calibration Date:	09/08/2021	Column (1):	RTX-VMS
Comments:	Chloroethane and trichlorofluoromethane dropped 80 point.		

COMPOUND	Mean RRF	RRF RSD	Linear COD	Quad COD	Limit Type & Limit	Q
Benzene	1.560855	11.2			RSD (15)	
Naphthalene	2.032914	4.7			RSD (15)	
1,2-Dichloroethane-d4	0.2752774	3.2			RSD (15)	
Toluene-d8	1.153923	1.3			RSD (15)	
4-Bromofluorobenzene	0.3964982	1.8			RSD (15)	
1,2-Dichlorobenzene-d4	0.8716693	1.6			RSD (15)	

SECOND-SOURCE CALIBRATION VERIFICATION

EPA 8260D

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EI00035
Laboratory ID: SJI0159-SCV1
Sequence: SJI0159
Standard ID: J009499

ANALYTE	EXPECTED (ug/L)	FOUND (ug/L)	% DRIFT	QC LIMIT
Benzene	10.000	9.42	-5.8	20.00
Naphthalene	10.000	10.6	5.9	20.00
1,2-Dichloroethane-d4	5.0000	4.77	-4.6	20.00
Toluene-d8	5.0000	4.99	-0.1	20.00
4-Bromofluorobenzene	5.0000	5.06	1.1	20.00
1,2-Dichlorobenzene-d4	5.0000	5.02	0.3	20.00

* Values outside of QC limits

SECOND-SOURCE
CONTINUING CALIBRATION CHECK
EPA 8260D

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT3	Calibration:	EI00035
Lab File ID:	V309082118.D	Calibration Date:	09/08/2021
Sequence:	SJI0159	Injection Date:	09/08/21
Lab Sample ID:	SJI0159-SCV1	Injection Time:	16:36
Sequence Name:	SCV		

		CONC. (ug/L)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Benzene	A	10.000	9.42	1.5608550	1.4710300	0.5	-5.8	+/-20
Naphthalene	A	10.000	10.6	2.0329140	2.1532930		5.9	+/-20
1,2-Dichloroethane-d4	A	5.0000	4.77	0.2752774	0.2626291		-4.6	+/-20
Toluene-d8	A	5.0000	4.99	1.1539230	1.1522480		-0.1	+/-20
4-Bromofluorobenzene	A	5.0000	5.06	0.3964982	0.4009671		1.1	+/-20
1,2-Dichlorobenzene-d4	A	5.0000	5.02	0.8716693	0.8746165		0.3	+/-20

* Values outside of QC limits

CONTINUING CALIBRATION CHECK
EPA 8260D

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT3	Calibration:	EI00035
Lab File ID:	V309092127.D	Calibration Date:	09/08/2021
Sequence:	SJI0166	Injection Date:	09/09/21
Lab Sample ID:	SJI0166-CCV1	Injection Time:	22:21
Sequence Name:	CCV		

		CONC. (ug/L)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Benzene	A	10.000	10.1	1.5608550	1.5762420	0.5	1.0	+/-50
Naphthalene	A	10.000	10.6	2.0329140	2.1573230		6.1	+/-50
1,2-Dichloroethane-d4	A	5.0000	5.60	0.2752774	0.3083547		12.0	+/-50
Toluene-d8	A	5.0000	4.92	1.1539230	1.1349430		-1.6	+/-50
4-Bromofluorobenzene	A	5.0000	4.78	0.3964982	0.3786597		-4.5	+/-50
1,2-Dichlorobenzene-d4	A	5.0000	4.80	0.8716693	0.8376229		-3.9	+/-50

* Values outside of QC limits

INITIAL CALIBRATION CHECK

EPA 8260D

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT3	Calibration:	EI00035
Lab File ID:	V309082113A.D	Calibration Date:	09/08/2021
Sequence:	SJI0159	Injection Date:	09/08/21
Lab Sample ID:	SJI0159-ICV1	Injection Time:	14:30
Sequence Name:	VOA 10		

		CONC. (ug/L)		RESPONSE FACTOR			% DRIFT/DIFF	
COMPOUND	TYPE	STD	ICV	ICAL	ICV	MIN	ICV	LIMIT
Benzene	A	10.000	9.46	1.5608550	1.4762390	0.5	-5.4	+/-20
Naphthalene	A	10.000	9.93	2.0329140	2.0189370		-0.7	+/-20
1,2-Dichloroethane-d4	A	5.0000	5.07	0.2752774	0.2791007		1.4	+/-20
Toluene-d8	A	5.0000	4.93	1.1539230	1.1387680		-1.3	+/-20
4-Bromofluorobenzene	A	5.0000	4.96	0.3964982	0.3933258		-0.8	+/-20
1,2-Dichlorobenzene-d4	A	5.0000	5.04	0.8716693	0.8777888		0.7	+/-20

* Values outside of QC limits

INITIAL CALIBRATION CHECK

EPA 8260D

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT3	Calibration:	EI00035
Lab File ID:	V309092106.D	Calibration Date:	09/08/2021
Sequence:	SJI0166	Injection Date:	09/09/21
Lab Sample ID:	SJI0166-ICV1	Injection Time:	12:32
Sequence Name:	VOA 10		

		CONC. (ug/L)		RESPONSE FACTOR			% DRIFT/DIFF	
COMPOUND	TYPE	STD	ICV	ICAL	ICV	MIN	ICV	LIMIT
Benzene	A	10.000	10.2	1.5608550	1.5965060	0.5	2.3	+/-20
Naphthalene	A	10.000	10.2	2.0329140	2.0696260		1.8	+/-20
1,2-Dichloroethane-d4	A	5.0000	5.11	0.2752774	0.2811215		2.1	+/-20
Toluene-d8	A	5.0000	4.94	1.1539230	1.1390310		-1.3	+/-20
4-Bromofluorobenzene	A	5.0000	4.93	0.3964982	0.3912571		-1.3	+/-20
1,2-Dichlorobenzene-d4	A	5.0000	4.87	0.8716693	0.8480838		-2.7	+/-20

* Values outside of QC limits

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 8260D

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0159
Instrument: NT3
Calibration: EI00035

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
MS Tune	SJI0159-TUN1	V309082108.D	NA	09/08/21 12:24
8260D 0.2	SJI0159-CAL1	V309082109.D	NA	09/08/21 12:49
8260D 0.5	SJI0159-CAL2	V309082110.D	NA	09/08/21 13:15
8260D 1.0	SJI0159-CAL3	V309082111.D	NA	09/08/21 13:40
8260D 2.0	SJI0159-CAL4	V309082112.D	NA	09/08/21 14:05
8260D 10	SJI0159-CAL5	V309082113.D	NA	09/08/21 14:30
VOA 10	SJI0159-ICV1	V309082113A.D	NA	09/08/21 14:30
8260D 20	SJI0159-CAL6	V309082114.D	NA	09/08/21 14:55
8260D 40	SJI0159-CAL7	V309082115.D	NA	09/08/21 15:21
8260D 80	SJI0159-CAL8	V309082116.D	NA	09/08/21 15:46
Initial Cal Blank	SJI0159-ICB1	V309082117.D	NA	09/08/21 16:11
SCV	SJI0159-SCV1	V309082118.D	NA	09/08/21 16:36
ZZZZZ	BJI0246-BS1	V309082119.D	Water	09/08/21 17:02
ZZZZZ	BJI0246-BSD1	V309082120.D	Water	09/08/21 17:27
ZZZZZ	BJI0246-BLK1	V309082122.D	Water	09/08/21 18:17
ZZZZZ	21H0389-01	V309082127.D	Water	09/08/21 20:30
ZZZZZ	21H0389-02	V309082128.D	Water	09/08/21 20:56
ZZZZZ	21I0068-01	V309082129.D	Water	09/08/21 21:21
ZZZZZ	21I0068-02	V309082130.D	Water	09/08/21 21:47
ZZZZZ	21I0068-03	V309082131.D	Water	09/08/21 22:12
ZZZZZ	21I0068-04	V309082132.D	Water	09/08/21 22:38
ZZZZZ	21I0068-05	V309082133.D	Water	09/08/21 23:03
ZZZZZ	21I0068-06	V309082134.D	Water	09/08/21 23:29
ZZZZZ	21I0085-01	V309082135.D	Water	09/08/21 23:54
ZZZZZ	21I0085-02	V309082136.D	Water	09/09/21 00:20
ZZZZZ	21I0085-03	V309082137.D	Water	09/09/21 00:46

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 8260D

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0166
Instrument: NT3
Calibration: EI00035

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
MS Tune	SJI0166-TUN1	V309092104.D	NA	09/09/21 11:22
VOA 10	SJI0166-ICV1	V309092106.D	NA	09/09/21 12:32
LCS	BJI0271-BS2	V309092106LCS.D	Water	09/09/21 12:32
LCS Dup	BJI0271-BSD2	V309092108.D	Water	09/09/21 13:23
Blank	BJI0271-BLK2	V309092110.D	Water	09/09/21 14:13
Trip Blanks	21I0042-41	V309092111.D	Water	09/09/21 15:12
ZZZZZ	21I0085-04	V309092112.D	Water	09/09/21 15:37
ZZZZZ	21I0085-05	V309092113.D	Water	09/09/21 16:03
ZZZZZ	21I0072-01	V309092114.D	Water	09/09/21 16:30
ZZZZZ	21I0098-01	V309092115.D	Water	09/09/21 16:58
ZZZZZ	21I0098-02	V309092116.D	Water	09/09/21 17:26
ZZZZZ	21I0098-03	V309092117.D	Water	09/09/21 17:54
ZZZZZ	21I0099-01	V309092118.D	Water	09/09/21 18:22
ZZZZZ	21I0099-02	V309092119.D	Water	09/09/21 18:49
ZZZZZ	21I0100-01	V309092120.D	Water	09/09/21 19:17
ZZZZZ	21I0100-02	V309092121.D	Water	09/09/21 19:45
ZZZZZ	21I0100-03	V309092122.D	Water	09/09/21 20:13
ZZZZZ	21I0103-01	V309092125.D	Water	09/09/21 21:29
CCV	SJI0166-CCV1	V309092127.D	NA	09/09/21 22:21

SURROGATE RECOVERY SUMMARY

EPA 8260D

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0159
Instrument: NT3
Calibration: EI00035
Calibration Date: 09/08/2021

Surrogate Compound	Spike Level ug/L	% Recovery	Recovery Limits	Q
SJI0159-ICV1 (Water)	Lab File ID: V309082113A.D		Analyzed: 09/08/21 14:30	
1,2-Dichloroethane-d4	5.0000	101	80 - 120	
Toluene-d8	5.0000	98.7	80 - 120	
4-Bromofluorobenzene	5.0000	99.2	80 - 120	
1,2-Dichlorobenzene-d4	5.0000	101	80 - 120	
SJI0159-ICB1 (Water)	Lab File ID: V309082117.D		Analyzed: 09/08/21 16:11	
1,2-Dichloroethane-d4			80 - 129	
Toluene-d8			80 - 120	
4-Bromofluorobenzene			80 - 120	
1,2-Dichlorobenzene-d4			80 - 120	
SJI0159-SCV1 (Water)	Lab File ID: V309082118.D		Analyzed: 09/08/21 16:36	
1,2-Dichloroethane-d4	5.0000	95.4	80 - 120	
Toluene-d8	5.0000	99.9	80 - 120	
4-Bromofluorobenzene	5.0000	101	80 - 120	
1,2-Dichlorobenzene-d4	5.0000	100	80 - 120	

SURROGATE RECOVERY SUMMARY

EPA 8260D

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0166
Instrument: NT3
Calibration: EI00035
Calibration Date: 09/08/2021

Surrogate Compound	Spike Level ug/L	% Recovery	Recovery Limits	Q
BJI0271-BS2 (Water)	Lab File ID: V309092106LCS.D		Analyzed: 09/09/21 12:32	
1,2-Dichloroethane-d4	5.0000	102	80 - 129	
Toluene-d8	5.0000	98.7	80 - 120	
4-Bromofluorobenzene	5.0000	98.7	80 - 120	
1,2-Dichlorobenzene-d4	5.0000	97.3	80 - 120	
SJI0166-ICV1 (Water)	Lab File ID: V309092106.D		Analyzed: 09/09/21 12:32	
1,2-Dichloroethane-d4	5.0000	102	80 - 120	
Toluene-d8	5.0000	98.7	80 - 120	
4-Bromofluorobenzene	5.0000	98.7	80 - 120	
1,2-Dichlorobenzene-d4	5.0000	97.3	80 - 120	
BJI0271-BSD2 (Water)	Lab File ID: V309092108.D		Analyzed: 09/09/21 13:23	
1,2-Dichloroethane-d4	5.0000	103	80 - 129	
Toluene-d8	5.0000	99.6	80 - 120	
4-Bromofluorobenzene	5.0000	103	80 - 120	
1,2-Dichlorobenzene-d4	5.0000	96.8	80 - 120	
BJI0271-BLK2 (Water)	Lab File ID: V309092110.D		Analyzed: 09/09/21 14:13	
1,2-Dichloroethane-d4	5.0000	107	80 - 129	
Toluene-d8	5.0000	102	80 - 120	
4-Bromofluorobenzene	5.0000	97.3	80 - 120	
1,2-Dichlorobenzene-d4	5.0000	98.2	80 - 120	
21I0042-41 (Water)	Lab File ID: V309092111.D		Analyzed: 09/09/21 15:12	
1,2-Dichloroethane-d4	5.0000	110	80 - 129	
Toluene-d8	5.0000	100	80 - 120	
4-Bromofluorobenzene	5.0000	98.9	80 - 120	
1,2-Dichlorobenzene-d4	5.0000	101	80 - 120	
SJI0166-CCV1 (Water)	Lab File ID: V309092127.D		Analyzed: 09/09/21 22:21	
1,2-Dichloroethane-d4	5.0000	112	50 - 150	
Toluene-d8	5.0000	98.4	50 - 150	
4-Bromofluorobenzene	5.0000	95.5	50 - 150	
1,2-Dichlorobenzene-d4	5.0000	96.1	50 - 150	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8260D

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0159
Instrument: NT3
Calibration: EI00035

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
Initial Cal Check (SJI0159-ICV1)		(Water)		Lab File ID: V309082113A.D				Analyzed: 09/08/21 14:30	
Pentafluorobenzene	290225	5.133	290225	5.133	100	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	428937	7.573	428937	7.573	100	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	456307	5.521	456307	5.521	100	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	241860	9.258	241860	9.258	100	50 - 200	0.000	+/-0.50	
Initial Cal Blank (SJI0159-ICB1)		(Water)		Lab File ID: V309082117.D				Analyzed: 09/08/21 16:11	
Pentafluorobenzene	289275	5.132	290225	5.133	100	50 - 200	-0.001	+/-0.50	
Chlorobenzene-d5	411279	7.578	428937	7.573	96	50 - 200	0.005	+/-0.50	
1,4-Difluorobenzene	467534	5.52	456307	5.521	102	50 - 200	-0.001	+/-0.50	
1,4-Dichlorobenzene-d4	238318	9.257	241860	9.258	99	50 - 200	-0.001	+/-0.50	
Secondary Cal Check (SJI0159-SCV1)		(Water)		Lab File ID: V309082118.D				Analyzed: 09/08/21 16:36	
Pentafluorobenzene	308732	5.133	290225	5.133	106	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	442555	7.573	428937	7.573	103	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	486194	5.521	456307	5.521	107	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	255863	9.258	241860	9.258	106	50 - 200	0.000	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8260D

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0166
Instrument: NT3
Calibration: EI00035

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
LCS (BJI0271-BS2)		(Water)	Lab File ID: V309092106LCS.D				Analyzed: 09/09/21 12:32		
Pentafluorobenzene	269677	5.137	269677	5.137	100	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	403847	7.577	403847	7.577	100	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	419927	5.525	419927	5.525	100	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	229383	9.257	229383	9.257	100	50 - 200	0.000	+/-0.50	
Initial Cal Check (SJI0166-ICV1)		(Water)	Lab File ID: V309092106.D				Analyzed: 09/09/21 12:32		
Pentafluorobenzene	269677	5.137	269677	5.137	100	50 - 200	0.000	+/-0.50	
Chlorobenzene-d5	403847	7.577	403847	7.577	100	50 - 200	0.000	+/-0.50	
1,4-Difluorobenzene	419927	5.525	419927	5.525	100	50 - 200	0.000	+/-0.50	
1,4-Dichlorobenzene-d4	229383	9.257	229383	9.257	100	50 - 200	0.000	+/-0.50	
LCS Dup (BJI0271-BSD2)		(Water)	Lab File ID: V309092108.D				Analyzed: 09/09/21 13:23		
Pentafluorobenzene	254677	5.139	269677	5.137	94	50 - 200	0.002	+/-0.50	
Chlorobenzene-d5	368284	7.574	403847	7.577	91	50 - 200	-0.003	+/-0.50	
1,4-Difluorobenzene	395665	5.522	419927	5.525	94	50 - 200	-0.003	+/-0.50	
1,4-Dichlorobenzene-d4	210753	9.259	229383	9.257	92	50 - 200	0.002	+/-0.50	
Blank (BJI0271-BLK2)		(Water)	Lab File ID: V309092110.D				Analyzed: 09/09/21 14:13		
Pentafluorobenzene	275932	5.139	269677	5.137	102	50 - 200	0.002	+/-0.50	
Chlorobenzene-d5	399977	7.573	403847	7.577	99	50 - 200	-0.004	+/-0.50	
1,4-Difluorobenzene	434789	5.521	419927	5.525	104	50 - 200	-0.004	+/-0.50	
1,4-Dichlorobenzene-d4	226468	9.258	229383	9.257	99	50 - 200	0.001	+/-0.50	
Trip Blanks (21I0042-41)		(Water)	Lab File ID: V309092111.D				Analyzed: 09/09/21 15:12		
Pentafluorobenzene	278620	5.139	269677	5.137	103	50 - 200	0.002	+/-0.50	
Chlorobenzene-d5	412874	7.578	403847	7.577	102	50 - 200	0.001	+/-0.50	
1,4-Difluorobenzene	440422	5.521	419927	5.525	105	50 - 200	-0.004	+/-0.50	
1,4-Dichlorobenzene-d4	225344	9.258	229383	9.257	98	50 - 200	0.001	+/-0.50	

HOLDING TIME SUMMARY

Analysis: EPA 8260D

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
Trip Blanks 21I0042-41	08/30/21 11:55	09/02/21 10:52	09/09/21 14:44	10	14	09/09/21 15:12	10	14	

* Indicates hold time exceedance.

METHOD DETECTION AND REPORTING LIMITS

EPA 8260D

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Matrix: Water Instrument: NT3

Analyte	MDL	RL	Units
Benzene	0.05	0.20	ug/L
Naphthalene	0.27	0.50	ug/L

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Quality System Audited & Registered by NSF-ISR to ISO 9001:2008

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Fax: 866.509.5146
www.o2si.com

ACCREDITED

ISO 17025 Accredited Chemical Testing Lab
Cert. No. 3031.01

Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
021111-01	366047	≤ -10 °C	P/T Methanol	13-Jan-2022	Bromoethane Solution, 2,000 mg/L, 1 ml

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
bromoethane	74-96-4	99.8	1111.1.1P	2014 +/- 20.63	mg/L

H003272
Bromoethane Solution
Solvent / Lot: p&t methanol
Prep: 4/1/2019 by PC
Exp: 1/13/2022
Location: F-40

Certified By: _____
Kara Catron
Manufacture Date 9-Jan-2019

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00. Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

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Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
020620-02	377123	≤ -10 °C	P/T Methanol	15-May-2024	n-Hexane Solution, 1,000 mg/L, 1 mL

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
n-hexane (C6)	110-54-3	98	620.24.1P	1000 +/- 14.42	mg/L

H009538
n-Hexane (C6)
Solvent / Lot: P&T MeOH
Prep: 10/2/2019 by LH
Exp: 5/15/2024

Auquilla Samuel

Certified By: _____

Auquilla Samuel

Manufacture Date 17-May-2019

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
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Cert. No. 3031.01

Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
122318-01	329610	≤ -10 °C	P/T Methanol	28-Nov-2021	MtBE & Freon 113 Solution, 1000 mg/L, 1 ml

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
methyl t-butyl ether	1634-04-4	99.96	208.24.2P	1003 +/- 10.42	mg/L
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	76-13-1	99.9	270.158.1P	1012 +/- 14.59	mg/L

H009539
MtBE&Freon 113 Solution
Solvent / Lot: p&t methanol
Prep: 10/2/2019 by LH
Exp: 11/28/2021

Certified By: Susan Mathews

Manufacture Date 28-Nov-2017

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

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CERTIFIED REFERENCE MATERIAL

Certificate of Analysis

ACCREDITED
ISO 17034 Accredited
Reference Material Producer
Certificate #3222.01

ACCREDITED
ISO/IEC 17025 Accredited
Testing Laboratory
Certificate #3222.02

FOR LABORATORY USE ONLY-READ SDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 30265 **Lot No.:** A0150481

Description : 2-Chloroethyl vinyl ether Standard

2-Chloroethyl vinyl ether Standard 2,000µg/mL, P&T Methanol, 1mL/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : June 30, 2024 **Storage:** 0°C or colder

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	2-Chloroethyl vinyl ether	2,000.6 µg/mL	+/- 11.6317	µg/mL	Gravimetric
	CAS # 110-75-8 (Lot MKBS6526V)		+/- 42.8331	µg/mL	Unstressed
	Purity 99%		+/- 44.0783	µg/mL	Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

H012546
2CEVE SS
Solvent / Lot: Methanol
Prep: 12/30/2019 by PC
Exp: 6/30/2024
Location:

Tech Tips:
Degradation of tetrachloroethylene to pentachloroethane may occur if solutions containing 2-chloroethyl vinyl ether are combined with solutions that contain tetrachloroethylene.

Column:
105m x 0.53mm x 3.0µm
Rtx-502.2 (cat.#10910)

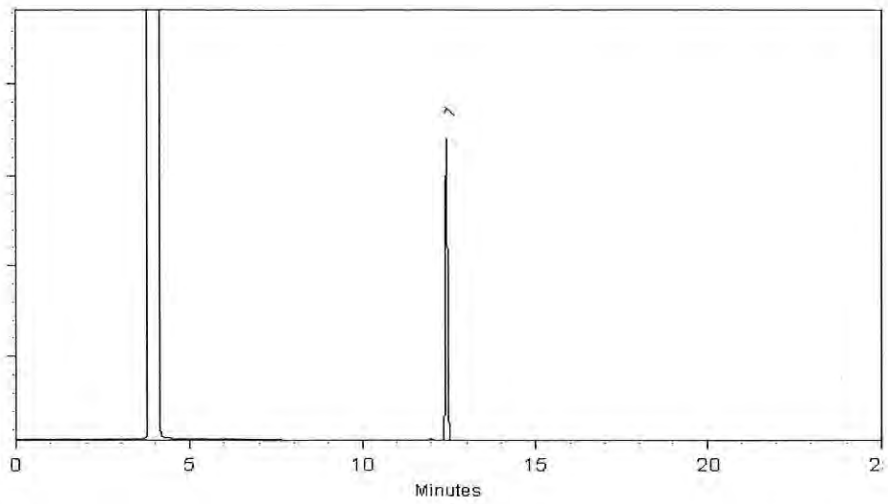
Carrier Gas:
hydrogen-constant pressure 11.0 psi.

Temp. Program:
40°C (hold 2 min.) to 240°C
@ 8°C/min. (hold 5 min.)

Inj. Temp:
200°C

Det. Temp:
250°C

Det. Type:
FID



This chromatogram represents a general set of testing conditions chosen for product acceptance. For optimal results in your lab, conditions should be adjusted for your specific instrument, method, and application.

Walker Workman - Operations Technician I

Date Mixed: 27-Jun-2019 **Balance:** B707717271

Jennifer Pollino - Operations Tech-ARM QC

Date Passed: 01-Jul-2019

Manufactured under Restek's ISO 9001:2015 Registered Quality System Certificate #FM 80397

General Certified Reference Material Notes

Expiration Notes:

- Expiration date valid for unopened ampul stored in compliance with the recommended conditions.
- Uncertainty, concentration, and expiration of the CRM are based on the unopened product being stored according to the recommended condition found in the storage field.

Purity Notes:

- Purity and/or chemical identity are determined by one or more of the following techniques: GC/FID, HPLC, GC/μECD, GC/MS, LC/MS, RI, and/or melting point.
- Compounds with a listed purity of less than 99% have been weight corrected to compensate for impurities and/or salts. A correction factor is used to calculate the amount of compound necessary to achieve the desired concentration of the parent compound in solution.
- Purity of isomeric compounds is reported as the sum of the isomers.
- Purity values are rounded to the nearest whole number.

Certified Uncertainty Value Notes:

- The uncertainties are determined in accordance with ISO 17034 and Guide 35. The certified combined stressed uncertainty value (includes gravimetric uncertainty, homogeneity between-ampul uncertainty, storage stability uncertainty and shipping stability uncertainty and were combined using the following formula:

$$U_{combined\ stressed} = k\sqrt{U^2_{gravimetric} + U^2_{homogeneity} + U^2_{storage\ stability} + U^2_{shipping\ stability}}$$

k is a coverage factor of 2, which gives a level of confidence of approximately 95%.

- It is important to note that the shipping stability uncertainty was obtained under temperature extremes for specific time intervals; therefore, the certified combined stressed uncertainty value should only be applied to the product if it was stored at non-standard temperature conditions up to and including 7 days. Contact Restek Technical Service at www.restek.com/Contact-Us for use recommendations if your shipment was in-transit for more than 7 days at non-standard temperature conditions.
- Apply the certified combined unstressed uncertainty value if the product was received under standard shipping conditions. Apply the certified combined stressed uncertainty value if the product was received under non-standard conditions as specified below.

Label Conditions	Standard Conditions	Non-Standard Conditions
25°C Nominal (Room Temperature)	< 60°C	≥ 60°C up to 7 days
10°C or colder (Refrigerate)	< 40°C	≥ 40°C up to 7 days
0°C or colder (Freezer)	< 25°C	≥ 25°C up to 7 days

- Separate (not combined) uncertainty values for gravimetric uncertainty are also displayed on the certificate, if needed, separate homogeneity between-ampul uncertainty, storage stability uncertainty and shipping stability uncertainty values are available by contacting Restek Technical Service at www.restek.com/Contact-Us.
- The packaged amount is the minimum sample size for which uncertainty is valid. The ampules are over-filled to ensure that the minimum packaged amount can be sufficiently transferred.

Manufacturing Notes:

- Concentration is based upon gravimetric preparation using either a balance whose calibration has been verified daily using NIST traceable weights, and/or dilutions with Class A glassware.

Handling Notes:

- Stability of the unopened product, when stored in compliance with the recommended conditions, is guaranteed through the expiration displayed on the product label and certificate. Contact Restek for additional opened product stability information, with the knowledge/understanding that open product stability is subject to the specific handling and environmental conditions to which the product is exposed. For your convenience Restek supplies deactivated vials with most standards packed in 2mL ampules. Larger volume deactivated vials are available through Restek as a custom ordered item. Additionally, Restek sells DMDCS for the purpose of glassware deactivation as catalog number 31861, which includes complete instructions.
- If any undissolved material is visible inside the ampul, sonicate the unopened ampul until the material is completely dissolved.

Agilent

Certificate of Ana

I009147
2CEVE
Solvent / Lot: Methanol
Prep: 10/5/2020 by PC
Exp: 8/31/2023
Location:

Product Name: 2-Chloroethylvinyl Ether Standard

Product Number: EPA-1016-1

Lot Number: 0006546244

Lot Issue Date: 23-Jul-2020

Expiration Date: 31-Aug-2023

Description:

This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system, and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
2-chloroethylvinyl ether	000110-75-8	RM06940	5020 ± 25 µg/mL

Matrix: methanol (methyl alcohol)

Storage Conditions: Store Frozen (-25° to -10°C).

Traceability:

The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:

This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:

This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:

Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:

Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

Expiration of Certification:

The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:

If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

Sample lot approver:

Monica Bourgeois
QMS Representative

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER

ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026

www.agilent.com/quality/

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

ISO 17025 Cert No. AT-1937

o2si smart solutions®

I009654
8260B Calibration Super Mix
Solvent / Lot: P/T Methanol
Prep: 10/14/2020 by PC
Exp: 10/29/2024
Location: F-40

ACCREDITED
ISO 17025 Accredited Chemical Testing Lab
Cert. No. 3031.01

Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
122150-01	425321	≤ -10 °C	P/T Methanol	29-Oct-2024	8260B Calibration Super Mix, 76-1, 2,000 mg/L, 1 ml (Ampule A) One of Two

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
2-nitropropane	79-46-9	99.4	219.8.1P	1997 ± 40.75	mg/L
acetonitrile	75-05-8	99.9	204.1.2P	2000 ± 35.59	mg/L
acrylonitrile	107-13-1	99	210.1.6P	2002 ± 36.99	mg/L
allyl chloride	107-05-1	98.6	227.1.1P	2013 ± 41.08	mg/L
benzene	71-43-2	99.99	146.1.9P	2001 ± 35.59	mg/L
bromobenzene	108-86-1	99.9	147.8.1.1P	2013 ± 41.08	mg/L
bromochloromethane	74-97-5	99.7	148.1.3P	2005 ± 35.72	mg/L
bromodichloromethane	75-27-4	99.5	149.1.9P	2001 ± 35.65	mg/L
bromoform	75-25-2	99.3	150.7.2P	2002 ± 35.67	mg/L
n-butylbenzene	104-51-8	99.2	151.7.3.2P	2003 ± 35.69	mg/L
sec-butylbenzene	135-98-8	99.5	152.1.2.1P	2011 ± 35.83	mg/L
tert-butylbenzene	98-06-6	99.9	153.29.1P	2010 ± 35.81	mg/L
carbon disulfide	75-15-0	99.99	200.18.2P	2001 ± 35.65	mg/L
carbon tetrachloride	56-23-5	100	154.9.1P	2003 ± 35.69	mg/L
chlorobenzene	108-90-7	99.9	155.29.1P	2001 ± 35.65	mg/L
2-chloroethanol	107-07-3	98.5	217.1.2.1P	2010 ± 41.02	mg/L

Auquilla Samuel

Certified By: _____

Auquilla Samuel

Manufacture Date 31-Oct-2019

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The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

Certificate of Analysis

Catalog No.: 122150-01 **Lot No.:** 425321 **Expiration Date:** 29-Oct-2024

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
chloroform	67-66-3	99.8	156.7.1P	2004 ± 35.7	mg/L
chloroprene	126-99-8	99	315.282.8P	2000 ± 35.58	mg/L
2-chlorotoluene	95-49-8	99.5	157.7.1P	2010 ± 35.81	mg/L
4-chlorotoluene	106-43-4	99.9	158.9.3P	2006 ± 35.74	mg/L
cis-1,2-dichloroethylene	156-59-2	99.7	166.286.1P	2004 ± 40.89	mg/L
dibromochloromethane	124-48-1	97.5	159.29.2P	2009 ± 35.74	mg/L
1,2-dibromo-3-chloropropane	96-12-8	98.4	160.7.2.1P	2001 ± 35.65	mg/L
1,2-dibromoethane	106-93-4	99.9	161.9.1P	2001 ± 35.65	mg/L
dibromomethane	74-95-3	99.8	162.1.2P	2001 ± 40.83	mg/L
1,2-dichlorobenzene	95-50-1	99.8	43.7.1P	2000 ± 35.63	mg/L
1,3-dichlorobenzene	541-73-1	99.9	44.7.1P	2011 ± 35.83	mg/L
1,4-dichlorobenzene	106-46-7	99.9	45.29.2P	2001 ± 35.65	mg/L
cis-1,4-dichloro-2-butene	1476-11-5	96.2	209.1.4.1P	2013 ± 35.87	mg/L
trans-1,4-dichloro-2-butene	110-57-6	98	201.1.17P	2002 ± 35.67	mg/L
1,1-dichloroethane	75-34-3	98.27	163.247.1P	2009 ± 35.74	mg/L
1,2-dichloroethane	107-06-2	99.9	164.158.1P	2001 ± 35.65	mg/L
1,1-dichloroethylene	75-35-4	99	165.1.1.1.1P	2002 ± 36.99	mg/L
trans-1,2-dichloroethylene	156-60-5	99.8	167.9.2P	2006 ± 35.74	mg/L
1,2-dichloropropane	78-87-5	99.7	168.8.1.1P	2001 ± 40.83	mg/L
1,3-dichloropropane	142-28-9	99.8	169.7.2.1P	2001 ± 35.65	mg/L
2,2-dichloropropane	594-20-7	99.1	170.7.2P	2000 ± 35.63	mg/L
1,1-dichloropropylene	563-58-6	99	171.158.1P	2000 ± 40.81	mg/L
cis-1,3-dichloropropylene	10061-01-5	99.6	172.7.4.1P	2007 ± 35.76	mg/L
trans-1,3-dichloropropylene	10061-02-6	99	173.7.4.5P	2000 ± 35.63	mg/L

Auquilla Samuel

Certified By: _____

Auquilla Samuel

Manufacture Date 31-Oct-2019

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Certificate of Analysis

Catalog No.: 122150-01 **Lot No.:** 425321 **Expiration Date:** 29-Oct-2024

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration
1,4-dioxane	123-91-1	100	223.1.3P	2003 ± 40.87 mg/L
ethyl ether	60-29-7	99.9	226.1.3P	2002 ± 35.61 mg/L
ethyl methacrylate	97-63-2	99.1	216.1.1P	2007 ± 40.96 mg/L
ethylbenzene	100-41-4	99.9	174.8.2P	2001 ± 40.83 mg/L
hexachlorobutadiene	87-68-3	98	47.158.1.2P	2009 ± 41 mg/L
iodomethane	74-88-4	99.9	203.1.3.1P	2003 ± 40.87 mg/L
isobutyl alcohol	78-83-1	100	220.7.2P	2001 ± 35.65 mg/L
isopropylbenzene	98-82-8	98.9	176.9.1P	2004 ± 40.89 mg/L
4-isopropyltoluene	99-87-6	99.7	177.9.2P	2003 ± 40.87 mg/L
methyl acrylonitrile	126-98-7	99.5	212.3.1P	2000 ± 36.96 mg/L
methyl methacrylate	80-62-6	98.5	231.8.1.1P	2012 ± 41.06 mg/L
methyl acrylate	96-33-3	99.9	349.1.1P	2004 ± 40.9 mg/L
methylene chloride	75-09-2	99.99	178.271.1P	2002 ± 35.61 mg/L
naphthalene	91-20-3	99.8	26.9.1P	2001 ± 35.65 mg/L
nitrobenzene	98-95-3	99.9	94.29.2P	2003 ± 35.63 mg/L
pentachloroethane	76-01-7	98.8	52.3.5P	2004 ± 37.03 mg/L
propionitrile	107-12-0	99.9	218.7.1P	2001 ± 35.65 mg/L
n-propylbenzene	103-65-1	99.7	179.7.2P	2005 ± 35.72 mg/L
styrene	100-42-5	99.5	180.286.1P	2010 ± 41.02 mg/L
1,1,1,2-tetrachloroethane	630-20-6	99.8	181.7.2.7P	2004 ± 35.7 mg/L
1,1,2,2-tetrachloroethane	79-34-5	99.4	182.8.2P	2001 ± 40.83 mg/L
tetrachloroethylene	127-18-4	100	183.1.2P	2006 ± 35.68 mg/L
tetrahydrofuran (THF)	109-99-9	99.9	299.18.1P	2003 ± 40.87 mg/L
toluene	108-88-3	100	184.48.1P	2001 ± 35.65 mg/L

Auquilla Samuel

Certified By: _____

Auquilla Samuel

Manufacture Date 31-Oct-2019

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Certificate of Analysis

Catalog No.: 122150-01 **Lot No.:** 425321 **Expiration Date:** 29-Oct-2024

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
1,2,3-trichlorobenzene	87-61-6	99	185.1.1.6P	2016 ± 37.25	mg/L
1,2,4-trichlorobenzene	120-82-1	99.6	54.29.1P	2005 ± 35.72	mg/L
1,1,1-trichloroethane	71-55-6	99	187.1.1P	2004 ± 40.89	mg/L
1,1,2-trichloroethane	79-00-5	99.6	195.7.1.6P	2004 ± 35.7	mg/L
trichloroethylene	79-01-6	100	188.1.1P	2015 ± 41.12	mg/L
1,2,3-trichloropropane	96-18-4	99.5	189.1.3P	2005 ± 35.72	mg/L
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	76-13-1	99	270.158.2P	2003 ± 40.88	mg/L
1,2,4-trimethylbenzene	95-63-6	99.1	190.1.3P	2008 ± 40.98	mg/L
1,3,5-trimethylbenzene	108-67-8	99.7	191.9.2.1P	2002 ± 40.85	mg/L
m-xylene	108-38-3	99.7	193.7.1.2P	2001 ± 35.65	mg/L
o-xylene	95-47-6	99.2	192.29.2P	2003 ± 35.69	mg/L
p-xylene	106-42-3	99.9	194.7.1P	2003 ± 35.69	mg/L

Auquilla Samuel

Certified By: _____

Auquilla Samuel

Manufacture Date 31-Oct-2019

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Certificate of Analysis

Catalog No.: 122150-01 **Lot No.:** 425321 **Expiration Date:** 29-Oct-2024

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration

Auquilla Samuel

Certified By: _____

Auquilla Samuel

Manufacture Date 31-Oct-2019

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.

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ACCREDITED
Reference Materials Producer
Cert #2495.01

SPEXertificate®
Certificate of Reference Material

ilac-MRA ACCREDITED
Chemical Testing
Cert #2495.02

Catalog Number: S-2986 **Lot No.** EN191002016

Description: 2-Pentanone

Matrix: Methanol (Purge & Trap Grade)

Ship Date: December 2, 2020
Expiration Date: December 2, 2022

This **SPEXOrganics®** Certified Reference Material, CRM, is intended primarily for use as a calibration standard or quality control standard for organic chromatography instrumentation such as GC, GC-MS, LC, and LC-MS. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Compounds:

Compound	CAS #	Labeled	Purity	Certified†	Uncertainty
2-Pentanone	107-87-9	1000 µg/mL	99%	990 µg/mL	± 35 µg/mL

I011378
2-Pentonone 1000
Solvent / Lot: MeOH
Prep: 12/10/2020 by PC
Exp: 12/2/2022
Location: VOA F-40

* - Isomer ratios (when applicable) are an uncertified parameter.

Final Solution Verification:

Final solution integrity verified by Gas Chromatography/Mass Spectrometry. The mass spectrum of each compound was confirmed against the NIST mass spectral database.

† Certified concentration based on gravimetric weights and corrected for the purity of the compound(s) used to prepare the standard. Analytical balance calibration is verified daily with C1 weight set #23-190006 which is registered with Atlantic Scale, and traceable to NIST and NJ Division of Weights and Measures.

This CRM is guaranteed stable and accurate to within the uncertainty listed for the certified value. This includes uncertainty components due to preparation, homogeneity, short term and long term stability. During the stated period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution. For further information, contact the Sales Support Department at crmsales@spexcsp.com.

Date of Certification: December 2, 2020

Certifying Officer: Shannon Mace
Shannon Macieira, Operations Manager

Report of Certification

Catalog Number: S-2986
Description: 2-Pentanone
Matrix: Methanol (Purge & Trap Grade)

Lot No. EN191002016

Ship Date: December 2, 2020
Expiration Date: December 2, 2022

This Certified Reference Material (CRM) has been prepared and certified under an ISO 9001 (certified by DQS) and ISO 17025 (accredited by A2LA), and ISO 17034 (accredited by A2LA) quality system consistent with the following standards:

- ISO 9001: Quality management systems - Requirements
- ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories
- ISO 17034: General requirements for the competence of reference material producers
- ISO Guide 30: Reference Materials - Selected terms and definitions
- ISO Guide 31: Reference Materials - Contents of certificates and lables
- ISO Guide 35: Refernece Materials - General and Statistical principals for certification
- Guide to the Expression of Uncertainty in Measurement, 2008
- EURACHEM/CITAC Guide: Qualifying Uncertainty in Analytical Measurement - Third Edition
- NIST Technical Note 1297

Storage Requirements:

To ensure the stability of the product once it arrives in your laboratory, please store this product in ambient conditions (18°C to 27°C). Note: Shipping conditions may differ from storage conditions. The EXPIRATION DATE is calculated from the SHIPPED DATE using our stability data and is applicable only if the product is stored under the laboratory specified conditions.

Instructions for Use:

Let material come to room temperature before use. Check for precipitate and if necessary sonicate for one minute. If compounds do not dissolve after one minute then sonicate further until the product is dissolved. A clear appearance is acceptable. The minimum recommended amount that should be removed from this vial is 5µL with a 25µL gas tight syringe. All solutions should be thoroughly mixed, by shaking, prior to use. All surfaces that come in contact with the solution must be thoroughly cleaned prior to use. Dilutions should be performed only with Class A volumetric glassware.

Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For assistance, please contact sales support at crmsales@spexcsp.com.

Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, and analytical instrumentation have been qualified prior to use. The highest purity solvents and Class A / calibrated volumetrics have been used in all preparations.

Homogeneity:

The homogeneity of this CRM has been confirmed by procedures consistent with ISO 17025, ISO 17034, and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed to prove homogeneity in accordance with our internal procedure 4300-HOMOGEN-1A. This is consistent with the intended use of this CRM. The Degree of Homogeneity, as expressed as maximum between-bo ttle variation, is 1.2%

Statistical Estimator and Confidence Limits:

The Certified value 'X' as listed on the reverse of this document is at the 95% level of confidence and can be expressed as:

- $X = x \pm U$ where X=certified value, U=expanded uncertainty, x=property value
- $U = ku_c$ where k=2 is the coverage factor at the 95% confidence level
- u_c = combined standard uncertainty obtained by combining the individual compound standard uncertainty components u_i, where $u_c = \sqrt{\sum u_i^2}$

Legal Notice:

SPEX CertiPrep Certified Reference Materials are not for any cosmetic, drug, or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep of any kind whatsoever, whether based on breech of warranty, alleged negligence, or otherwise, with respect to this Reference Material shall be greater than the purchase price. In no event shall SPEX CertiPrep be liable for any loss of profits or any incidental, special, or consequential damages.

SPEX CertiPrep®
Your Science is Our Passion.®

203 Norcross Ave. Metuchen, NJ 08840
www.spexcertiprep.com • E-mail: crmsales@spexcsp.com
Phone: 1-732-549-7144 • Fax 1-732-603-9647

Agilent

Certificate of Analysis

Product Name: Custom Standard

Product Number: CUS-1756

Lot Number: 0006580093

Lot Issue Date: 30-Dec-2020

Expiration Date: 31-Jan-2023

Description:
This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
acrylonitrile	000107-13-1	RM16463	5020 ± 25 µg/mL
bromoethane	000074-96-4	RM00936	5023 ± 25 µg/mL
carbon disulfide	000075-15-0	RM08158	5019 ± 25 µg/mL
iodomethane	000074-88-4	RM14171	5023 ± 25 µg/mL
1,1,2-trichlorotrifluoroethane	000076-13-1	RM04848	5025 ± 25 µg/mL
trans-1,4-dichloro-2-butene	000110-57-6	RM13971	5019 ± 25 µg/mL

Matrix: methanol (methyl alcohol)

Storage Conditions: Store Frozen (-25° to -10°C).

Traceability:
The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:
This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:
This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:
Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:
Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

J000092
Custom Mix
Solvent / Lot: Methanol
Prep: 1/5/2021 by PC
Exp: 1/31/2023
Location:

ANAB ACCREDITED ISO17034 REFERENCE MATERIAL PRODUCER
ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026
Page: 1 of 2
www.agilent.com/quality/
CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY
ISO 17025 Cert No. AT-1937

Certificate of Analysis

Product Number: CUS-1756 **Lot Number:** 0006580093

Expiration of Certification:
The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:
If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

Sample lot approver:

Monica Bourgeois
QMS Representative

ANAB ACCREDITED ISO17034 REFERENCE MATERIAL PRODUCER
ISO 17034 Cert
No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026
Page: 2 of 2
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CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY
ISO 17025 Cert
No. AT-1937

Agilent

Certificate of Analysis

Product Name: VOC Standard

Product Number: DWM-588-1

Lot Number: 0006518400

Lot Issue Date: 09-Mar-2020

Expiration Date: 30-Apr-2023

Description:

This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system, and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
bromochloromethane	000074-97-5	RM00009	2006 ± 10 µg/mL
bromodichloromethane	000075-27-4	RM14215	2010 ± 10 µg/mL
bromoform	000075-25-2	RM07516	2006 ± 10 µg/mL
carbon tetrachloride	000056-23-5	RM07576	2009 ± 10 µg/mL
chloroform	000067-66-3	RM13988	2007 ± 10 µg/mL
dibromochloromethane	000124-48-1	RM14843	2005 ± 10 µg/mL
dibromomethane	000074-95-3	RM12878	2007 ± 10 µg/mL
methylene chloride	000075-09-2	RM09575	2008 ± 10 µg/mL
trichlorofluoromethane	000075-69-4	RM00017	2010 ± 10 µg/mL
1,2-dibromoethane	000106-93-4	RM00018	2007 ± 10 µg/mL
1,1-dichloroethane	000075-34-3	RM15556	2005 ± 10 µg/mL
1,2-dichloroethane	000107-06-2	RM04655	2010 ± 10 µg/mL
1,1-dichloroethene	000075-35-4	RM14486	2009 ± 10 µg/mL
cis-1,2-dichloroethene	000156-59-2	RM15008	2009 ± 10 µg/mL
trans-1,2-dichloroethene	000156-60-5	RM07565	2006 ± 10 µg/mL
1,1,1,2-tetrachloroethane	000630-20-6	RM12632	2009 ± 10 µg/mL
1,1,2,2-tetrachloroethane	000079-34-5	NT00390	2008 ± 10 µg/mL

J000093
VOC mixture
Solvent / Lot: Methanol
Prep: 1/5/2021 by PC
Exp: 4/30/2023
Location:

ANAB ACCREDITED ISO17034 REFERENCE MATERIAL PRODUCER

ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026

www.agilent.com/quality/
CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

ISO 17025 Cert No. AT-1937

Certificate of Analysis

Product Number: DWM-588-1 **Lot Number:** 0006518400

tetrachloroethene	000127-18-4	RM06491	2008 ± 10 µg/mL
1,1,1-trichloroethane	000071-55-6	RM15035	2010 ± 10 µg/mL
1,1,2-trichloroethane	000079-00-5	RM01175	2007 ± 10 µg/mL
trichloroethene	000079-01-6	RM00029	2010 ± 10 µg/mL
1,2-dibromo-3-chloropropane	000096-12-8	RM13666	2009 ± 10 µg/mL
1,2-dichloropropane	000078-87-5	RM12821	2008 ± 10 µg/mL
1,3-dichloropropane	000142-28-9	RM02080	2008 ± 10 µg/mL
2,2-dichloropropane	000594-20-7	RM12927	2005 ± 10 µg/mL
1,1-dichloropropene	000563-58-6	RM16247	2010 ± 10 µg/mL
cis-1,3-dichloropropene	010061-01-5	RM12891	2007 ± 10 µg/mL
trans-1,3-dichloropropene	010061-02-6	RM12254	2006 ± 10 µg/mL
hexachlorobutadiene	000087-68-3	RM09157	2005 ± 10 µg/mL
1,2,3-trichloropropane	000096-18-4	RM13082	2004 ± 10 µg/mL
naphthalene	000091-20-3	NT00970	2006 ± 10 µg/mL
benzene	000071-43-2	RM12931	2009 ± 10 µg/mL
n-butylbenzene	000104-51-8	RM03651	2008 ± 10 µg/mL
sec-butylbenzene	000135-98-8	RM10905	2005 ± 10 µg/mL
tert-butylbenzene	000098-06-6	RM14040	2007 ± 10 µg/mL
ethylbenzene	000100-41-4	RM12195	2006 ± 10 µg/mL
isopropylbenzene	000098-82-8	RM00835	2009 ± 10 µg/mL
4-isopropyltoluene	000099-87-6	RM09747	2009 ± 10 µg/mL
n-propylbenzene	000103-65-1	RM12785	2010 ± 10 µg/mL

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER

ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026

www.agilent.com/quality/
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ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

ISO 17025 Cert No. AT-1937

Agilent

Certificate of Analysis

Product Number: DWM-588-1 **Lot Number:** 0006518400

styrene	000100-42-5	RM13393	2010 ± 10 µg/mL
toluene	000108-88-3	RM06650	2008 ± 10 µg/mL
1,2,4-trimethylbenzene	000095-63-6	RM06731	2002 ± 10 µg/mL
1,3,5-trimethylbenzene	000108-67-8	RM12905	2009 ± 10 µg/mL
o-xylene	000095-47-6	RM15639	2005 ± 10 µg/mL
m-xylene	000108-38-3	RM15919	2006 ± 10 µg/mL
p-xylene	000106-42-3	RM02647	2009 ± 10 µg/mL
1,4-dichlorobenzene	000106-46-7	RM12826	2009 ± 10 µg/mL
bromobenzene	000108-86-1	RM10227	2008 ± 10 µg/mL
chlorobenzene	000108-90-7	RM01874	2008 ± 10 µg/mL
2-chlorotoluene	000095-49-8	RM13774	2007 ± 10 µg/mL
4-chlorotoluene	000106-43-4	RM11750	2009 ± 10 µg/mL
1,2-dichlorobenzene	000095-50-1	RM13636	2005 ± 10 µg/mL
1,3-dichlorobenzene	000541-73-1	NT00356	2009 ± 10 µg/mL
1,2,3-trichlorobenzene	000087-61-6	RM10193	2007 ± 10 µg/mL
1,2,4-trichlorobenzene	000120-82-1	RM09454	2009 ± 10 µg/mL
bromomethane	000074-83-9	RM00064	2002 ± 10 µg/mL
chloroethane	000075-00-3	RM00065	2010 ± 10 µg/mL
chloromethane	000074-87-3	RM12571	2010 ± 10 µg/mL
dichlorodifluoromethane	000075-71-8	RM05289	2010 ± 10 µg/mL
vinyl chloride	000075-01-4	RM05458	2010 ± 10 µg/mL

Matrix: methanol (methyl alcohol)

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER

ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026

www.agilent.com/quality/ CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

ISO 17025 Cert No. AT-1937

Certificate of Analysis

Product Number: DWM-588-1 **Lot Number:** 0006518400

Storage Conditions: Store Frozen (-25° to -10°C).

Traceability:
The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:
This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:
This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:
Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:
Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

Expiration of Certification:
The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:
If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

Sample lot approver:

Monica Bourgeois
QMS Representative

ANAB ACCREDITED ISO17034 REFERENCE MATERIAL PRODUCER
ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026

www.agilent.com/quality/
CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY
ISO 17025 Cert No. AT-1937

Agilent

Certificate of Analysis

Product Name: Methyl tert-Butyl Ether Standard

Product Number: STS-440-1 **Lot Issue Date:** 19-Aug-2020

Lot Number: 0006555762 **Expiration Date:** 31-Aug-2022

Description:
This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system, and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
tert-butylmethyl ether	001634-04-4	RM06568	2006 ± 10 µg/mL

Matrix: methanol (methyl alcohol)

Storage Conditions: Store Frozen (-25° to -10°C).

Traceability:
The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:
This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:
This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:
Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:
Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

Expiration of Certification:
The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:
If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

J000094
MTBE Solution
Solvent / Lot: Methanol
Prep: 1/5/2021 by PC
Exp: 8/31/2022
Location: VOA F-40

Sample lot approver:
Monica Bourgeois
QMS Representative

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER
ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026
Page: 1 of 1
www.agilent.com/quality/
CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY
ISO 17025 Cert No. AT-1937

Reference Materials Producer
Cert #2495.01

SPEXertificate®
Certificate of Reference Material

Chemical Testing
Cert #2495.02

Catalog Number: S-3800 **Lot No.** CP201130003

Description: Vinyl acetate

Matrix: Methanol (Purge & Trap Grade)

Ship Date: January 14, 2021
Expiration Date: January 14, 2022

This **SPEXOrganics®** Certified Reference Material, CRM, is intended primarily for use as a calibration standard or quality control standard for organic chromatography instrumentation such as GC, GC-MS, LC, and LC-MS. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Compounds:

Compound	CAS #	Labeled	Purity	Certified†	Uncertainty
Vinyl acetate	108-05-4	1000 µg/mL	99%	988 µg/mL	± 35 µg/mL

J000707
Vinyl Acetate 1000
Solvent / Lot: MeOH
Prep: 1/20/2021 by PC
Exp: 1/14/2022
Location: VOA F-40

* - Isomer ratios (when applicable) are an uncertified parameter.

Final Solution Verification:

Final solution integrity verified by Gas Chromatography/Mass Spectrometry. The mass spectrum of each compound was confirmed against the NIST mass spectral database.

† Certified concentration based on gravimetric weights and corrected for the purity of the compound(s) used to prepare the standard. Analytical balance calibration is verified daily with C1 weight set #23-190006 which is registered with Atlantic Scale, and traceable to NIST and NJ Division of Weights and Measures.

This CRM is guaranteed stable and accurate to within the uncertainty listed for the certified value. This includes uncertainty components due to preparation, homogeneity, short term and long term stability. During the stated period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution. For further information, contact the Sales Support Department at crmsales@spexcsp.com.

Date of Certification: January 14, 2021

Certifying Officer: Shannon Mac

Shannon Macieira, Operations Manager

Report of Certification

Catalog Number: S-3800 **Lot No.** CP201130003

Description: Vinyl acetate

Matrix: Methanol (Purge & Trap Grade)

Ship Date: January 14, 2021

Expiration Date: January 14, 2022

This Certified Reference Material (CRM) has been prepared and certified under an ISO 9001 (certified by DQS) and ISO 17025 (accredited by A2LA), and ISO 17034 (accredited by A2LA) quality system consistent with the following standards:

- ISO 9001: Quality management systems - Requirements
- ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories
- ISO 17034: General requirements for the competence of reference material producers
- ISO Guide 30: Reference Materials - Selected terms and definitions
- ISO Guide 31: Reference Materials - Contents of certificates and lables
- ISO Guide 35: Refernece Materials - General and Statistical principals for certification
- Guide to the Expression of Uncertainty in Measurement, 2008
- EURACHEM/CITAC Guide: Qualifying Uncertainty in Analytical Measurement - Third Edition
- NIST Technical Note 1297

Storage Requirements:

To ensure the stability of the product once it arrives in your laboratory, please store this product in a freezer (-35°C to -10°C). Note: Shipping conditions may differ from storage conditions. The EXPIRATION DATE is calculated from the SHIPPED DATE using our stability data and is applicable only if the product is stored under the laboratory specified conditions.

Instructions for Use:

Let material come to room temperature before use. Check for precipitate and if necessary sonicate for one minute. If compounds do not dissolve after one minute then sonicate further until the product is dissolved. A clear appearance is acceptable. The minimum recommended amount that should be removed from this vial is 5µL with a 25µL gas tight syringe. All solutions should be thoroughly mixed, by shaking, prior to use. All surfaces that come in contact with the solution must be thoroughly cleaned prior to use. Dilutions should be performed only with Class A volumetric glassware.

Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For assistance, please contact sales support at crmsales@spexcsp.com.

Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, and analytical instrumentation have been qualified prior to use. The highest purity solvents and Class A / calibrated volumetrics have been used in all preparations.

Homogeneity:

The homogeneity of this CRM has been confirmed by procedures consistent with ISO 17025, ISO 17034, and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed to prove homogeneity in accordance with our internal procedure 4300-HOMOGEN-1A. This is consistent with the intended use of this CRM. The Degree of Homogeneity, as expressed as maximum between-bo ttle variation, is 1.2%

Statistical Estimator and Confidence Limits:

The Certified value 'X' as listed on the reverse of this document is at the 95% level of confidence and can be expressed as:

- $X = x \pm U$ where X=certified value, U=expanded uncertainty, x=property value
- $U = ku_c$ where k=2 is the coverage factor at the 95% confidence level
- u_c = combined standard uncertainty obtained by combining the individual compound standard uncertainty components u_i, where $u_c=\sqrt{\sum u_i^2}$

Legal Notice:

SPEX CertiPrep Certified Reference Materials are not for any cosmetic, drug, or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep of any kind whatsoever, whether based on breech of warranty, alleged negligence, or otherwise, with respect to this Reference Material shall be greater than the purchase price. In no event shall SPEX CertiPrep be liable for any loss of profits or any incidental, special, or consequential damages.

SPEX CertiPrep®
Your Science is Our Passion.®

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www.spexcertiprep.com • E-mail: crmsales@spexcsp.com
Phone: 1-732-549-7144 • Fax 1-732-603-9647

Absolute Standards, Inc.
800-368-1131
www.absolutestandards.com

Certified Reference Material CRM

ANAB ISO 17034 Accredited
AR-1539 Certificate Number
https://Absolutestandards.com

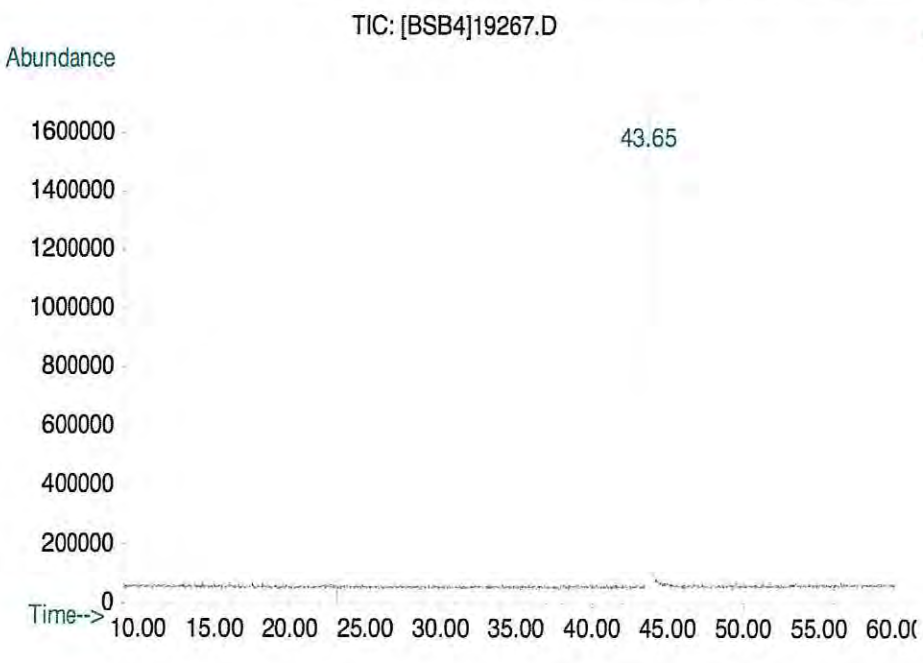
CERTIFIED WEIGHT REPORT

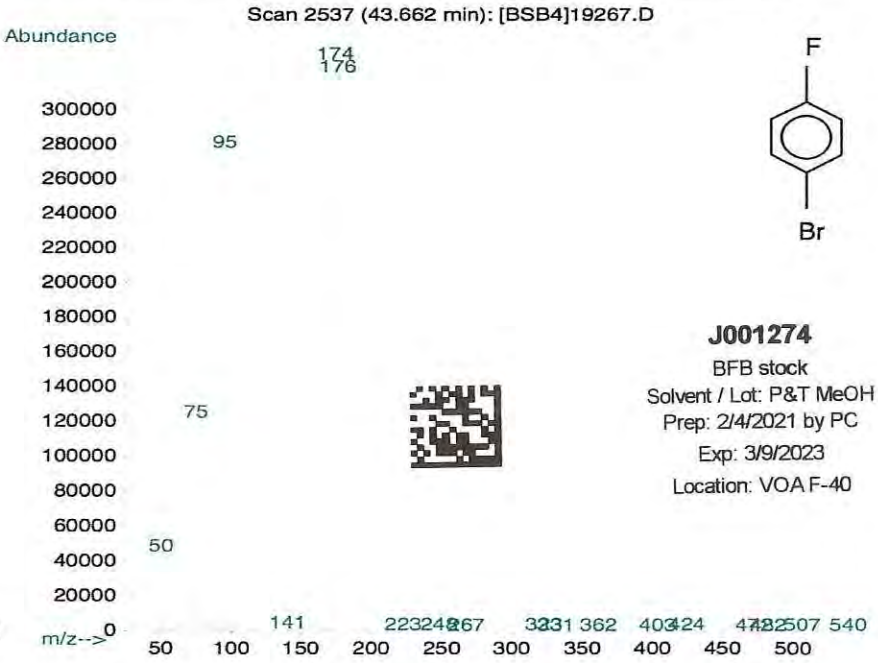
Part Number:	**19267**	**Solvent(s):**	**Lot#**
Lot Number:	030918	Methanol	DS435
Description:	p-Bromofluorobenzene		
	EPA Method 502/524 Surrogate Standard #2		
Expiration Date:	030923		
Recommended Storage:	Refrigerate (4 °C)		
Nominal Concentration (µg/mL):	2000		
NIST Test ID#:	2506734D	5E-05 Balance Uncertainty	
Weight(s) shown below were combined and diluted to (mL):	100.0	0.001 Flask Uncertainty	

	030918
Formulated By: Jason Criscio	DATE
	030918
Reviewed By: Pedro L. Rentas	DATE

Compound	RM#	Lot Number	Nominal Conc (µg/mL)	Purity (%)	Uncertainty Purity	Target Weight(g)	Actual Weight(g)	Actual Conc (µg/mL)	Expanded Uncertainty (+/-) (µg/mL)	SDS Information (Solvent Safety Info. On Attached pg.) CAS#	OSHA PEL (TWA)	LD50
1. p-Bromofluorobenzene	48	01127COV	2000	99	0.2	0.20204	0.20234	2002.9	8.2	460-00-4	N/A	orl-rat 2700mg/kg

Method: GC6MSD-1: **Detector:** Mass Selective Detector. **Column:** Vocol (60m X 0.25mm ID X 1.5µm film thickness). **Oven Profile:** Temp. 1 = 35°C (Time1=10min.), Temp. 2 = 200°C (Time2=8.75 min.), Rate = 4°C/min., Injector Temp.= 200°C, Detector Temp. = 220°C. **Analyst:** Candice Warren.





J001274
BFB stock
Solvent / Lot: P&T MeOH
Prep: 2/4/2021 by PC
Exp: 3/9/2023
Location: VOA F-40

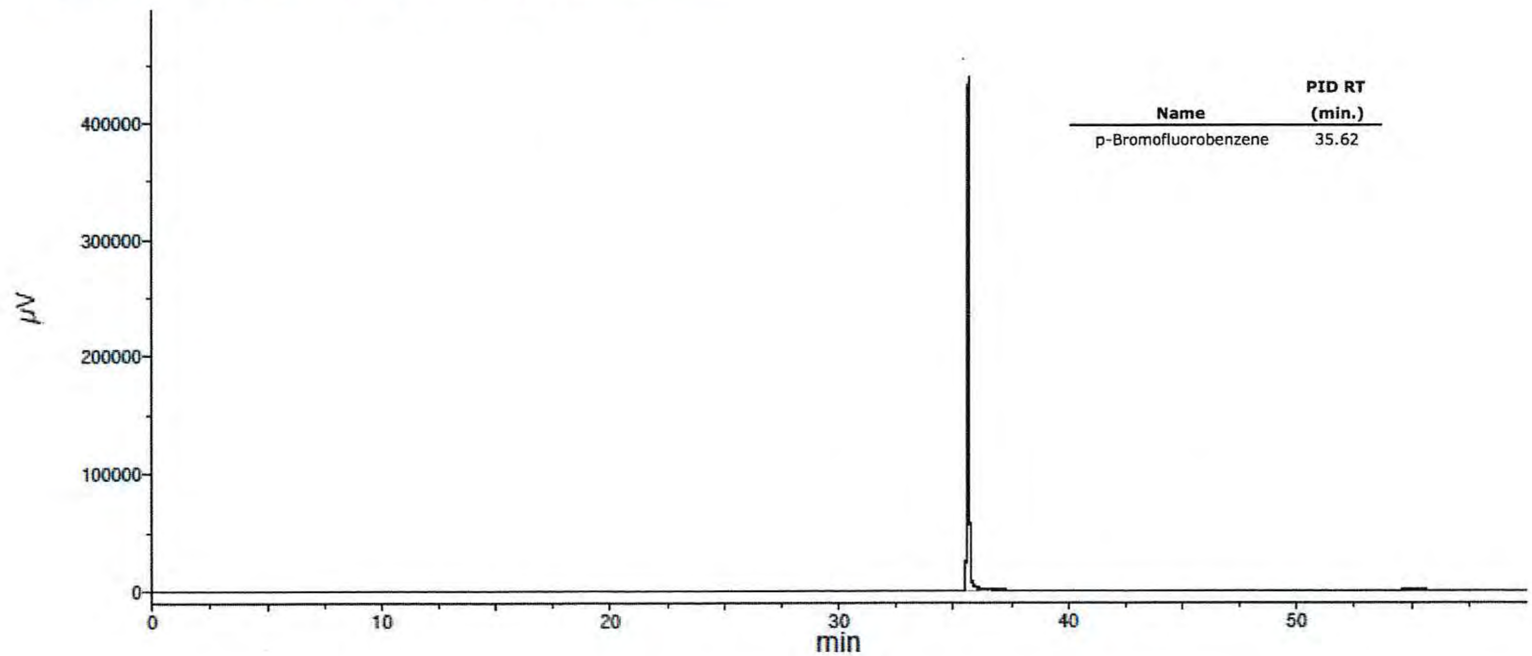
- **The certified value is the concentration calculated from gravimetric and volumetric measurements unless otherwise stated.**
- **Standards are prepared gravimetrically using balances that are calibrated with weights traceable to NIST (see above).**
- **Standards are certifed (+/-) 0.5% of the stated value, unless otherwise stated.**
- **All Standards, after opening ampule, should be stored with caps tight and under appropriate laboratory conditions.**
- **Uncertainty Reference: Taylor, B.N. and Kuyat, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Result," NIST Technical Note 1297, U.S. Government Printing Office, Washington, DC, (1994).**

Run 37, "P19267 L030918 [2000μg/mL in MeOH]"

Run Length: 60.00 min, 36000 points at 10 points/second.
Created: Mon, Mar 12, 2018 at 10:30:10 AM.
Sampled: Sequence "030818-GC1", Method "GC1-M7".
Analyzed using Method "GC1-M7".

Comments

GC1-M7 Analysis by Candice Warren
Column ID SPB-Vocol 105 meter X 0.53mm X 3.0μm film thickness
Flow rates: Total flow=150mL/min., Helium (carrier)=10mL/min.,
Helium(make-up)=40mL/min., Hydogen(make-up)=100mL/min.
Oven Profile: Temp. 1=35˚C (Time 1=10 min.), Temp 2=200˚C (Time 2=8.75 min.),
Rate = 4˚C/min., Total run time=60 min. Injector temp.=200˚C, FID Temp.=200˚C.
ELCD Signal = Edaq Channel 1 PID Signal = Edaq Channel 2
Standard injection = 0.5μL, Range=4 Purge Valve = 8 min.



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Cert. No. 3031.01

Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
120016-01	434093	≤ -10 °C	P/T Methanol	9-Feb-2026	Method 8260 Gases, 2,000 mg/L, 1 mL

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
bromomethane	74-83-9	99.5	139.158.1.1P	2009 ± 4.5	mg/L
chloroethane	75-00-3	99.94	141.2.2P	2005 ± 4.03	mg/L
chloromethane	74-87-3	99	140.158.2.2P	1997 ± 20.36	mg/L
dichlorodifluoromethane	75-71-8	99	142.158.5P	1993 ± 20.32	mg/L
trichlorofluoromethane	75-69-4	99	144.1.3P	2000 ± 12.17	mg/L
vinyl chloride	75-01-4	99	143.158.5.1P	1987 ± 20.26	mg/L

J002342
CLP VOA Gases Stock
Solvent / Lot: MeOH
Prep: 3/2/2021 by PC
Exp: 2/9/2026
Location: VOA F-40

Certified By: _____
Erica Lawson
Manufacture Date 10-Feb-2021

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.
The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

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Certificate of Analysis

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Certificate #3222.02

FOR LABORATORY USE ONLY-READ SDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 30216 **Lot No.:** A0170990

Description : Vinyl Acetate Standard

Vinyl Acetate Standard 2000 µg/mL, P&T Methanol, 1mL/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : October 31, 2022 **Storage:** -20°C or colder

Handling: This product is photosensitive. **Ship:** On Ice

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Vinyl acetate	2,006.0 µg/mL	+/- 11.7723	µg/mL	Gravimetric
	CAS # 108-05-4 (Lot RD200601)		+/- 121.0414	µg/mL	Unstressed
	Purity 99%		+/- 121.3288	µg/mL	Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

J005912
Vinyl Acetate
Solvent / Lot: p&t methanol
Prep: 6/4/2021 by PC
Exp: 10/31/2022
Location: VOA F-40

Tech Tips:
Vinyl acetate is a volatile organic ester included in the target lists of several US EPA and other methods . Under acidic conditions, esters react with alcohols to form new esters (transesterification). Methanol-based mixes containing halogenated compounds are slightly acidic, so it is important to minimize exposure of vinyl acetate to mixes of halogenated compounds in methanol. For this reason, we offer vinyl acetate in individual solution, and suggest that it be introduced into the working level calibration solution immediately before use. This will minimize problems and ensure more consistent results.

Column:
105m x 0.53mm x 3.0µm
Rtx-502.2 (cat.#10910)

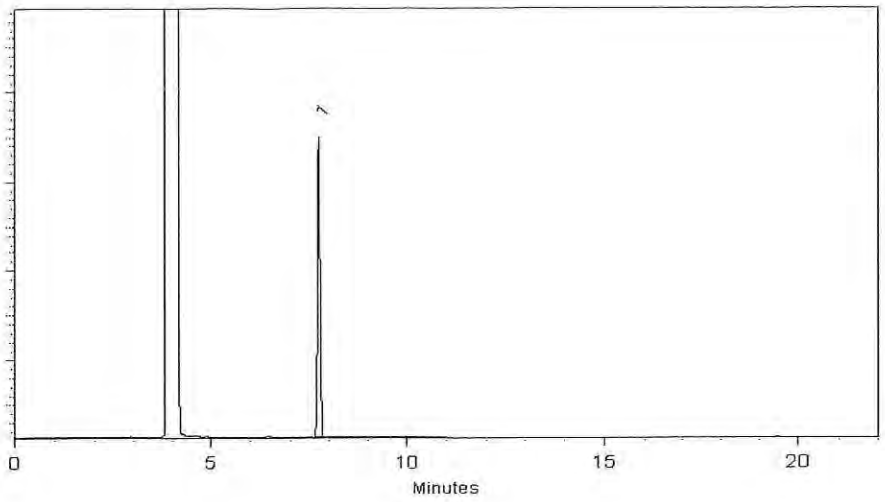
Carrier Gas:
hydrogen-constant pressure 11.0 psi.

Temp. Program:
40°C (hold 2 min.) to 240°C
@ 8°C/min. (hold 5 min.)

Inj. Temp:
200°C

Det. Temp:
250°C

Det. Type:
FID



This chromatogram represents a general set of testing conditions chosen for product acceptance. For optimal results in your lab, conditions should be adjusted for your specific instrument, method, and application.

Russ Bookhamer - Operations Technician I

Date Mixed: 05-Apr-2021 **Balance:** 1128342314

Alexis Shelow - Operations Tech I

Date Passed: 09-Apr-2021

Manufactured under Restek's ISO 9001:2015 Registered Quality System Certificate #FM 80397

Agilent

Certificate of Analysis

Product Name: 1,2-Dichlorobenzene-d4 Standard

Product Number: STS-210-1 **Lot Issue Date:** 11-Aug-2020

Lot Number: 0006552847 **Expiration Date:** 30-Sep-2024

Description:

This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system, and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
1,2-dichlorobenzene-d4	002199-69-1	RM11038	2002 ± 10 µg/mL

Matrix: methanol (methyl alcohol)

Storage Conditions: Store Frozen (-25° to -10°C).

Traceability:

The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:

This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:

This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:

Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:

Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

Expiration of Certification:

The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:

If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

J007623

d4 1,2 Dichlorobenzene Stock
Solvent / Lot: Methanol
Prep: 7/23/2021 by PC
Exp: 9/30/2024
Location: VOA F-40

Sample lot approver:

Monica Bourgeois
QMS Representative

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER
ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026

Page: 1 of 1

www.agilent.com/quality/

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Cert. No. 3031.01

Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
120002-01-5PAK	456477	≤ -10 °C	P/T Methanol	22-Jul-2026	8260B Surrogate Solution, 2,000 mg/L, 5 x 1 ml

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
4-bromofluorobenzene (BFB)	460-00-4	99.5	135.7.1P	1982 ± 25.4	mg/L
dibromofluoromethane	1868-53-7	99	136.290.3P	2008 ± 28.96	mg/L
1,2-dichloroethane-d4	17060-07-0	99.8	138.120.2P	1992 ± 25.6	mg/L
toluene-d_8	2037-26-5	100	137.12.4P	2003 ± 25.74	mg/L

J008077
8260B Surrogate Solution
Solvent / Lot: Methanol
Prep: 8/5/2021 by PC
Exp: 7/22/2026
Location:

Certified By: _____
Jared Ball
Manufacture Date 23-Jul-2021

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.
The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

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Date Received: _____

Certificate of Analysis

Catalog No.:	Lot No.:	Storage:	Solvent:	Exp. Date:	Description:
121020-02	425069	≤ 6 °C	P/T Methanol	1-Oct-2025	Ketones Solution, 5000 mg/L, 1 mL

Compound	CAS No.	Purity (%)	Neat Material Lot No.	Concentration	
acetone	67-64-1	99.6	196.271.4P	5024 ± 52.27	mg/L
2-butanone (MEK)	78-93-3	99.9	197.18.1P	5018 ± 72.37	mg/L
2-hexanone	591-78-6	99.7	199.7.2.1P	5002 ± 52.22	mg/L
4-methyl-2-pentanone (MIBK)	108-10-1	99.6	198.1.3P	5015 ± 72.32	mg/L

J008079
Ketones SS Stock
Solvent / Lot: P/T Methanol
Prep: 8/5/2021 by PC
Exp: 10/1/2025
Location: VOA F-40

Certified By: Melissa Workoff

Melissa Workoff
Manufacture Date 2-Oct-2020

Follow all storage requirements, keep tightly closed when not in use, and use good laboratory practices when handling.
This Reference Material was manufactured, produced, and/or certified under a quality management system that is accredited to ISO 17034 and ISO/IEC 17025.

All weights are traceable through N. I. S. T. Test No. 822/264157-00.
Concentration (correct for purity) and uncertainty (95% confidence) values listed are determined gravimetricly.

The stated uncertainty is the expanded uncertainty with a coverage factor of two to give a 95% confidence level.

CERTIFIED WEIGHT REPORT

Part Number:	92579	**Solvent(s):**	**Lot#**
Lot Number:	052319	Methanol	DU230-US (90%)
Description:	2-Pentanone	Water	011619 (10%)
Expiration Date:	052324		
Recommended Storage:	Refrigerate (4 °C)		
Nominal Concentration (µg/mL):	2000		
NIST Test ID#:	6UTB	5E-05	Balance Uncertainty
Weight(s) shown below were combined and diluted to (mL):	25.0	0.002	Flask Uncertainty

J008176
2- entonone 2www
Solvent Lot: MeOH
reᵛ:Ŏr r2w2ODyŎ C
K:Ŏr2kr2w2C
Lo ! t'on:Ŏ O$Ŏ Gw

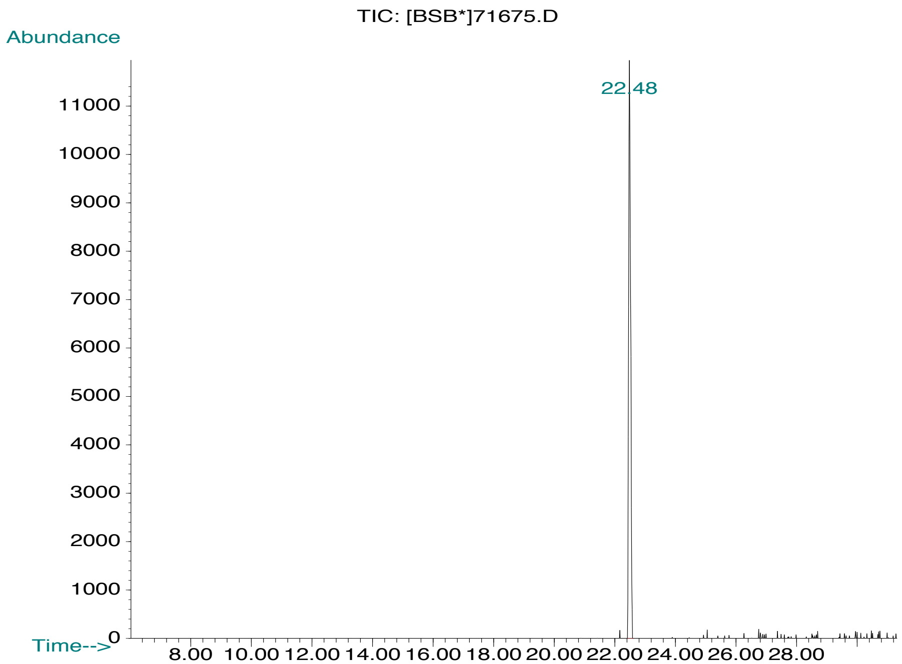
Formulate[redacted] 052319 DATE

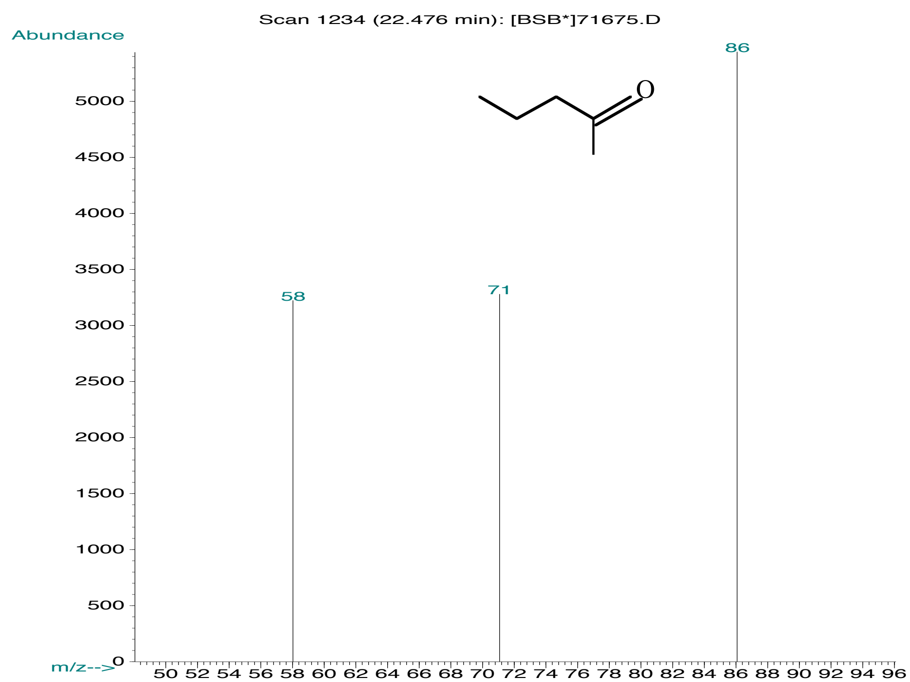
Reviewed By: Pedro L. Rentas 052319 DATE

Compound	RM#	Lot Number	Nominal Conc (µg/mL)	Purity (%)	Uncertainty Purity	Target Weight(g)	Actual Weight(g)	Actual Conc (µg/mL)	Expanded Uncertainty (+/-) µg/mL	CAS#	OSHA PEL (TWA)	LD50
1. 2-Pentanone	1675	ER 07040KN	2000	99	0.2	0.05051	0.05060	2003.5	9.0	107-87-9	N/A	N/A

SDS Information (Solvent Safety Info. On Attached pg.)

Method GC6MSD-1: Column: Vocol (60m X 0.25mm ID X 1.5µm film thickness). Temp. 1 = 35°C (10min.), Temp. 2 = 200°C (8.75 min.), Rate = 4°C/min., Injector Temp. = 200°C, Detector Temp. = 220°C. Solvent Delay: 7 minutes. Analysis performed by Candice Warren.



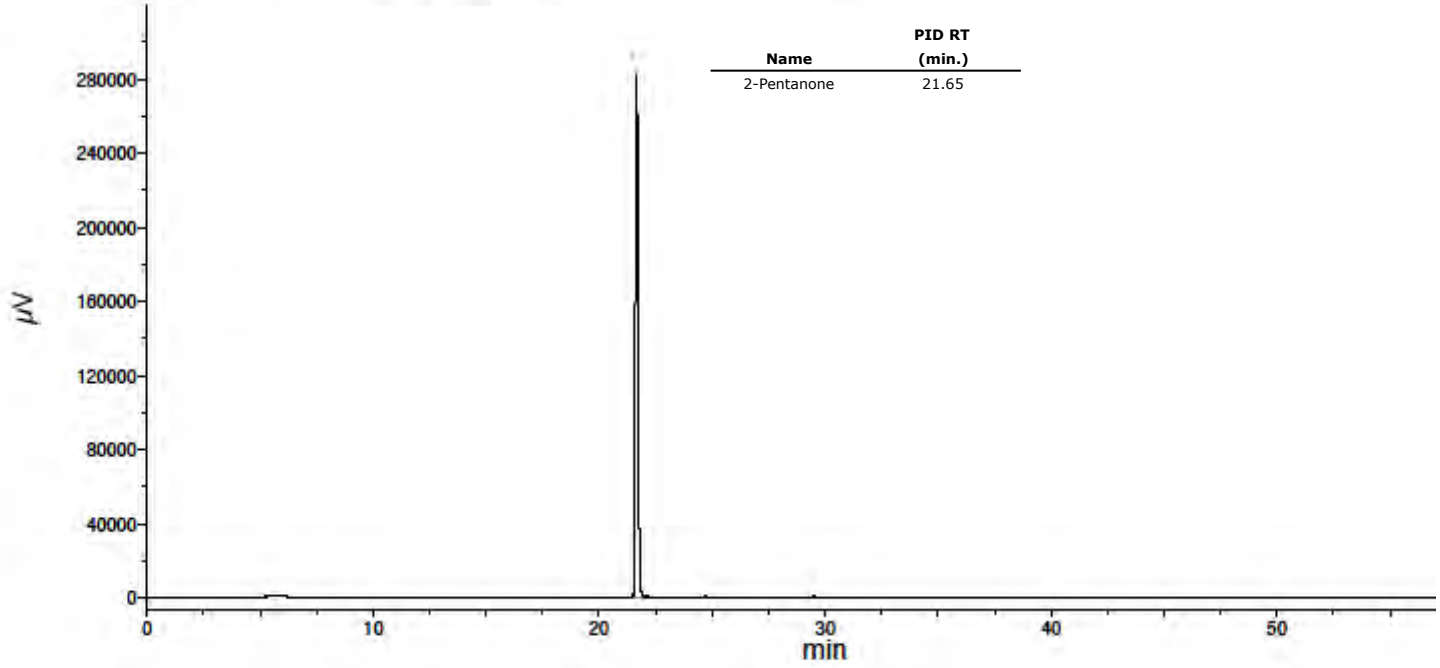


- **The certified value is the concentration calculated from gravimetric and volumetric measurements unless otherwise stated.**
- **Standards are prepared gravimetrically using balances that are calibrated with weights traceable to NIST (see above).**
- **Standards are certifed (+/-) 0.5% of the stated value, unless otherwise stated.**
- **All Standards, after opening ampule, should be stored with caps tight and under appropriate laboratory conditions.**
- **Uncertainty Reference: Taylor, B.N. and Kuyat, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Result," NIST Technical Note 1297, U.S. Government Printing Office, Washington, DC, (1994).**

Run 119, "P92579 L052319 [2000µg/mL in M:W(9:1)]"

Run Length: 60.00 min, 36000 points at 10 points/second.
Created: Mon, May 27, 2019 at 8:24:48 PM.
Sampled: Sequence "052119-GC1", Method "GC1-M7".
Analyzed using Method "GC1-M7".

Comments
GC1-M7 Analysis by Candice Warren
Column ID SPB-Vocol 105 meter X 0.53mm X 3.0µm film thickness
Flow rates: Total flow=150mL/min., Helium (carrier)=10mL/min.,
Helium(make-up)=40mL/min., Hydogen(make-up)=100mL/min.
Oven Profile: Temp. 1=35˚C (Time 1=10 min.), Temp 2=200˚C (Time 2=8.75 min.),
Rate = 4˚C/min., Total run time=60 min. Injector temp.=200˚C, FID Temp.=200˚C.
ELCD Signal = Edaq Channel 1 PID Signal = Edaq Channel 2
Standard injection = 1.0µL, Range=4 Purge Valve = 8 min.



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FOR LABORATORY USE ONLY-READ SDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : !!!"　　**Lot No.:** #!$"%&"

Description : '(#　)*+,-./+0-12)3-4)5$

'(#　)*+,-./+0-12)3-4)5$)67!!!89:;<7)=>　?)3@0A+21B +0@CD!E$!F7)
$;<:+;GH,

Container Size : L);<　　**Pkg Amt:** M)$);<

Expiration Date : N@J@;.@/) $7)L!L　　**Storage:** !!*)1/)J1,K@/

Ship: #;.-@20

CERTIFIED VALUES

Elution Order	Compound			Grav. Conc. (weight/volume)		Expanded Uncertainty (95% C.L.; K=2)			
1	Acetone			5,002.8	µg/mL	+/-	29.0869	µg/mL	Gravimetric
	CAS #	67-64-1	(Lot SHBL7812)			+/-	301.8431	µg/mL	Unstressed
	Purity	99%				+/-	302.5597	µg/mL	Stressed
2	2-Butanone (MEK)			5,015.7	µg/mL	+/-	29.1615	µg/mL	Gravimetric
	CAS #	78-93-3	(Lot SHBL6194)			+/-	302.6174	µg/mL	Unstressed
	Purity	99%				+/-	303.3359	µg/mL	Stressed
3	4-Methyl-2-pentanone (MIBK)			5,008.7	µg/mL	+/-	29.1208	µg/mL	Gravimetric
	CAS #	108-10-1	(Lot SHBL5515)			+/-	302.1951	µg/mL	Unstressed
	Purity	99%				+/-	302.9125	µg/mL	Stressed
4	2-Hexanone			5,004.2	µg/mL	+/-	29.0947	µg/mL	Gravimetric
	CAS #	591-78-6	(Lot MKCL1599)			+/-	301.9236	µg/mL	Unstressed
	Purity	99%				+/-	302.6404	µg/mL	Stressed

Solvent: P&T Methanol/Water (90:10)
CAS # 67-56-1/7732-18-5
Purity 99%

J008268
Kɍ tonɍ sǑto !
Solvɍ ntǑǑLot:Ǒẇ1ẇǑMɍ thanol:Watɍ
Cɍ Ɏ:Ǒ8/11/ȑ ẇȑ 1Ǒ, ǑC
¯KɎ:Ǒ1ȑ /ƙ1/ȑ ẇȑ ƙ
Lo at"on:Ǒ#$ %Ǒ&'(ẇ

Column:
105m x 0.53mm x 3.0µm
Rtx-502.2 (cat.#10910)

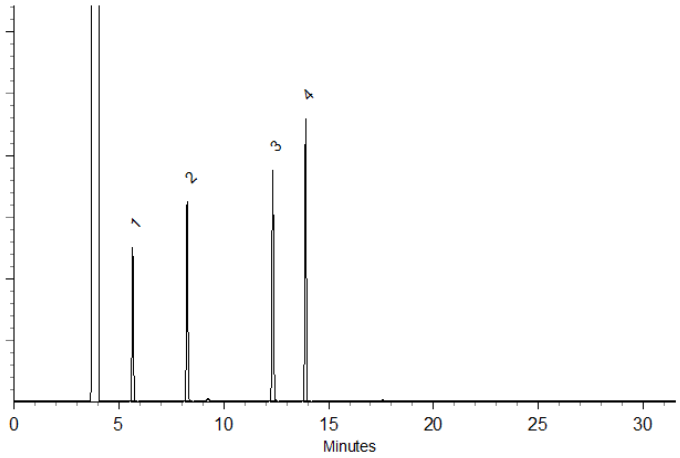
Carrier Gas:
hydrogen-constant pressure 11.0 psi.

Temp. Program:
40°C (hold 2 min.) to 240°C
@ 8°C/min. (hold 5 min.)

Inj. Temp:
200°C

Det. Temp:
250°C

Det. Type:
FID



?A-S)JA/1;+019/+;)/@G/@S@20S)+)9@2@/+,)S@0)1R)0@S0-29)J12K-0-12S)JA1S@2)R1/)G/1KHJ0)
+JJ@G0+2J@Q))T1/)1G0-;+,)/@SH,0S)-2)U1H/),+.7)J12K-0-12S)SA1H,K).@)+KVHS0@K)R1/)U1H/)
SG@J-R-J)-2S0/H;@207);@0A1K7)+2K)+GG,-J+0-12Q

Jeremy Johnson - Mfg. Supervisor

Date Mixed: 25-Sep-2020 **Balance:** B251644995

Justine Albertson - Operations Tech-ARM QC

Date Passed: 30-Sep-2020

Manufactured under Restek's ISO 9001:2015
Registered Quality System
Certificate #FM 80397

!$O#H9OL!L!)/@PQ

ȡ)L)1R

General Certified Reference Material Notes

Expiration Notes:

- [4G-/+0-12)K+0@)P+,-K)R1/)H21G@2@K)+;GH,)S01/@K)-2)J1;G,-+2J@)\-0A)0A@)/@J1;;@2K@K)J12K-0-12SQ
-]2J@/0+-20U7)J12J@20/+0-127)+2K)@4G-/+0-12)1R)0A@)*X3)+/@).+S@K)12)0A@)H21G@2@K)G/1KHJ0).@-29)S01/@K)+JJ1/K-29)0 /@J1;;@2K@K)J12K-0-12)R1H2K)-2)0A@)S01/+9@)R-@,KQ

Purity Notes:

- =H/-0U)+2K:1/)JA@;-J+,)-K@20-0U)+/@)K@0@/;-2@K).U)12@)1/);1/@)1R)0A@)R1,,1\-29)0@JA2-^H@SE)_*:T`N7)a=<*7)_*:8[*N7) _*:3b7)<*:3b7)X`7)+2K:1/);@,0-29)G1-20Q
- *1;G1H2KS)\-0A)+),-S0@K)GH/-0U)1R),@SS)0A+2)DDc)A+P@).@@2)\@-9A0)J1//@J0@K)01)J1;G@2S+0@)R1/)-;GH/-0-@S)+2K:1/)S+ J1//@J0-12)R+J01/)-S)HS@K)01)J+,JH,+0@)0A@)+;1H20)1R)J1;G1H2K)2@J@SS+/U)01)+JA-@P@)0A@)K@S-/@K)J12J@20/+0-12)1 G+/@20)J1;G1H2K)-2)S1,H0-12Q))
- =H/-0U)1R)-S1;@/-J)J1;G1H2KS)-S)/@G1/0@K)+S)0A@)SH;)1R)0A@)-S1;@/SQ))
- =H/-0U)P+,H@S)+/@)/1H2K@K)01)0A@)2@+/@S0)\A1,@)2H;.@/Q

Certified Uncertainty Value Notes:

- ?A@)H2J@/0+-20-@S)+/@)K@0@/;-2@K)-2)+JJ1/K+2J@)\-0A)`b()$&! %)+2K)_H-K@) 6Q)?A@)J@/0-R-@K)J1;.-2@K)S0/@SS@K) H2J@/0+-20U)P+,H@)C)-2J,HK@S)9/+P-;@0/-J)H2J@/0+-20U7)A1;19@2@-0U).@0\@@2O+;GH,)H2J@/0+-20U7)S01/+9@)S0+.-,-0U H2J@/0+-20U)+2K)SA-GG-29)S0+.-,-0U)H2J@/0+-20U)+2K)\@/@)J1;.-2@K)HS-29)0A@)R1,,1\-29)R1/;H,+E

$$U_{combined\ stressed} = k\sqrt{U^2_{gravimetric} + U^2_{homogeneity} + U^2_{storage\ stability} + U^2_{shipping\ stability}}$$

k -S)+)J1P@/+9@)R+J01/)1R)L7)\A-JA)9-P@S)+),@P@,)1R)J12R-K@2J@)1R)+GG/14-;+0@,U)D6cQ

- `0)-S)-;G1/0+20)01)210@)0A+0)0A@)SA-GG-29)S0+.-,-0U)H2J@/0+-20U)\+S)1.0+-2@K)H2K@/)0@;G@/+0H/@)@40/@;@S)R1/)SG@J -20@/P+,Sd)0A@)@R1/@7)0A@)J@/0-R-@K)J1;.-2@K)S0/@SS@K)H2J@/0+-20U)P+,H@)SA1H,K)12,U).@)+GG,-@K)01)0A@)G/1KH S01/@K)+0)212OS0+2K+/K)0@;G@/+0H/@)J12K-0-12S)HG)01)+2K)-2J,HK-29)K+U)L6cQ)@@)J@/0-R-@K)J1;.-2@K)A2-J+,)b@/P-J@)+0) \\\Q/@S0@eQJ1;:*120+J0O)S)R1/)HS@)/@J1;;@2K+0-12S)-R)U1H/)SA-G;@20)\+S)-2O0/+2S-0)R1/);1/@)0A+2)&)K+US)+0))212O S0+2K+/K)0@;G@/+0H/@)J12K-0-12SQ
- #GG,U)0A@)J@/0-R-@K)J1;.-2@K)H2S0/@SS@K)H2J@/0+-20U)P+,H@)-R)0A@)G/1KHJ0)\+S)/@J@-P@K)H2K@/)S0+2K+/K)SA-GG J12K-0-12SQ)))#GG,U)0A@)J@/0-R-@K)J1;.-2@K)S0/@SS@K)H2J@/0+-20U)P+,H@)-R)0A@)G/1KHJ0)\+S)/@J@-P@K)H2K@/)212O J12K-0-12S)+S)SG@J-R-@K).@,1\Q)

Label Conditions	Standard Conditions	Non-Standard Conditions
L6I*)W1;-2+,))CX11;)?@;G@/+0H/@F	f)"!I*)	Z)"!I*)HG)01)&)K+US
$!I*)1/)J1,K@/)CX@R/-9@/+0@F	f)%!I*)	Z)%!I*)HG)01)&)K+US
!I*)1/)J1,K@/)CT/@@Y@/F OL!I*)1/)J1,K@/)CN@@G)T/@@Y@/F	f)L6I*)	Z)L6I*))HG)01)&)K+US

- b@G+/+0@)C210)J1;.-2@KF)H2J@/0+-20U)P+,H@S)R1/)9/+P-;@0/-J)H2J@/0+-20U)+/@)+,S1)K-SG,+U@K)12)0A@)J@/0-R-J+0@7)-R S@G+/+0@)A1;19@2@-0U).@0\@@2O+;GH,)H2J@/0+-20U7)S01/+9@)S0+.-,-0U)H2J@/0+-20U)+2K)SA-GG-29)S0+.-,-0U)H2J@/0+-20 +/@)+P+-,+.,@).U)J120+J0-29)X@S0@e)?@JA2-J+,)b@/P-J@)+0)\\\Q/@S0@eQJ1;:*120+J0O)S
- ?A@)G+Je+9@K)+;1H20)-S)0A@);-2-;H;)S+;G,@)S-Y@)R1/)\A-JA)H2J@/0+-20U)-S)P+,-KQ))?A@)+;GH,@S)+/@)1P@/OR-,,@K)01)@2 0A+0)0A@);-2-;H;)G+Je+9@K)+;1H20)J+2).@)/@J1P@/@K)R/1;)0A@)+;GH,@)@20,U)0/+2SR@/@K

Manufacturing Notes:

- *12J@20/+0-12)-S).+S@K)HG12)9/+P-;@0/-J)G/@G+/+0-12)HS-29)@-0A@/)+).+,+2J@)\A1S@)J+,-./+0-12)A+S).@@2)P@/-R-@K)K+-,U HS-29)W`b)*0/+J@+.,@)\@-9A0S)0A+0)+/@)K1H.,@)J1;G+/@K)01)@+JA)1R)K-,H0-12S)\-0A)*,+SS)#)X$:9,+SS\+/@Q

Handling Notes:

- b0+.-,-0U)1R)0A@)H21G@2@K)G/1KHJ07)\A@2)S01/@K)-2)J1;G,-+2J@)\-0A)0A@)/@J1;;@2K@K)J12K-0-12S7)-S)9H+/+20@@K)0A/1 0A@)@4G-/+0-12)K-SG,+U@K)12)0A@)G/1KHJ0),+.@,)+2K)J@/0-R-J+0@Q)*120+J0)X@S0@e)R1/)+KK-0-12+,)1G@2@K)G/1KHJ0)S0 -2R1/;+0-127)\-0A)0A@)e21\,@K9@:H2K@/S0+2K-29)0A+0)1G@2@K)G/1KHJ0)S0+.-,-0U)-S)SH.V@J0)01)0A@)SG@J-R-J)A+2K,-29)+2K) @2P-/12;@20+,)J12K-0-12S)01)\A-JA)0A@)G/1KHJ0)-S)@4G1S@K)Q)T1/)U1H/)J12P@2-@2J@)X@S0@e)SHGG,-@S)K@+J0-P+0@K) ;1S0)S0+2K+/KS)G+Je@K)-2)L)+;GH,@S)1/)<+/9@/)P1,H;@)K@+J0-P+0@K)P-+,S)+/@)+P+-,+.,@)0A/1H9A)X@S0@e)+S)+)JHS01;) 1/K@/@K)-0@;Q)#KK-0-12+,,U7)X@S0@e)S@,,S)N3N*b)R1/)0A@)GH/G1S@)1R)9,+SS\+/@)K@+J0-P+0-12)+S)J+0+,19)2H;.@/) $g"$7 \A-JA)-2J,HK@S)J1;G,@0@)-2S0/HJ0-12SQ

Agilent

Certificate of Analysis

Product Name: Acrolein Standard

Product Number: AM-170-1 **Lot Issue Date:** 26-Jul-2021

Lot Number: 0006622911 **Expiration Date:** 30-Nov-2021

Description:
This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
acrolein	000107-02-8	RM18390	100.1 ± 0.5 µg/mL

Matrix: methanol (methyl alcohol)

Storage Conditions: Store Frozen (-25° to -10°C).

Traceability:
The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:
This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:
This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:
Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:
Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

Expiration of Certification:
The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:
If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

J009008
Acrolein SCV
Solvent / Lot: MeOH
Prep: 8/23/2021 by LH
Exp: 11/30/2021

Sample lot approver:

Monica Bourgeois
QMS Representative

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER
ISO 17034 Cert
No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026

www.agilent.com/quality/
CSD-QA-015.1

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY
ISO 17025 Cert
No. AT-1937

250 Smith Street North Kingstown, Rhode Island 02852 www.agilent.com/quality

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CERTIFIED REFERENCE MATERIAL

Certificate of Analysis

ACCREDITED
ISO 17034 Accredited
Reference Material Producer
Certificate #3222.01

ACCREDITED
ISO/IEC 17025 Accredited
Testing Laboratory
Certificate #3222.02

FOR LABORATORY USE ONLY-READ SDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 30645 **Lot No.:** A0173747

Description : Acrolein Standard

Acrolein Standard 5000 µg/mL, P&T Methanol 1mL/ampul

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : September 30, 2021 **Storage:** 0°C or colder

Handling: This product is photosensitive. **Ship:** On Ice

CERTIFIED VALUES

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)	
1	Acrolein	5,026.7 µg/mL	+/- 29.4993 µg/mL	Gravimetric
	CAS # 107-02-8 (Lot RD210416)		+/- 100.4390 µg/mL	Unstressed
	Purity 99%		+/- 225.2970 µg/mL	Stressed

Solvent: P&T Methanol
CAS # 67-56-1
Purity 99%

J009159
Acrolein
Solvent / Lot: MeOH
Prep: 8/25/2021 by PC
Exp: 9/30/2021
Location: VOA F-40

Column:
105m x 0.53mm x 3.0µm
Rtx-502.2 (cat.#10910)

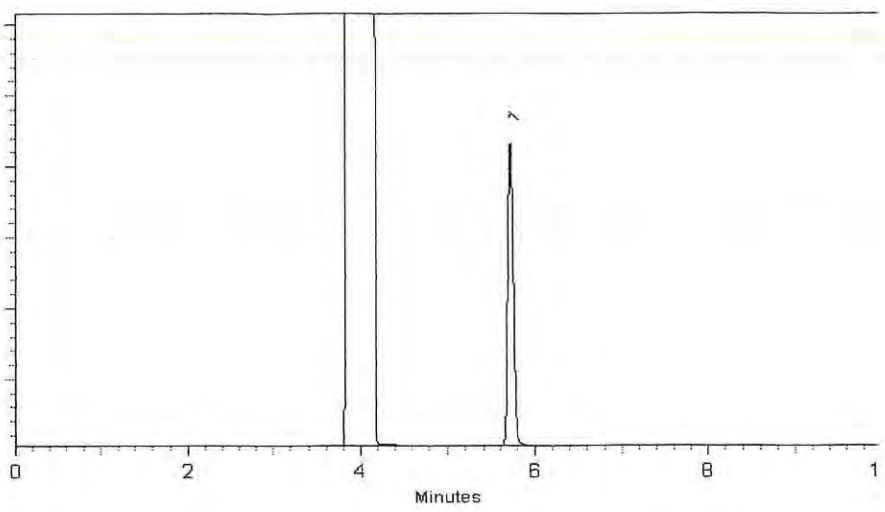
Carrier Gas:
hydrogen-constant pressure 11.0 psi.

Temp. Program:
40°C (hold 2 min.) to 240°C
@ 8°C/min. (hold 5 min.)

Inj. Temp:
200°C

Det. Temp:
250°C

Det. Type:
FID



This chromatogram represents a general set of testing conditions chosen for product acceptance. For optimal results in your lab, conditions should be adjusted for your specific instrument, method, and application.

Tom Suckar - Mix Technician

Date Mixed: 23-Jun-2021 **Balance:** B707717271

Alexis Shelow - Operations Tech I

Date Passed: 29-Jun-2021

Manufactured under Restek's ISO 9001:2015
Registered Quality System
Certificate #FM 80397

HA-15-0-1

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-05 A	SDG:	21I0042
Sampled:	09/01/21 12:40	Prepared:	09/10/21 13:18	File ID:	NT1121092206.D
% Solids:	93.90	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/22/21 12:23
Batch:	BJI0287	Sequence:	SJI0344	Initial/Final:	10.65 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	5	897	D, E	0.36	2.50
218-01-9	Chrysene	5	1130	D, E	0.35	2.50
205-99-2	Benzo(b)fluoranthene	5	1770	D, E	0.33	2.50
207-08-9	Benzo(k)fluoranthene	5	1070	D, E	0.50	2.50
50-32-8	Benzo(a)pyrene	5	1760	D, E	0.43	2.50
193-39-5	Indeno(1,2,3-cd)pyrene	5	2580	D, E	0.44	2.50
53-70-3	Dibenzo(a,h)anthracene	5	1260	D, E	0.52	2.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.999	8.41	56.1	32 - 120	
Dibenzo[a,h]anthracene-d14	14.999			21 - 133	NRS
Fluoranthene-d10	14.999	12.7	84.7	36 - 134	

HA-15-0-1

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-05RE1 A	SDG:	21I0042
Sampled:	09/01/21 12:40	Prepared:	09/10/21 13:18	File ID:	NT1121092306.D
% Solids:	93.90	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 12:11
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	10.65 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	100	2630	D	7.20	50.0
218-01-9	Chrysene	100	3830	D	7.00	50.0
205-99-2	Benzo(b)fluoranthene	100	3600	D	6.60	50.0
207-08-9	Benzo(k)fluoranthene	100	2390	D	10.1	50.0
50-32-8	Benzo(a)pyrene	100	3060	D	8.70	50.0
193-39-5	Indeno(1,2,3-cd)pyrene	100	3430	D	8.80	50.0
53-70-3	Dibenzo(a,h)anthracene	100	1110	D	10.5	50.0

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.999			32 - 120	D1
Dibenzo[a,h]anthracene-d14	14.999			21 - 133	D1
Fluoranthene-d10	14.999			36 - 134	D1

HA-15-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-06 A	SDG:	21I0042
Sampled:	09/01/21 12:45	Prepared:	09/10/21 13:18	File ID:	NT1121092207.D
% Solids:	94.79	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/22/21 12:53
Batch:	BJI0287	Sequence:	SJI0344	Initial/Final:	10.55 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	5	799	D, E	0.36	2.50
218-01-9	Chrysene	5	1010	D, E	0.35	2.50
205-99-2	Benzo(b)fluoranthene	5	1230	D, E	0.33	2.50
207-08-9	Benzo(k)fluoranthene	5	1010	D, E	0.50	2.50
50-32-8	Benzo(a)pyrene	5	1280	D, E	0.43	2.50
193-39-5	Indeno(1,2,3-cd)pyrene	5	1840	D, E	0.44	2.50
53-70-3	Dibenzo(a,h)anthracene	5	837	D, E	0.52	2.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.999	7.90	52.7	32 - 120	
Dibenzo[a,h]anthracene-d14	14.999			21 - 133	NRS
Fluoranthene-d10	14.999	11.5	76.4	36 - 134	

HA-15-1-2

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-06RE1 A	SDG:	21I0042
Sampled:	09/01/21 12:45	Prepared:	09/10/21 13:18	File ID:	NT1121092307.D
% Solids:	94.79	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 12:41
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	10.55 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	100	2040	D	7.20	50.0
218-01-9	Chrysene	100	2810	D	7.00	50.0
205-99-2	Benzo(b)fluoranthene	100	2790	D	6.60	50.0
207-08-9	Benzo(k)fluoranthene	100	1790	D	10.1	50.0
50-32-8	Benzo(a)pyrene	100	2200	D	8.70	50.0
193-39-5	Indeno(1,2,3-cd)pyrene	100	2490	D	8.80	50.0
53-70-3	Dibenzo(a,h)anthracene	100	827	D	10.5	50.0

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.999			32 - 120	D1
Dibenzo[a,h]anthracene-d14	14.999			21 - 133	D1
Fluoranthene-d10	14.999			36 - 134	D1

HA-16-0-1

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-07 A	SDG:	21I0042
Sampled:	09/01/21 10:40	Prepared:	09/10/21 13:18	File ID:	NT1121092304.D
% Solids:	93.90	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 11:10
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	10.67 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	100	6440	D, E	7.19	49.9
218-01-9	Chrysene	100	6220	D, E	6.99	49.9
205-99-2	Benzo(b)fluoranthene	100	3390	D	6.59	49.9
207-08-9	Benzo(k)fluoranthene	100	2470	D	10.1	49.9
50-32-8	Benzo(a)pyrene	100	6480	D, E	8.68	49.9
193-39-5	Indeno(1,2,3-cd)pyrene	100	3280	D	8.78	49.9
53-70-3	Dibenzo(a,h)anthracene	100	1310	D	10.5	49.9

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.971			32 - 120	D1
Dibenzo[a,h]anthracene-d14	14.971			21 - 133	D1
Fluoranthene-d10	14.971			36 - 134	D1

HA-16-0-1

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-07RE1 A	SDG:	21I0042
Sampled:	09/01/21 10:40	Prepared:	09/10/21 13:18	File ID:	NT1121092313.D
% Solids:	93.90	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 15:41
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	10.67 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	200	7490	D	14.4	99.8
218-01-9	Chrysene	200	7070	D	14.0	99.8
205-99-2	Benzo(b)fluoranthene	200	3850	D	13.2	99.8
207-08-9	Benzo(k)fluoranthene	200	2650	D	20.2	99.8
50-32-8	Benzo(a)pyrene	200	7480	D	17.4	99.8
193-39-5	Indeno(1,2,3-cd)pyrene	200	3580	D	17.6	99.8
53-70-3	Dibenzo(a,h)anthracene	200	1400	D	21.0	99.8

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.971			32 - 120	D1
Dibenzo[a,h]anthracene-d14	14.971			21 - 133	D1
Fluoranthene-d10	14.971			36 - 134	D1

HA-16-1-2

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-08 A	SDG:	21I0042
Sampled:	09/01/21 10:45	Prepared:	09/10/21 13:18	File ID:	NT1121092305.D
% Solids:	88.66	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 11:40
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	11.28 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	100	8430	D, E	7.20	50.0
218-01-9	Chrysene	100	10500	D, E	7.00	50.0
205-99-2	Benzo(b)fluoranthene	100	10500	D, E	6.60	50.0
207-08-9	Benzo(k)fluoranthene	100	6900	D, E	10.1	50.0
50-32-8	Benzo(a)pyrene	100	4270	D	8.70	50.0
193-39-5	Indeno(1,2,3-cd)pyrene	100	10100	D, E	8.80	50.0
53-70-3	Dibenzo(a,h)anthracene	100	3400	D	10.5	50.0

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.999			32 - 120	D1
Dibenzo[a,h]anthracene-d14	14.999			21 - 133	D1
Fluoranthene-d10	14.999			36 - 134	D1

HA-16-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-08RE1 A	SDG:	21I0042
Sampled:	09/01/21 10:45	Prepared:	09/10/21 13:18	File ID:	NT1121092314.D
% Solids:	88.66	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 16:11
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	11.28 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	500	11700	D	36.0	250
218-01-9	Chrysene	500	15700	D	35.0	250
205-99-2	Benzo(b)fluoranthene	500	14900	D	33.0	250
207-08-9	Benzo(k)fluoranthene	500	9320	D	50.5	250
50-32-8	Benzo(a)pyrene	500	4660	D	43.5	250
193-39-5	Indeno(1,2,3-cd)pyrene	500	11300	D	44.0	250
53-70-3	Dibenzo(a,h)anthracene	500	3330	D	52.5	250

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.999			32 - 120	D1
Dibenzo[a,h]anthracene-d14	14.999			21 - 133	D1
Fluoranthene-d10	14.999			36 - 134	D1

HA-17-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-09 A	SDG:	21I0042
Sampled:	09/01/21 09:00	Prepared:	09/10/21 13:18	File ID:	NT1121092210.D
% Solids:	94.95	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/22/21 14:24
Batch:	BJI0287	Sequence:	SJI0344	Initial/Final:	10.53 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	24.7		0.07	0.50
218-01-9	Chrysene	1	38.6		0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	27.3		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	17.0		0.10	0.50
50-32-8	Benzo(a)pyrene	1	37.0		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	26.2		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	8.03		0.11	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	15.003	7.77	51.8	32 - 120	
Dibenzo[a,h]anthracene-d14	15.003	13.9	92.8	21 - 133	
Fluoranthene-d10	15.003	12.9	86.1	36 - 134	

HA-18-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-10 A	SDG:	21I0042
Sampled:	08/31/21 15:30	Prepared:	09/10/21 13:18	File ID:	NT1121092211.D
% Solids:	92.77	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/22/21 14:54
Batch:	BJI0287	Sequence:	SJI0344	Initial/Final:	10.79 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	57.8	E	0.07	0.50
218-01-9	Chrysene	1	70.4	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	40.7		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	27.1		0.10	0.50
50-32-8	Benzo(a)pyrene	1	66.0	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	37.4		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	13.6		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.985	8.53	56.9	32 - 120	
Dibenzo[a,h]anthracene-d14	14.985	13.0	86.4	21 - 133	
Fluoranthene-d10	14.985	13.2	88.2	36 - 134	

HA-18-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-10RE1 A	SDG:	21I0042
Sampled:	08/31/21 15:30	Prepared:	09/10/21 13:18	File ID:	NT1121092315.D
% Solids:	92.77	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 16:41
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	10.79 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	3	64.0	D	0.22	1.50
218-01-9	Chrysene	3	71.1	D	0.21	1.50
205-99-2	Benzo(b)fluoranthene	3	42.7	D	0.20	1.50
207-08-9	Benzo(k)fluoranthene	3	27.2	D	0.30	1.50
50-32-8	Benzo(a)pyrene	3	69.5	D	0.26	1.50
193-39-5	Indeno(1,2,3-cd)pyrene	3	38.7	D	0.26	1.50
53-70-3	Dibenzo(a,h)anthracene	3	13.8	D	0.31	1.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.985	8.29	55.3	32 - 120	
Dibenzo[a,h]anthracene-d14	14.985	12.8	85.7	21 - 133	
Fluoranthene-d10	14.985	12.7	85.0	36 - 134	

Analytical Resources, Incorporated
Analytical Chemists and Consultants

HA-19-0-1

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-11 A	SDG:	21I0042
Sampled:	08/31/21 15:10	Prepared:	09/10/21 13:18	File ID:	NT1121092212.D
% Solids:	93.35	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/22/21 15:24
Batch:	BJI0287	Sequence:	SJI0344	Initial/Final:	10.71 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	21.7		0.07	0.50
218-01-9	Chrysene	1	31.4		0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	23.1		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	12.7		0.10	0.50
50-32-8	Benzo(a)pyrene	1	27.6		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	18.6		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	5.95		0.11	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	15.003	7.49	50.0	32 - 120	
Dibenzo[a,h]anthracene-d14	15.003	12.8	85.2	21 - 133	
Fluoranthene-d10	15.003	12.6	84.3	36 - 134	

HA-19-1-2

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-12 A	SDG:	21I0042
Sampled:	08/31/21 15:20	Prepared:	09/10/21 13:18	File ID:	NT1121092213.D
% Solids:	94.12	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/22/21 15:54
Batch:	BJI0287	Sequence:	SJI0344	Initial/Final:	10.65 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	23.7		0.07	0.50
218-01-9	Chrysene	1	37.2		0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	28.6		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	15.8		0.10	0.50
50-32-8	Benzo(a)pyrene	1	34.1		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	24.4		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	7.44		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.964	7.93	53.0	32 - 120	
Dibenzo[a,h]anthracene-d14	14.964	13.2	88.0	21 - 133	
Fluoranthene-d10	14.964	13.3	88.8	36 - 134	

HA-20-0-1

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-13 A	SDG:	21I0042
Sampled:	08/31/21 15:45	Prepared:	09/10/21 13:18	File ID:	NT1121092214.D
% Solids:	94.50	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/22/21 16:24
Batch:	BJI0287	Sequence:	SJI0344	Initial/Final:	10.6 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	30.2		0.07	0.50
218-01-9	Chrysene	1	46.6		0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	25.8		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	16.3		0.10	0.50
50-32-8	Benzo(a)pyrene	1	26.6		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	21.4		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	7.78		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.975	8.69	58.0	32 - 120	
Dibenzo[a,h]anthracene-d14	14.975	13.9	92.6	21 - 133	
Fluoranthene-d10	14.975	13.6	90.7	36 - 134	

HA-20-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-14 A	SDG:	21I0042
Sampled:	08/31/21 16:00	Prepared:	09/10/21 13:18	File ID:	NT1121092215.D
% Solids:	95.13	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/22/21 16:54
Batch:	BJI0287	Sequence:	SJI0344	Initial/Final:	10.51 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	10.9		0.07	0.50
218-01-9	Chrysene	1	13.4		0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	12.0		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	6.08		0.10	0.50
50-32-8	Benzo(a)pyrene	1	15.4		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	12.2		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	3.13		0.11	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	15.003	7.75	51.6	32 - 120	
Dibenzo[a,h]anthracene-d14	15.003	12.0	79.9	21 - 133	
Fluoranthene-d10	15.003	12.6	83.7	36 - 134	

HA-21-1-2

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-15 A	SDG:	21I0042
Sampled:	09/01/21 09:20	Prepared:	09/10/21 13:18	File ID:	NT1121092216.D
% Solids:	95.04	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/22/21 17:24
Batch:	BJI0287	Sequence:	SJI0344	Initial/Final:	10.53 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	56.5	E	0.07	0.50
218-01-9	Chrysene	1	65.7	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	57.9	E	0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	33.9		0.10	0.50
50-32-8	Benzo(a)pyrene	1	83.0	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	56.2	E	0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	13.9		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.988	7.87	52.5	32 - 120	
Dibenzo[a,h]anthracene-d14	14.988	11.5	76.6	21 - 133	
Fluoranthene-d10	14.988	11.9	79.2	36 - 134	

HA-21-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-15RE1 A	SDG:	21I0042
Sampled:	09/01/21 09:20	Prepared:	09/10/21 13:18	File ID:	NT1121092316.D
% Solids:	95.04	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 17:11
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	10.53 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	3	63.1	D	0.22	1.50
218-01-9	Chrysene	3	69.6	D	0.21	1.50
205-99-2	Benzo(b)fluoranthene	3	59.2	D	0.20	1.50
207-08-9	Benzo(k)fluoranthene	3	34.5	D	0.30	1.50
50-32-8	Benzo(a)pyrene	3	87.3	D	0.26	1.50
193-39-5	Indeno(1,2,3-cd)pyrene	3	58.1	D	0.26	1.50
53-70-3	Dibenzo(a,h)anthracene	3	13.9	D	0.31	1.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.988	7.75	51.7	32 - 120	
Dibenzo[a,h]anthracene-d14	14.988	11.3	75.1	21 - 133	
Fluoranthene-d10	14.988	11.3	75.3	36 - 134	

HA-22-0-1

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-16 A	SDG:	21I0042
Sampled:	09/01/21 09:35	Prepared:	09/10/21 13:18	File ID:	NT1121092217.D
% Solids:	94.46	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/22/21 17:55
Batch:	BJI0287	Sequence:	SJI0344	Initial/Final:	10.61 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	213	E	0.07	0.50
218-01-9	Chrysene	1	395	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	547	E	0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	358	E	0.10	0.50
50-32-8	Benzo(a)pyrene	1	541	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	518	E	0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	211	E	0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.967	9.10	60.8	32 - 120	
Dibenzo[a,h]anthracene-d14	14.967	12.3	82.2	21 - 133	
Fluoranthene-d10	14.967	12.8	85.7	36 - 134	

HA-22-0-1

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-16RE1 A	SDG:	21I0042
Sampled:	09/01/21 09:35	Prepared:	09/10/21 13:18	File ID:	NT1121092317.D
% Solids:	94.46	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 17:42
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	10.61 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	100	555	D	7.18	49.9
218-01-9	Chrysene	100	2060	D	6.98	49.9
205-99-2	Benzo(b)fluoranthene	100	794	D	6.59	49.9
207-08-9	Benzo(k)fluoranthene	100	516	D	10.1	49.9
50-32-8	Benzo(a)pyrene	100	784	D	8.68	49.9
193-39-5	Indeno(1,2,3-cd)pyrene	100	576	D	8.78	49.9
53-70-3	Dibenzo(a,h)anthracene	100	180	D	10.5	49.9

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.967			32 - 120	D1
Dibenzo[a,h]anthracene-d14	14.967			21 - 133	D1
Fluoranthene-d10	14.967			36 - 134	D1

HA-22-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-17 A	SDG:	21I0042
Sampled:	09/01/21 09:40	Prepared:	09/10/21 13:18	File ID:	NT1121092218.D
% Solids:	94.01	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/22/21 18:25
Batch:	BJI0287	Sequence:	SJI0344	Initial/Final:	10.66 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	105	E	0.07	0.50
218-01-9	Chrysene	1	138	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	90.8	E	0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	66.0	E	0.10	0.50
50-32-8	Benzo(a)pyrene	1	133	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	77.5	E	0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	27.5		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.968	8.76	58.5	32 - 120	
Dibenzo[a,h]anthracene-d14	14.968	11.3	75.8	21 - 133	
Fluoranthene-d10	14.968	12.2	81.2	36 - 134	

HA-22-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-17RE1 A	SDG:	21I0042
Sampled:	09/01/21 09:40	Prepared:	09/10/21 13:18	File ID:	NT1121092318.D
% Solids:	94.01	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 18:11
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	10.66 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	10	145	D	0.72	4.99
218-01-9	Chrysene	10	197	D	0.70	4.99
205-99-2	Benzo(b)fluoranthene	10	117	D	0.66	4.99
207-08-9	Benzo(k)fluoranthene	10	75.2	D	1.01	4.99
50-32-8	Benzo(a)pyrene	10	183	D	0.87	4.99
193-39-5	Indeno(1,2,3-cd)pyrene	10	112	D	0.88	4.99
53-70-3	Dibenzo(a,h)anthracene	10	37.7	D	1.05	4.99

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.968	9.48	63.3	32 - 120	
Dibenzo[a,h]anthracene-d14	14.968	14.0	93.8	21 - 133	
Fluoranthene-d10	14.968	13.5	90.2	36 - 134	

HA-23-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-18 A	SDG:	21I0042
Sampled:	09/01/21 11:10	Prepared:	09/10/21 13:18	File ID:	NT1121092219.D
% Solids:	91.76	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/22/21 18:55
Batch:	BJI0287	Sequence:	SJI0344	Initial/Final:	10.92 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	96.7	E	0.07	0.50
218-01-9	Chrysene	1	116	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	67.9	E	0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	39.4		0.10	0.50
50-32-8	Benzo(a)pyrene	1	102	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	57.0	E	0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	21.7		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.970	7.87	52.6	32 - 120	
Dibenzo[a,h]anthracene-d14	14.970	12.2	81.5	21 - 133	
Fluoranthene-d10	14.970	13.6	91.0	36 - 134	

HA-23-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-18RE1 A	SDG:	21I0042
Sampled:	09/01/21 11:10	Prepared:	09/10/21 13:18	File ID:	NT1121092319.D
% Solids:	91.76	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 18:41
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	10.92 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	10	146	D	0.72	4.99
218-01-9	Chrysene	10	155	D	0.70	4.99
205-99-2	Benzo(b)fluoranthene	10	81.5	D	0.66	4.99
207-08-9	Benzo(k)fluoranthene	10	51.3	D	1.01	4.99
50-32-8	Benzo(a)pyrene	10	137	D	0.87	4.99
193-39-5	Indeno(1,2,3-cd)pyrene	10	79.5	D	0.88	4.99
53-70-3	Dibenzo(a,h)anthracene	10	28.5	D	1.05	4.99

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.970	8.74	58.4	32 - 120	
Dibenzo[a,h]anthracene-d14	14.970	14.8	98.9	21 - 133	
Fluoranthene-d10	14.970	14.5	96.8	36 - 134	

HA-24-0-1

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-19 A	SDG:	21I0042
Sampled:	08/31/21 11:15	Prepared:	09/10/21 13:18	File ID:	NT1121092220.D
% Solids:	94.38	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/22/21 19:25
Batch:	BJI0287	Sequence:	SJI0344	Initial/Final:	10.6 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	6.42		0.07	0.50
218-01-9	Chrysene	1	10.5		0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	8.49		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	4.48		0.10	0.50
50-32-8	Benzo(a)pyrene	1	10.4		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	7.03		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	1.88		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.994	7.62	50.8	32 - 120	
Dibenzo[a,h]anthracene-d14	14.994	12.3	82.2	21 - 133	
Fluoranthene-d10	14.994	12.7	85.0	36 - 134	

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Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-20 A	SDG:	21I0042
Sampled:	08/31/21 11:20	Prepared:	09/10/21 13:18	File ID:	NT1121092308.D
% Solids:	94.19	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 13:11
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	10.62 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	6.91		0.07	0.50
218-01-9	Chrysene	1	11.1		0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	8.64		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	4.73		0.10	0.50
50-32-8	Benzo(a)pyrene	1	9.04		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	7.44		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	2.23		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.996	7.89	52.6	32 - 120	
Dibenzo[a,h]anthracene-d14	14.996	12.9	85.9	21 - 133	
Fluoranthene-d10	14.996	11.8	78.7	36 - 134	

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ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-21 A	SDG:	21I0042
Sampled:	08/31/21 10:40	Prepared:	09/10/21 13:18	File ID:	NT1121092311.D
% Solids:	95.30	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 14:41
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	10.5 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	10	167	D	0.72	5.00
218-01-9	Chrysene	10	196	D	0.70	5.00
205-99-2	Benzo(b)fluoranthene	10	154	D	0.66	5.00
207-08-9	Benzo(k)fluoranthene	10	95.5	D	1.01	5.00
50-32-8	Benzo(a)pyrene	10	218	D	0.87	5.00
193-39-5	Indeno(1,2,3-cd)pyrene	10	180	D	0.88	5.00
53-70-3	Dibenzo(a,h)anthracene	10	56.3	D	1.05	5.00

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.990	8.38	55.9	32 - 120	
Dibenzo[a,h]anthracene-d14	14.990	13.1	87.3	21 - 133	
Fluoranthene-d10	14.990	11.3	75.2	36 - 134	

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Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-22 A	SDG:	21I0042
Sampled:	08/31/21 10:50	Prepared:	09/10/21 13:18	File ID:	NT1121092312.D
% Solids:	94.80	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/23/21 15:11
Batch:	BJI0287	Sequence:	SJI0360	Initial/Final:	10.58 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfuric Acid				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	3	87.7	D	0.22	1.50
218-01-9	Chrysene	3	115	D	0.21	1.50
205-99-2	Benzo(b)fluoranthene	3	96.9	D	0.20	1.50
207-08-9	Benzo(k)fluoranthene	3	57.5	D	0.30	1.50
50-32-8	Benzo(a)pyrene	3	110	D	0.26	1.50
193-39-5	Indeno(1,2,3-cd)pyrene	3	110	D	0.26	1.50
53-70-3	Dibenzo(a,h)anthracene	3	38.5	D	0.31	1.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.955	7.21	48.2	32 - 120	
Dibenzo[a,h]anthracene-d14	14.955	10.8	72.2	21 - 133	
Fluoranthene-d10	14.955	10.4	69.6	36 - 134	

HA-26-0-1

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-23 A	SDG:	21I0042
Sampled:	08/31/21 11:35	Prepared:	09/10/21 13:18	File ID:	NT1121092406.D
% Solids:	95.42	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 15:33
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	10.5 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	42.1		0.07	0.50
218-01-9	Chrysene	1	62.8	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	41.1		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	25.6		0.10	0.50
50-32-8	Benzo(a)pyrene	1	52.6	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	41.3		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	14.4		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.971	8.56	57.2	32 - 120	
Dibenzo[a,h]anthracene-d14	14.971	12.1	81.0	21 - 133	
Fluoranthene-d10	14.971	11.7	78.1	36 - 134	

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Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-23RE1 A	SDG:	21I0042
Sampled:	08/31/21 11:35	Prepared:	09/10/21 13:18	File ID:	NT1121092508.D
% Solids:	95.42	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/25/21 14:07
Batch:	BJI0296	Sequence:	SJI0404	Initial/Final:	10.5 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	2	47.5	D	0.14	1.00
218-01-9	Chrysene	2	69.2	D	0.14	1.00
205-99-2	Benzo(b)fluoranthene	2	46.1	D	0.13	1.00
207-08-9	Benzo(k)fluoranthene	2	26.3	D	0.20	1.00
50-32-8	Benzo(a)pyrene	2	57.6	D	0.17	1.00
193-39-5	Indeno(1,2,3-cd)pyrene	2	39.4	D	0.18	1.00
53-70-3	Dibenzo(a,h)anthracene	2	13.6	D	0.21	1.00

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.971	8.36	55.8	32 - 120	
Dibenzo[a,h]anthracene-d14	14.971	11.2	75.0	21 - 133	
Fluoranthene-d10	14.971	11.8	78.8	36 - 134	

HA-26-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-24 A	SDG:	21I0042
Sampled:	08/31/21 11:45	Prepared:	09/10/21 13:18	File ID:	NT1121092407.D
% Solids:	96.88	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 16:04
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	10.32 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	103	E	0.07	0.50
218-01-9	Chrysene	1	111	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	69.5	E	0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	51.1	E	0.10	0.50
50-32-8	Benzo(a)pyrene	1	96.6	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	77.1	E	0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	30.1		0.11	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	15.003	8.76	58.4	32 - 120	
Dibenzo[a,h]anthracene-d14	15.003	12.4	82.8	21 - 133	
Fluoranthene-d10	15.003	12.8	85.4	36 - 134	

HA-26-1-2

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-24RE1 A	SDG:	21I0042
Sampled:	08/31/21 11:45	Prepared:	09/10/21 13:18	File ID:	NT1121092512.D
% Solids:	96.88	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/25/21 16:08
Batch:	BJI0296	Sequence:	SJI0404	Initial/Final:	10.32 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	10	182	D	0.72	5.00
218-01-9	Chrysene	10	191	D	0.70	5.00
205-99-2	Benzo(b)fluoranthene	10	103	D	0.66	5.00
207-08-9	Benzo(k)fluoranthene	10	74.3	D	1.01	5.00
50-32-8	Benzo(a)pyrene	10	149	D	0.87	5.00
193-39-5	Indeno(1,2,3-cd)pyrene	10	88.9	D	0.88	5.00
53-70-3	Dibenzo(a,h)anthracene	10	31.3	D	1.05	5.00

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	15.003	9.27	61.8	32 - 120	
Dibenzo[a,h]anthracene-d14	15.003	12.2	81.2	21 - 133	
Fluoranthene-d10	15.003	13.0	86.9	36 - 134	

HA-27-0-1

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-25 A	SDG:	21I0042
Sampled:	08/31/21 12:20	Prepared:	09/10/21 13:18	File ID:	NT1121092408.D
% Solids:	97.16	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 16:34
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	10.31 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	3.63		0.07	0.50
218-01-9	Chrysene	1	6.06		0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	5.56		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	2.74		0.10	0.50
50-32-8	Benzo(a)pyrene	1	6.42		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	10.2		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	2.62		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.974	7.30	48.7	32 - 120	
Dibenzo[a,h]anthracene-d14	14.974	7.09	47.4	21 - 133	
Fluoranthene-d10	14.974	7.90	52.8	36 - 134	

HA-27-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-26 A	SDG:	21I0042
Sampled:	08/31/21 12:25	Prepared:	09/10/21 13:18	File ID:	NT1121092409.D
% Solids:	98.17	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 17:04
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	10.2 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	32.5		0.07	0.50
218-01-9	Chrysene	1	53.5	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	53.5	E	0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	23.9		0.10	0.50
50-32-8	Benzo(a)pyrene	1	80.5	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	128	E	0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	36.6		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.980	8.75	58.4	32 - 120	
Dibenzo[a,h]anthracene-d14	14.980	13.2	88.4	21 - 133	
Fluoranthene-d10	14.980	11.5	77.0	36 - 134	

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Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-26RE1 A	SDG:	21I0042
Sampled:	08/31/21 12:25	Prepared:	09/10/21 13:18	File ID:	NT1121092513.D
% Solids:	98.17	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/25/21 16:38
Batch:	BJI0296	Sequence:	SJI0404	Initial/Final:	10.2 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	10	37.5	D	0.72	4.99
218-01-9	Chrysene	10	64.8	D	0.70	4.99
205-99-2	Benzo(b)fluoranthene	10	69.4	D	0.66	4.99
207-08-9	Benzo(k)fluoranthene	10	32.6	D	1.01	4.99
50-32-8	Benzo(a)pyrene	10	113	D	0.87	4.99
193-39-5	Indeno(1,2,3-cd)pyrene	10	157	D	0.88	4.99
53-70-3	Dibenzo(a,h)anthracene	10	36.8	D	1.05	4.99

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.980	8.82	58.9	32 - 120	
Dibenzo[a,h]anthracene-d14	14.980	12.4	82.8	21 - 133	
Fluoranthene-d10	14.980	11.9	79.7	36 - 134	

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Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-27 A	SDG:	21I0042
Sampled:	08/31/21 12:55	Prepared:	09/10/21 13:18	File ID:	NT1121092410.D
% Solids:	95.22	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 17:34
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	10.54 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	25.9		0.07	0.50
218-01-9	Chrysene	1	29.4		0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	17.5		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	12.0		0.10	0.50
50-32-8	Benzo(a)pyrene	1	27.0		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	17.1		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	5.77		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.946	7.93	53.0	32 - 120	
Dibenzo[a,h]anthracene-d14	14.946	11.3	75.6	21 - 133	
Fluoranthene-d10	14.946	11.9	79.5	36 - 134	

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Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-28 A	SDG:	21I0042
Sampled:	08/31/21 13:00	Prepared:	09/10/21 13:18	File ID:	NT1121092411.D
% Solids:	95.12	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 18:04
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	10.53 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	39.7		0.07	0.50
218-01-9	Chrysene	1	42.5		0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	29.5		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	17.0		0.10	0.50
50-32-8	Benzo(a)pyrene	1	45.9		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	28.0		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	9.86		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.976	7.60	50.8	32 - 120	
Dibenzo[a,h]anthracene-d14	14.976	13.1	87.2	21 - 133	
Fluoranthene-d10	14.976	12.3	82.4	36 - 134	

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Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-29 A	SDG:	21I0042
Sampled:	08/31/21 13:45	Prepared:	09/10/21 13:18	File ID:	NT1121092412.D
% Solids:	87.82	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 18:34
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	11.39 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	26.2		0.07	0.50
218-01-9	Chrysene	1	44.4		0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	30.8		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	17.1		0.10	0.50
50-32-8	Benzo(a)pyrene	1	38.3		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	26.5		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	8.73		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.996	8.58	57.2	32 - 120	
Dibenzo[a,h]anthracene-d14	14.996	13.1	87.2	21 - 133	
Fluoranthene-d10	14.996	12.4	83.0	36 - 134	

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ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-30 A	SDG:	21I0042
Sampled:	08/31/21 13:50	Prepared:	09/10/21 13:18	File ID:	NT1121092413.D
% Solids:	87.23	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 19:05
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	11.5 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	38.2		0.07	0.50
218-01-9	Chrysene	1	56.1	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	36.6		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	21.1		0.10	0.50
50-32-8	Benzo(a)pyrene	1	47.5		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	32.0		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	11.0		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.953	8.62	57.7	32 - 120	
Dibenzo[a,h]anthracene-d14	14.953	13.1	87.8	21 - 133	
Fluoranthene-d10	14.953	13.1	87.3	36 - 134	

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Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-30RE1 A	SDG:	21I0042
Sampled:	08/31/21 13:50	Prepared:	09/10/21 13:18	File ID:	NT1121092509.D
% Solids:	87.23	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/25/21 14:37
Batch:	BJI0296	Sequence:	SJI0404	Initial/Final:	11.5 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	2	44.8	D	0.14	1.00
218-01-9	Chrysene	2	60.6	D	0.14	1.00
205-99-2	Benzo(b)fluoranthene	2	40.1	D	0.13	1.00
207-08-9	Benzo(k)fluoranthene	2	21.7	D	0.20	1.00
50-32-8	Benzo(a)pyrene	2	51.5	D	0.17	1.00
193-39-5	Indeno(1,2,3-cd)pyrene	2	30.8	D	0.18	1.00
53-70-3	Dibenzo(a,h)anthracene	2	10.6	D	0.21	1.00

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.953	8.56	57.2	32 - 120	
Dibenzo[a,h]anthracene-d14	14.953	12.3	82.1	21 - 133	
Fluoranthene-d10	14.953	13.4	89.4	36 - 134	

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ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-31 A	SDG:	21I0042
Sampled:	08/31/21 14:15	Prepared:	09/10/21 13:18	File ID:	NT1121092414.D
% Solids:	93.12	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 19:35
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	10.76 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	123	E	0.07	0.50
218-01-9	Chrysene	1	127	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	81.1	E	0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	61.0	E	0.10	0.50
50-32-8	Benzo(a)pyrene	1	131	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	96.5	E	0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	40.4		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.970	8.24	55.0	32 - 120	
Dibenzo[a,h]anthracene-d14	14.970	12.8	85.3	21 - 133	
Fluoranthene-d10	14.970	12.8	85.8	36 - 134	

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Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-31RE1 A	SDG:	21I0042
Sampled:	08/31/21 14:15	Prepared:	09/10/21 13:18	File ID:	NT1121092514.D
% Solids:	93.12	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/25/21 17:08
Batch:	BJI0296	Sequence:	SJI0404	Initial/Final:	10.76 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	10	232	D	0.72	4.99
218-01-9	Chrysene	10	230	D	0.70	4.99
205-99-2	Benzo(b)fluoranthene	10	131	D	0.66	4.99
207-08-9	Benzo(k)fluoranthene	10	92.4	D	1.01	4.99
50-32-8	Benzo(a)pyrene	10	250	D	0.87	4.99
193-39-5	Indeno(1,2,3-cd)pyrene	10	116	D	0.88	4.99
53-70-3	Dibenzo(a,h)anthracene	10	42.1	D	1.05	4.99

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.970	7.99	53.4	32 - 120	
Dibenzo[a,h]anthracene-d14	14.970	12.2	81.2	21 - 133	
Fluoranthene-d10	14.970	13.4	89.3	36 - 134	

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Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-32 A	SDG:	21I0042
Sampled:	08/31/21 14:40	Prepared:	09/10/21 13:18	File ID:	NT1121092415.D
% Solids:	83.49	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 20:05
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	12 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	49.6		0.07	0.50
218-01-9	Chrysene	1	53.8	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	32.2		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	19.2		0.10	0.50
50-32-8	Benzo(a)pyrene	1	48.2		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	29.2		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	11.3		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.972	7.58	50.6	32 - 120	
Dibenzo[a,h]anthracene-d14	14.972	12.1	80.6	21 - 133	
Fluoranthene-d10	14.972	11.6	77.4	36 - 134	

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Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-32RE1 A	SDG:	21I0042
Sampled:	08/31/21 14:40	Prepared:	09/10/21 13:18	File ID:	NT1121092510.D
% Solids:	83.49	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/25/21 15:07
Batch:	BJI0296	Sequence:	SJI0404	Initial/Final:	12 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	2	57.7	D	0.14	1.00
218-01-9	Chrysene	2	60.6	D	0.14	1.00
205-99-2	Benzo(b)fluoranthene	2	31.4	D	0.13	1.00
207-08-9	Benzo(k)fluoranthene	2	23.2	D	0.20	1.00
50-32-8	Benzo(a)pyrene	2	52.1	D	0.17	1.00
193-39-5	Indeno(1,2,3-cd)pyrene	2	28.0	D	0.18	1.00
53-70-3	Dibenzo(a,h)anthracene	2	10.7	D	0.21	1.00

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.972	7.60	50.8	32 - 120	
Dibenzo[a,h]anthracene-d14	14.972	11.6	77.2	21 - 133	
Fluoranthene-d10	14.972	11.9	79.5	36 - 134	

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Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-33 A	SDG:	21I0042
Sampled:	08/31/21 14:45	Prepared:	09/10/21 13:18	File ID:	NT1121092418.D
% Solids:	81.94	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 21:35
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	12.23 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	126	E	0.07	0.50
218-01-9	Chrysene	1	131	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	73.2	E	0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	52.8	E	0.10	0.50
50-32-8	Benzo(a)pyrene	1	111	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	75.4	E	0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	33.9		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.968	8.54	57.1	32 - 120	
Dibenzo[a,h]anthracene-d14	14.968	12.5	83.4	21 - 133	
Fluoranthene-d10	14.968	12.6	84.4	36 - 134	

HA-31-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-33RE1 A	SDG:	21I0042
Sampled:	08/31/21 14:45	Prepared:	09/10/21 13:18	File ID:	NT1121092515.D
% Solids:	81.94	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/25/21 17:38
Batch:	BJI0296	Sequence:	SJI0404	Initial/Final:	12.23 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	10	289	D	0.72	4.99
218-01-9	Chrysene	10	282	D	0.70	4.99
205-99-2	Benzo(b)fluoranthene	10	118	D	0.66	4.99
207-08-9	Benzo(k)fluoranthene	10	88.0	D	1.01	4.99
50-32-8	Benzo(a)pyrene	10	203	D	0.87	4.99
193-39-5	Indeno(1,2,3-cd)pyrene	10	92.9	D	0.88	4.99
53-70-3	Dibenzo(a,h)anthracene	10	37.8	D	1.05	4.99

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.968	8.95	59.8	32 - 120	
Dibenzo[a,h]anthracene-d14	14.968	12.6	84.0	21 - 133	
Fluoranthene-d10	14.968	13.3	89.1	36 - 134	

HA-32-0-1

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-34 A	SDG:	21I0042
Sampled:	08/31/21 13:25	Prepared:	09/10/21 13:18	File ID:	NT1121092419.D
% Solids:	90.53	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 22:05
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	11.08 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	51.8	E	0.07	0.50
218-01-9	Chrysene	1	58.6	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	39.5		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	23.4		0.10	0.50
50-32-8	Benzo(a)pyrene	1	55.1	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	34.7		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	12.3		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.954	8.09	54.1	32 - 120	
Dibenzo[a,h]anthracene-d14	14.954	13.0	86.9	21 - 133	
Fluoranthene-d10	14.954	12.5	83.8	36 - 134	

HA-32-0-1

Form I

ORGANIC ANALYSIS DATA SHEET

EPA 8270E-SIM

Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-34RE1 A	SDG:	21I0042
Sampled:	08/31/21 13:25	Prepared:	09/10/21 13:18	File ID:	NT1121092511.D
% Solids:	90.53	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/25/21 15:38
Batch:	BJI0296	Sequence:	SJI0404	Initial/Final:	11.08 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	2	57.6	D	0.14	1.00
218-01-9	Chrysene	2	64.9	D	0.14	1.00
205-99-2	Benzo(b)fluoranthene	2	39.1	D	0.13	1.00
207-08-9	Benzo(k)fluoranthene	2	27.9	D	0.20	1.00
50-32-8	Benzo(a)pyrene	2	59.8	D	0.17	1.00
193-39-5	Indeno(1,2,3-cd)pyrene	2	33.5	D	0.18	1.00
53-70-3	Dibenzo(a,h)anthracene	2	11.8	D	0.21	1.00

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.954	8.28	55.4	32 - 120	
Dibenzo[a,h]anthracene-d14	14.954	12.5	83.4	21 - 133	
Fluoranthene-d10	14.954	12.8	85.9	36 - 134	

HA-32-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-35 A	SDG:	21I0042
Sampled:	08/31/21 13:30	Prepared:	09/10/21 13:18	File ID:	NT1121092420.D
% Solids:	90.16	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 22:35
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	11.09 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	78.4	E	0.07	0.50
218-01-9	Chrysene	1	85.3	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	54.3	E	0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	34.5		0.10	0.50
50-32-8	Benzo(a)pyrene	1	80.0	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	52.1	E	0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	19.2		0.11	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	15.002	8.23	54.9	32 - 120	
Dibenzo[a,h]anthracene-d14	15.002	13.0	86.9	21 - 133	
Fluoranthene-d10	15.002	13.0	86.5	36 - 134	

HA-32-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-35RE1 A	SDG:	21I0042
Sampled:	08/31/21 13:30	Prepared:	09/10/21 13:18	File ID:	NT1121092516.D
% Solids:	90.16	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/25/21 18:08
Batch:	BJI0296	Sequence:	SJI0404	Initial/Final:	11.09 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	10	107	D	0.72	5.00
218-01-9	Chrysene	10	115	D	0.70	5.00
205-99-2	Benzo(b)fluoranthene	10	64.7	D	0.66	5.00
207-08-9	Benzo(k)fluoranthene	10	46.5	D	1.01	5.00
50-32-8	Benzo(a)pyrene	10	105	D	0.87	5.00
193-39-5	Indeno(1,2,3-cd)pyrene	10	54.3	D	0.88	5.00
53-70-3	Dibenzo(a,h)anthracene	10	18.8	D	1.05	5.00

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	15.002	8.80	58.7	32 - 120	
Dibenzo[a,h]anthracene-d14	15.002	12.5	83.3	21 - 133	
Fluoranthene-d10	15.002	13.0	86.8	36 - 134	

HA-33-0-1

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-36 A	SDG:	21I0042
Sampled:	08/31/21 12:00	Prepared:	09/10/21 13:18	File ID:	NT1121092421.D
% Solids:	94.24	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 23:06
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	10.63 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	12.1		0.07	0.50
218-01-9	Chrysene	1	19.9		0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	14.3		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	7.72		0.10	0.50
50-32-8	Benzo(a)pyrene	1	18.2		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	13.1		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	4.23		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.973	7.49	50.0	32 - 120	
Dibenzo[a,h]anthracene-d14	14.973	12.6	83.9	21 - 133	
Fluoranthene-d10	14.973	12.0	80.1	36 - 134	

HA-33-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-37 A	SDG:	21I0042
Sampled:	08/31/21 12:10	Prepared:	09/10/21 13:18	File ID:	NT1121092422.D
% Solids:	94.33	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/24/21 23:36
Batch:	BJI0296	Sequence:	SJI0378	Initial/Final:	10.61 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	17.3		0.07	0.50
218-01-9	Chrysene	1	22.8		0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	17.9		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	10.3		0.10	0.50
50-32-8	Benzo(a)pyrene	1	25.4		0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	16.6		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	5.59		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.987	9.47	63.2	32 - 120	
Dibenzo[a,h]anthracene-d14	14.987	15.1	100	21 - 133	
Fluoranthene-d10	14.987	13.8	92.3	36 - 134	

HA-34-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-38 A	SDG:	21I0042
Sampled:	08/31/21 10:15	Prepared:	09/10/21 13:18	File ID:	NT1121092517.D
% Solids:	96.77	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/25/21 18:39
Batch:	BJI0296	Sequence:	SJI0404	Initial/Final:	10.33 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	95.8	E	0.07	0.50
218-01-9	Chrysene	1	101	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	95.8	E	0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	69.2	E	0.10	0.50
50-32-8	Benzo(a)pyrene	1	162	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	139	E	0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	54.3	E	0.11	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	15.005	8.13	54.2	32 - 120	
Dibenzo[a,h]anthracene-d14	15.005	16.0	107	21 - 133	
Fluoranthene-d10	15.005	12.4	82.5	36 - 134	

HA-34-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-38RE1 A	SDG:	21I0042
Sampled:	08/31/21 10:15	Prepared:	09/10/21 13:18	File ID:	NT1121092804.D
% Solids:	96.77	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/28/21 10:58
Batch:	BJI0296	Sequence:	SJI0424	Initial/Final:	10.33 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	10	141	D	0.72	5.00
218-01-9	Chrysene	10	146	D	0.70	5.00
205-99-2	Benzo(b)fluoranthene	10	110	D	0.66	5.00
207-08-9	Benzo(k)fluoranthene	10	76.8	D	1.01	5.00
50-32-8	Benzo(a)pyrene	10	222	D	0.87	5.00
193-39-5	Indeno(1,2,3-cd)pyrene	10	141	D	0.88	5.00
53-70-3	Dibenzo(a,h)anthracene	10	47.4	Q, D	1.05	5.00

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	15.005	8.03	53.5	32 - 120	
Dibenzo[a,h]anthracene-d14	15.005	13.2	87.7	21 - 133	Q
Fluoranthene-d10	15.005	12.6	83.7	36 - 134	

DUP-01-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-39 A	SDG:	21I0042
Sampled:	09/01/21 11:15	Prepared:	09/10/21 13:18	File ID:	NT1121092518.D
% Solids:	93.83	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/25/21 19:09
Batch:	BJI0296	Sequence:	SJI0404	Initial/Final:	10.68 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	37.0		0.07	0.50
218-01-9	Chrysene	1	55.4	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	38.0		0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	22.8		0.10	0.50
50-32-8	Benzo(a)pyrene	1	54.0	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	39.6		0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	13.8		0.10	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.969	7.86	52.5	32 - 120	
Dibenzo[a,h]anthracene-d14	14.969	12.5	83.5	21 - 133	
Fluoranthene-d10	14.969	12.4	82.6	36 - 134	

DUP-01-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-39RE1 A	SDG:	21I0042
Sampled:	09/01/21 11:15	Prepared:	09/10/21 13:18	File ID:	NT1121092805.D
% Solids:	93.83	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/28/21 11:29
Batch:	BJI0296	Sequence:	SJI0424	Initial/Final:	10.68 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	2	41.7	D	0.14	1.00
218-01-9	Chrysene	2	55.9	D	0.14	1.00
205-99-2	Benzo(b)fluoranthene	2	34.8	D	0.13	1.00
207-08-9	Benzo(k)fluoranthene	2	23.9	D	0.20	1.00
50-32-8	Benzo(a)pyrene	2	52.5	D	0.17	1.00
193-39-5	Indeno(1,2,3-cd)pyrene	2	38.0	D	0.18	1.00
53-70-3	Dibenzo(a,h)anthracene	2	12.9	Q, D	0.21	1.00

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	14.969	7.75	51.8	32 - 120	
Dibenzo[a,h]anthracene-d14	14.969	11.7	78.2	21 - 133	Q
Fluoranthene-d10	14.969	11.3	75.3	36 - 134	

DUP-02-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-40 A	SDG:	21I0042
Sampled:	08/31/21 14:00	Prepared:	09/10/21 13:18	File ID:	NT1121092519.D
% Solids:	93.25	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/25/21 19:39
Batch:	BJI0296	Sequence:	SJI0404	Initial/Final:	10.72 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	176	E	0.07	0.50
218-01-9	Chrysene	1	175	E	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	170	E	0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	127	E	0.10	0.50
50-32-8	Benzo(a)pyrene	1	276	E	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	213	E	0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	102	E	0.11	0.50

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	15.005	8.81	58.7	32 - 120	
Dibenzo[a,h]anthracene-d14	15.005	19.2	128	21 - 133	
Fluoranthene-d10	15.005	13.4	89.4	36 - 134	

DUP-02-1-2

Form I
ORGANIC ANALYSIS DATA SHEET
EPA 8270E-SIM
Polynuclear Aromatic Hydrocarbons - low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-40RE1 A	SDG:	21I0042
Sampled:	08/31/21 14:00	Prepared:	09/10/21 13:18	File ID:	NT1121092806.D
% Solids:	93.25	Preparation:	EPA 3546 (Microwave) Low Lev	Analyzed:	09/28/21 11:59
Batch:	BJI0296	Sequence:	SJI0424	Initial/Final:	10.72 g Wet / 0.5 mL
Instrument:	NT11	Column:	RXi-17Sil-MS	Calibration:	EH00019
Cleanups:	Silica Gel, Sulfur				

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg dry)	Q	DL	RL
56-55-3	Benzo(a)anthracene	20	507	D	1.44	10.0
218-01-9	Chrysene	20	465	D	1.40	10.0
205-99-2	Benzo(b)fluoranthene	20	250	D	1.32	10.0
207-08-9	Benzo(k)fluoranthene	20	178	D	2.02	10.0
50-32-8	Benzo(a)pyrene	20	535	D	1.74	10.0
193-39-5	Indeno(1,2,3-cd)pyrene	20	236	D	1.76	10.0
53-70-3	Dibenzo(a,h)anthracene	20	89.5	Q, D	2.10	10.0

SURROGATES	ADDED: (ug/kg dry)	FOUND: (ug/kg dry)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	15.005	8.73	58.2	32 - 120	
Dibenzo[a,h]anthracene-d14	15.005	15.4	102	21 - 133	Q
Fluoranthene-d10	15.005	12.9	86.3	36 - 134	

PREPARATION BATCH SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Batch: BJI0287 Batch Matrix: Solid Preparation: EPA 3546 (Microwave) Low Level

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
HA-15-0-1	21I0042-05	NT1121092206.D	09/10/21 13:18	Check Version
HA-15-0-1	21I0042-05RE1	NT1121092306.D	09/10/21 13:18	Check Version
HA-15-1-2	21I0042-06	NT1121092207.D	09/10/21 13:18	Check Version
HA-15-1-2	21I0042-06RE1	NT1121092307.D	09/10/21 13:18	Check Version
HA-16-0-1	21I0042-07	NT1121092304.D	09/10/21 13:18	Check Version
HA-16-0-1	21I0042-07RE1	NT1121092313.D	09/10/21 13:18	Check Version
HA-16-1-2	21I0042-08	NT1121092305.D	09/10/21 13:18	Check Version
HA-16-1-2	21I0042-08RE1	NT1121092314.D	09/10/21 13:18	Check Version
HA-17-1-2	21I0042-09	NT1121092210.D	09/10/21 13:18	Check Version
HA-18-1-2	21I0042-10	NT1121092211.D	09/10/21 13:18	Check Version
HA-18-1-2	21I0042-10RE1	NT1121092315.D	09/10/21 13:18	Check Version
HA-19-0-1	21I0042-11	NT1121092212.D	09/10/21 13:18	Check Version
HA-19-1-2	21I0042-12	NT1121092213.D	09/10/21 13:18	Check Version
HA-20-0-1	21I0042-13	NT1121092214.D	09/10/21 13:18	Check Version
HA-20-1-2	21I0042-14	NT1121092215.D	09/10/21 13:18	Check Version
HA-21-1-2	21I0042-15	NT1121092216.D	09/10/21 13:18	Check Version
HA-21-1-2	21I0042-15RE1	NT1121092316.D	09/10/21 13:18	Check Version
HA-22-0-1	21I0042-16	NT1121092217.D	09/10/21 13:18	Check Version
HA-22-0-1	21I0042-16RE1	NT1121092317.D	09/10/21 13:18	Check Version
HA-22-1-2	21I0042-17	NT1121092218.D	09/10/21 13:18	Check Version
HA-22-1-2	21I0042-17RE1	NT1121092318.D	09/10/21 13:18	Check Version
HA-23-1-2	21I0042-18	NT1121092219.D	09/10/21 13:18	Check Version
HA-23-1-2	21I0042-18RE1	NT1121092319.D	09/10/21 13:18	Check Version
HA-24-0-1	21I0042-19	NT1121092220.D	09/10/21 13:18	Check Version
HA-24-1-2	21I0042-20	NT1121092308.D	09/10/21 13:18	Check Version
HA-25-0-1	21I0042-21	NT1121092311.D	09/10/21 13:18	Check Version
HA-25-1-2	21I0042-22	NT1121092312.D	09/10/21 13:18	Check Version
Blank	BJI0287-BLK1	NT1121092203.D	09/10/21 13:18	
LCS	BJI0287-BS1	NT1121092204.D	09/10/21 13:18	
LCS Dup	BJI0287-BSD1	NT1121092205.D	09/10/21 13:18	
HA-24-1-2	BJI0287-MS1	NT1121092309.D	09/10/21 13:18	
HA-24-1-2	BJI0287-MSD1	NT1121092310.D	09/10/21 13:18	

PREPARATION BATCH SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Batch: BJI0296 Batch Matrix: Solid Preparation: EPA 3546 (Microwave) Low Level

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
HA-26-0-1	21I0042-23	NT1121092406.D	09/10/21 13:18	Check Version
HA-26-0-1	21I0042-23RE1	NT1121092508.D	09/10/21 13:18	Check Version
HA-26-1-2	21I0042-24	NT1121092407.D	09/10/21 13:18	Check Version
HA-26-1-2	21I0042-24RE1	NT1121092512.D	09/10/21 13:18	Check Version
HA-27-0-1	21I0042-25	NT1121092408.D	09/10/21 13:18	Check Version
HA-27-1-2	21I0042-26	NT1121092409.D	09/10/21 13:18	Check Version
HA-27-1-2	21I0042-26RE1	NT1121092513.D	09/10/21 13:18	Check Version
HA-28-0-1	21I0042-27	NT1121092410.D	09/10/21 13:18	Check Version
HA-28-1-2	21I0042-28	NT1121092411.D	09/10/21 13:18	Check Version
HA-29-0-1	21I0042-29	NT1121092412.D	09/10/21 13:18	Check Version
HA-29-1-2	21I0042-30	NT1121092413.D	09/10/21 13:18	Check Version
HA-29-1-2	21I0042-30RE1	NT1121092509.D	09/10/21 13:18	Check Version
HA-30-1-2	21I0042-31	NT1121092414.D	09/10/21 13:18	Check Version
HA-30-1-2	21I0042-31RE1	NT1121092514.D	09/10/21 13:18	Check Version
HA-31-0-1	21I0042-32	NT1121092415.D	09/10/21 13:18	Check Version
HA-31-0-1	21I0042-32RE1	NT1121092510.D	09/10/21 13:18	Check Version
HA-31-1-2	21I0042-33	NT1121092418.D	09/10/21 13:18	Check Version
HA-31-1-2	21I0042-33RE1	NT1121092515.D	09/10/21 13:18	Check Version
HA-32-0-1	21I0042-34	NT1121092419.D	09/10/21 13:18	Check Version
HA-32-0-1	21I0042-34RE1	NT1121092511.D	09/10/21 13:18	Check Version
HA-32-1-2	21I0042-35	NT1121092420.D	09/10/21 13:18	Check Version
HA-32-1-2	21I0042-35RE1	NT1121092516.D	09/10/21 13:18	Check Version
HA-33-0-1	21I0042-36	NT1121092421.D	09/10/21 13:18	Check Version
HA-33-1-2	21I0042-37	NT1121092422.D	09/10/21 13:18	Check Version
HA-34-1-2	21I0042-38	NT1121092517.D	09/10/21 13:18	Check Version
HA-34-1-2	21I0042-38RE1	NT1121092804.D	09/10/21 13:18	Check Version
DUP-01-1-2	21I0042-39	NT1121092518.D	09/10/21 13:18	Check Version
DUP-01-1-2	21I0042-39RE1	NT1121092805.D	09/10/21 13:18	Check Version
DUP-02-1-2	21I0042-40	NT1121092519.D	09/10/21 13:18	Check Version
DUP-02-1-2	21I0042-40RE1	NT1121092806.D	09/10/21 13:18	Check Version
Blank	BJI0296-BLK1	NT1121092403.D	09/10/21 13:18	
LCS	BJI0296-BS1	NT1121092404.D	09/10/21 13:18	
LCS Dup	BJI0296-BSD1	NT1121092405.D	09/10/21 13:18	

PREPARATION BATCH SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Batch: BJI0296
Batch Matrix: Solid
Preparation: EPA 3546 (Microwave) Low Level

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
HA-31-0-1	BJI0296-MS1	NT1121092416.D	09/10/21 13:18	
HA-31-0-1	BJI0296-MSD1	NT1121092417.D	09/10/21 13:18	

CLEANUP BATCH SUMMARY

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Cleanup Batch:	CJI0168	Cleanup Type:	Silica Gel
Cleanup Method:	EPA 3630C Silica Gel Cleanup	Analysis:	EPA 8270E-SIM

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
Matrix Spike Dup	BJI0287-MSD1	NT1121092310.D	09/22/2021	
HA-15-0-1	21I0042-05	NT1121092206.D	09/22/2021	
HA-25-1-2	21I0042-22	NT1121092312.D	09/22/2021	
HA-24-1-2	21I0042-20	NT1121092308.D	09/22/2021	
HA-23-1-2	21I0042-18	NT1121092219.D	09/22/2021	
HA-22-1-2	21I0042-17	NT1121092218.D	09/22/2021	
HA-22-0-1	21I0042-16	NT1121092217.D	09/22/2021	
HA-21-1-2	21I0042-15	NT1121092216.D	09/22/2021	
Blank	BJI0287-BLK1	NT1121092203.D	09/22/2021	
LCS	BJI0287-BS1	NT1121092204.D	09/22/2021	
HA-24-0-1	21I0042-19	NT1121092220.D	09/22/2021	
Matrix Spike	BJI0287-MS1	NT1121092309.D	09/22/2021	
HA-15-1-2	21I0042-06	NT1121092207.D	09/22/2021	
HA-17-1-2	21I0042-09	NT1121092210.D	09/22/2021	
HA-25-0-1	21I0042-21	NT1121092311.D	09/22/2021	
HA-16-0-1	21I0042-07	NT1121092304.D	09/22/2021	
HA-16-1-2	21I0042-08	NT1121092305.D	09/22/2021	
HA-18-1-2	21I0042-10	NT1121092211.D	09/22/2021	
HA-19-0-1	21I0042-11	NT1121092212.D	09/22/2021	
HA-19-1-2	21I0042-12	NT1121092213.D	09/22/2021	
HA-20-0-1	21I0042-13	NT1121092214.D	09/22/2021	
HA-20-1-2	21I0042-14	NT1121092215.D	09/22/2021	
LCS Dup	BJI0287-BSD1	NT1121092205.D	09/22/2021	

CLEANUP BATCH SUMMARY

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Cleanup Batch:	CJI0169	Cleanup Type:	Sulfuric Acid
Cleanup Method:	EPA 3665 Sulfuric Acid Cleanup - uL	Analysis:	EPA 8270E-SIM

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
Matrix Spike Dup	BJI0287-MSD1	NT1121092310.D	09/22/2021	
HA-16-1-2	21I0042-08	NT1121092305.D	09/22/2021	
HA-25-0-1	21I0042-21	NT1121092311.D	09/22/2021	
HA-19-1-2	21I0042-12	NT1121092213.D	09/22/2021	
HA-23-1-2	21I0042-18	NT1121092219.D	09/22/2021	
HA-25-1-2	21I0042-22	NT1121092312.D	09/22/2021	
HA-22-1-2	21I0042-17	NT1121092218.D	09/22/2021	
HA-22-0-1	21I0042-16	NT1121092217.D	09/22/2021	
HA-21-1-2	21I0042-15	NT1121092216.D	09/22/2021	
HA-20-1-2	21I0042-14	NT1121092215.D	09/22/2021	
HA-24-1-2	21I0042-20	NT1121092308.D	09/22/2021	
HA-24-0-1	21I0042-19	NT1121092220.D	09/22/2021	
HA-17-1-2	21I0042-09	NT1121092210.D	09/22/2021	
Blank	BJI0287-BLK1	NT1121092203.D	09/22/2021	
LCS Dup	BJI0287-BSD1	NT1121092205.D	09/22/2021	
HA-18-1-2	21I0042-10	NT1121092211.D	09/22/2021	
Matrix Spike	BJI0287-MS1	NT1121092309.D	09/22/2021	
HA-19-0-1	21I0042-11	NT1121092212.D	09/22/2021	
HA-15-0-1	21I0042-05	NT1121092206.D	09/22/2021	
HA-15-1-2	21I0042-06	NT1121092207.D	09/22/2021	
HA-16-0-1	21I0042-07	NT1121092304.D	09/22/2021	
LCS	BJI0287-BS1	NT1121092204.D	09/22/2021	
HA-20-0-1	21I0042-13	NT1121092214.D	09/22/2021	

CLEANUP BATCH SUMMARY

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Cleanup Batch:	CJI0187	Cleanup Type:	Sulfur
Cleanup Method:	EPA 3660B Sulfur Cleanup - uL	Analysis:	EPA 8270E-SIM

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
LCS	BJI0296-BS1	NT1121092404.D	09/23/2021	
DUP-01-1-2	21I0042-39	NT1121092518.D	09/23/2021	
DUP-02-1-2	21I0042-40	NT1121092519.D	09/23/2021	
HA-26-0-1	21I0042-23	NT1121092406.D	09/23/2021	
HA-30-1-2	21I0042-31	NT1121092414.D	09/23/2021	
HA-32-1-2	21I0042-35	NT1121092420.D	09/23/2021	
HA-27-0-1	21I0042-25	NT1121092408.D	09/23/2021	
LCS Dup	BJI0296-BSD1	NT1121092405.D	09/23/2021	
Matrix Spike	BJI0296-MS1	NT1121092416.D	09/23/2021	
Matrix Spike Dup	BJI0296-MSD1	NT1121092417.D	09/23/2021	
HA-26-1-2	21I0042-24	NT1121092407.D	09/23/2021	
Blank	BJI0296-BLK1	NT1121092403.D	09/23/2021	
HA-33-1-2	21I0042-37	NT1121092422.D	09/23/2021	
HA-33-0-1	21I0042-36	NT1121092421.D	09/23/2021	
HA-34-1-2	21I0042-38	NT1121092517.D	09/23/2021	
HA-32-0-1	21I0042-34	NT1121092419.D	09/23/2021	
HA-31-1-2	21I0042-33	NT1121092418.D	09/23/2021	
HA-31-0-1	21I0042-32	NT1121092415.D	09/23/2021	
HA-29-1-2	21I0042-30	NT1121092413.D	09/23/2021	
HA-28-1-2	21I0042-28	NT1121092411.D	09/23/2021	
HA-28-0-1	21I0042-27	NT1121092410.D	09/23/2021	
HA-27-1-2	21I0042-26	NT1121092409.D	09/23/2021	
HA-29-0-1	21I0042-29	NT1121092412.D	09/23/2021	

CLEANUP BATCH SUMMARY

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Cleanup Batch:	CJI0188	Cleanup Type:	Silica Gel
Cleanup Method:	EPA 3630C Silica Gel Cleanup	Analysis:	EPA 8270E-SIM

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
HA-30-1-2	21I0042-31	NT1121092414.D	09/23/2021	
HA-34-1-2	21I0042-38	NT1121092517.D	09/23/2021	
HA-33-0-1	21I0042-36	NT1121092421.D	09/23/2021	
Blank	BJI0296-BLK1	NT1121092403.D	09/23/2021	
HA-32-1-2	21I0042-35	NT1121092420.D	09/23/2021	
LCS Dup	BJI0296-BSD1	NT1121092405.D	09/23/2021	
HA-28-0-1	21I0042-27	NT1121092410.D	09/23/2021	
Matrix Spike	BJI0296-MS1	NT1121092416.D	09/23/2021	
LCS	BJI0296-BS1	NT1121092404.D	09/23/2021	
HA-32-0-1	21I0042-34	NT1121092419.D	09/23/2021	
HA-33-1-2	21I0042-37	NT1121092422.D	09/23/2021	
HA-31-0-1	21I0042-32	NT1121092415.D	09/23/2021	
HA-29-0-1	21I0042-29	NT1121092412.D	09/23/2021	
HA-29-1-2	21I0042-30	NT1121092413.D	09/23/2021	
HA-28-1-2	21I0042-28	NT1121092411.D	09/23/2021	
HA-27-1-2	21I0042-26	NT1121092409.D	09/23/2021	
HA-27-0-1	21I0042-25	NT1121092408.D	09/23/2021	
HA-26-1-2	21I0042-24	NT1121092407.D	09/23/2021	
HA-26-0-1	21I0042-23	NT1121092406.D	09/23/2021	
DUP-02-1-2	21I0042-40	NT1121092519.D	09/23/2021	
DUP-01-1-2	21I0042-39	NT1121092518.D	09/23/2021	
Matrix Spike Dup	BJI0296-MSD1	NT1121092417.D	09/23/2021	
HA-31-1-2	21I0042-33	NT1121092418.D	09/23/2021	

Form I

METHOD BLANK DATA SHEET

EPA 8270E-SIM

Blank

Laboratory:	Analytical Resources, Inc.			SDG:	21I0042
Client:	GeoEngineers			Project:	South State Street PRDI
Matrix:	Solid	Laboratory ID:	BJI0287-BLK1	File ID:	NT1121092203.D
Sampled:	N/A	Prepared:	09/10/21 13:18	Analyzed:	09/22/21 10:53
Solids:		Preparation:	EPA 3546 (Microwave) Low	Initial/Final:	10 g / 0.5 mL
Batch:	BJI0287	Sequence:	SJI0344	Calibration:	EH00019
Instrument:	NT11	Column:	RXi-17Sil-MS	Cleanups:	Silica Gel, Sulfuric Acid

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg wet)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	0.50	U	0.07	0.50
218-01-9	Chrysene	1	0.50	U	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	0.50	U	0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	0.50	U	0.10	0.50
50-32-8	Benzo(a)pyrene	1	0.50	U	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	0.50	U	0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	0.50	U	0.11	0.50

SURROGATES	ADDED: (ug/kg wet)	FOUND: (ug/kg wet)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	15.000	7.87	52.4	32 - 120	
Dibenzo[a,h]anthracene-d14	15.000	10.1	67.5	21 - 133	
Fluoranthene-d10	15.000	10.9	72.5	36 - 134	

Form I

METHOD BLANK DATA SHEET

EPA 8270E-SIM

Blank

Laboratory:	Analytical Resources, Inc.			SDG:	21I0042
Client:	GeoEngineers			Project:	South State Street PRDI
Matrix:	Solid	Laboratory ID:	BJI0296-BLK1	File ID:	NT1121092403.D
Sampled:	N/A	Prepared:	09/10/21 13:18	Analyzed:	09/24/21 14:03
Solids:		Preparation:	EPA 3546 (Microwave) Low	Initial/Final:	10 g / 0.5 mL
Batch:	BJI0296	Sequence:	SJI0378	Calibration:	EH00019
Instrument:	NT11	Column:	RXi-17Sil-MS	Cleanups:	Silica Gel, Sulfur

CAS NO.	COMPOUND	DILUTION	CONC: (ug/kg wet)	Q	DL	RL
56-55-3	Benzo(a)anthracene	1	0.50	U	0.07	0.50
218-01-9	Chrysene	1	0.50	U	0.07	0.50
205-99-2	Benzo(b)fluoranthene	1	0.50	U	0.07	0.50
207-08-9	Benzo(k)fluoranthene	1	0.50	U	0.10	0.50
50-32-8	Benzo(a)pyrene	1	0.50	U	0.09	0.50
193-39-5	Indeno(1,2,3-cd)pyrene	1	0.50	U	0.09	0.50
53-70-3	Dibenzo(a,h)anthracene	1	0.50	U	0.11	0.50

SURROGATES	ADDED: (ug/kg wet)	FOUND: (ug/kg wet)	% REC	QC LIMITS	Q
2-Methylnaphthalene-d10	15.000	8.53	56.9	32 - 120	
Dibenzo[a,h]anthracene-d14	15.000	13.3	88.5	21 - 133	
Fluoranthene-d10	15.000	11.7	78.1	36 - 134	

LCS / LCS DUPLICATE RECOVERY

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/22/21 11:23
Batch:	BJI0287	Laboratory ID:	BJI0287-BS1
Preparation:	EPA 3546 (Microwave) Low Level	Sequence Name:	LCS
Initial/Final:	10 g / 0.5 mL		

COMPOUND	SPIKE ADDED (ug/kg wet)	LCS CONCENTRATION (ug/kg wet)	Q	LCS % REC. #	QC LIMITS REC.
Benzo(a)anthracene	15.0	11.2		74.9	42 - 120
Chrysene	15.0	11.2		74.5	48 - 120
Benzo(b)fluoranthene	15.0	9.82		65.5	46 - 120
Benzo(k)fluoranthene	15.0	12.8		85.1	46 - 120
Benzo(a)pyrene	15.0	10.4		69.6	36 - 120
Indeno(1,2,3-cd)pyrene	15.0	10.9		72.7	40 - 120
Dibenzo(a,h)anthracene	15.0	11.0		73.2	38 - 120

* Indicates values outside of QC limits

COMPOUND	SPIKE ADDED (ug/kg wet)	LCSD CONCENTRATION (ug/kg wet)	Q	LCSD % REC. #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Benzo(a)anthracene	15.0	11.4		76.3	1.84	30	42 - 120
Chrysene	15.0	11.5		76.3	2.46	30	48 - 120
Benzo(b)fluoranthene	15.0	9.91		66.1	0.913	30	46 - 120
Benzo(k)fluoranthene	15.0	13.0		86.6	1.79	30	46 - 120
Benzo(a)pyrene	15.0	10.6		71.0	1.94	30	36 - 120
Indeno(1,2,3-cd)pyrene	15.0	11.1		73.7	1.43	30	40 - 120
Dibenzo(a,h)anthracene	15.0	11.0		73.3	0.254	30	38 - 120

* Indicates values outside of QC limits

LCS / LCS DUPLICATE RECOVERY

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/24/21 14:33
Batch:	BJI0296	Laboratory ID:	BJI0296-BS1
Preparation:	EPA 3546 (Microwave) Low Level	Sequence Name:	LCS
Initial/Final:	10 g / 0.5 mL		

COMPOUND	SPIKE ADDED (ug/kg wet)	LCS CONCENTRATION (ug/kg wet)	Q	LCS % REC. #	QC LIMITS REC.
Benzo(a)anthracene	15.0	10.8		72.2	42 - 120
Chrysene	15.0	10.6		70.5	48 - 120
Benzo(b)fluoranthene	15.0	10.6		70.5	46 - 120
Benzo(k)fluoranthene	15.0	11.7		78.0	46 - 120
Benzo(a)pyrene	15.0	9.65		64.4	36 - 120
Indeno(1,2,3-cd)pyrene	15.0	11.8		78.5	40 - 120
Dibenzo(a,h)anthracene	15.0	12.2		81.3	38 - 120

* Indicates values outside of QC limits

COMPOUND	SPIKE ADDED (ug/kg wet)	LCSD CONCENTRATION (ug/kg wet)	Q	LCSD % REC. #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Benzo(a)anthracene	15.0	11.5		76.4	5.65	30	42 - 120
Chrysene	15.0	10.9		72.8	3.10	30	48 - 120
Benzo(b)fluoranthene	15.0	11.0		73.3	3.81	30	46 - 120
Benzo(k)fluoranthene	15.0	11.6		77.1	1.10	30	46 - 120
Benzo(a)pyrene	15.0	10.4		69.3	7.37	30	36 - 120
Indeno(1,2,3-cd)pyrene	15.0	12.1		80.6	2.65	30	40 - 120
Dibenzo(a,h)anthracene	15.0	12.4		82.6	1.62	30	38 - 120

* Indicates values outside of QC limits

MS / MS DUPLICATE RECOVERY
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/23/21 13:41
Batch:	BJI0287	Laboratory ID:	BJI0287-MS1
Preparation:	EPA 3546 (Microwave) Low Level	Sequence Name:	Matrix Spike
Initial/Final:	10.62 g / 0.5 mL	Source Sample:	HA-24-1-2

COMPOUND	SPIKE ADDED (ug/kg dry)	SAMPLE CONCENTRATION (ug/kg dry)	Q	MS CONCENTRATION (ug/kg dry)	Q	MS % REC. #		QC LIMITS REC.
Benzo(a)anthracene	15.0	6.91		50.0	*, E	287	*	42 - 120
Chrysene	15.0	11.1		56.5	*, E	303	*	48 - 120
Benzo(b)fluoranthene	15.0	8.64		31.3	*	151	*	46 - 120
Benzo(k)fluoranthene	15.0	4.73		26.2	*	143	*	46 - 120
Benzo(a)pyrene	15.0	9.04		46.9	*	252	*	36 - 120
Indeno(1,2,3-cd)pyrene	15.0	7.44		32.1	*	164	*	40 - 120
Dibenzo(a,h)anthracene	15.0	2.23		19.8		117		38 - 120

* Values outside of QC limits

MS / MS DUPLICATE RECOVERY
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/23/21 14:11
Batch:	BJI0287	Laboratory ID:	BJI0287-MSD1
Preparation:	EPA 3546 (Microwave) Low Level	Sequence Name:	Matrix Spike Dup
Initial/Final:	10.62 g / 0.5 mL	Source Sample:	HA-24-1-2

COMPOUND	SPIKE ADDED (ug/kg dry)	MSD CONCENTRATION (ug/kg dry)	Q	MSD % REC. #		% RPD #		QC LIMITS RPD	QC LIMITS REC.
Benzo(a)anthracene	15.0	5.95	*	-6.37	*	157	*	30	42 - 120
Chrysene	15.0	8.40	*	-17.8	*	148	*	30	48 - 120
Benzo(b)fluoranthene	15.0	7.18	*	-9.70	*	125	*	30	46 - 120
Benzo(k)fluoranthene	15.0	4.89	*	1.05	*	137	*	30	46 - 120
Benzo(a)pyrene	15.0	7.55	*	-9.94	*	145	*	30	36 - 120
Indeno(1,2,3-cd)pyrene	15.0	5.98	*	-9.76	*	137	*	30	40 - 120
Dibenzo(a,h)anthracene	15.0	2.58	*	2.34	*	154	*	30	38 - 120

* Values outside of QC limits

MS / MS DUPLICATE RECOVERY
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/24/21 20:35
Batch:	BJI0296	Laboratory ID:	BJI0296-MS1
Preparation:	EPA 3546 (Microwave) Low Level	Sequence Name:	Matrix Spike
Initial/Final:	12 g / 0.5 mL	Source Sample:	HA-31-0-1

COMPOUND	SPIKE ADDED (ug/kg dry)	SAMPLE CONCENTRATION (ug/kg dry)	Q	MS CONCENTRATION (ug/kg dry)	Q	MS % REC. #		QC LIMITS REC.
Benzo(a)anthracene	15.0	49.6		52.0	*, E	16.4	*	42 - 120
Chrysene	15.0	53.8	E	55.3	*, E	10.0	*	48 - 120
Benzo(b)fluoranthene	15.0	32.2		38.8	*	44.2	*	46 - 120
Benzo(k)fluoranthene	15.0	19.2		25.7	*	43.9	*	46 - 120
Benzo(a)pyrene	15.0	48.2		52.8	*, E	30.8	*	36 - 120
Indeno(1,2,3-cd)pyrene	15.0	29.2		36.5		48.8		40 - 120
Dibenzo(a,h)anthracene	15.0	11.3		20.8		63.6		38 - 120

* Values outside of QC limits

MS / MS DUPLICATE RECOVERY
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/24/21 21:05
Batch:	BJI0296	Laboratory ID:	BJI0296-MSD1
Preparation:	EPA 3546 (Microwave) Low Level	Sequence Name:	Matrix Spike Dup
Initial/Final:	12 g / 0.5 mL	Source Sample:	HA-31-0-1

COMPOUND	SPIKE ADDED (ug/kg dry)	MSD CONCENTRATION (ug/kg dry)	Q	MSD % REC. #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Benzo(a)anthracene	15.0	69.2	*, E	131 *	28.3	30	42 - 120
Chrysene	15.0	74.1	*, E	136 *	29.1	30	48 - 120
Benzo(b)fluoranthene	15.0	47.1		99.3	19.2	30	46 - 120
Benzo(k)fluoranthene	15.0	32.1		86.5	22.0	30	46 - 120
Benzo(a)pyrene	15.0	67.6	*, E	130 *	24.6	30	36 - 120
Indeno(1,2,3-cd)pyrene	15.0	46.5		116	24.2	30	40 - 120
Dibenzo(a,h)anthracene	15.0	25.5		94.7	20.1	30	38 - 120

* Values outside of QC limits

Analytical Resources, Incorporated
Analytical Chemists and Consultants

MASS SPECTROMETER
INSTRUMENT PERFORMANCE CHECK
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Lab File ID:	NT1121080701.D	Injection Date:	08/07/21
Instrument ID:	NT11	Injection Time:	08:35
Sequence:	SJH0087	Lab Sample ID:	SJH0087-TUN1

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
68	Less than 2% of 69	0.755	PASS
69	Less than 100% of 198	49.5	PASS
70	Less than 2% of 69	0.38	PASS
197	Less than 2% of 198	0.152	PASS
198	Base peak, 100% relative abundance	100	PASS
199	5 - 9% of 198	8.35	PASS
365	1 - 100% of 198	4.43	PASS
441	Less than 150% of 443	74.7	PASS
442	1 - 200% of 198	105	PASS
443	15 - 24% of 442	23	PASS
4,4'-DDD	Less than 20% of		
4,4'-DDE	Less than 20% of 4,4'-DDT		
4,4'-DDT	Less than 200% of		

Analytical Resources, Incorporated
Analytical Chemists and Consultants

MASS SPECTROMETER
INSTRUMENT PERFORMANCE CHECK
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Lab File ID:	NT1121080701.D	Injection Date:	08/07/21
Instrument ID:	NT11	Injection Time:	08:35
Sequence:	SJH0087	Lab Sample ID:	SJH0087-TUN1

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
68	Less than 2% of 69	0.755	PASS
69	Less than 100% of 198	49.5	PASS
70	Less than 2% of 69	0.38	PASS
197	Less than 2% of 198	0.152	PASS
198	Base peak, 100% relative abundance	100	PASS
199	5 - 9% of 198	8.35	PASS
365	1 - 100% of 198	4.43	PASS
441	Less than 150% of 443	74.7	PASS
442	1 - 200% of 198	105	PASS
443	15 - 24% of 442	23	PASS
4,4'-DDD	Less than 20% of		
4,4'-DDE	Less than 20% of 4,4'-DDT		
4,4'-DDT	Less than 200% of		

Client Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
MS Tune	SJH0087-TUN1	NT1121080701.D	08/07/2021	8:35
Cal Standard	SJH0087-CAL4	NT1121080702.D	08/07/2021	8:50
Cal Standard	SJH0087-CAL6	NT1121080703.D	08/07/2021	9:20
Cal Standard	SJH0087-CAL1	NT1121080704.D	08/07/2021	9:50
Cal Standard	SJH0087-CAL5	NT1121080705.D	08/07/2021	10:21
Cal Standard	SJH0087-CAL2	NT1121080706.D	08/07/2021	10:51
Cal Standard	SJH0087-CAL3	NT1121080707.D	08/07/2021	11:21
Initial Cal Blank	SJH0087-ICB1	NT1121080709.D	08/07/2021	12:21
Secondary Cal Check	SJH0087-SCV1	NT1121080710.D	08/07/2021	12:51
MS Tune	SJH0087-TUN2	NT1121080711.D	08/07/2021	13:18
Initial Cal Check	SJH0087-ICV1	NT1121080712.D	08/07/2021	13:43
Blank	BJG0598-BLK1	NT1121080713.D	08/07/2021	14:19
LCS	BJG0598-BS1	NT1121080714.D	08/07/2021	14:49
LCS Dup	BJG0598-BSD1	NT1121080715.D	08/07/2021	15:19
ZZZZZ	21G0257-01	NT1121080716.D	08/07/2021	15:49
ZZZZZ	21G0257-02	NT1121080717.D	08/07/2021	16:20
ZZZZZ	21G0257-03	NT1121080718.D	08/07/2021	16:50
ZZZZZ	21G0257-04	NT1121080719.D	08/07/2021	17:20
ZZZZZ	21G0292-01	NT1121080720.D	08/07/2021	17:50
ZZZZZ	21G0292-02	NT1121080721.D	08/07/2021	18:20
ZZZZZ	21G0292-03	NT1121080724.D	08/07/2021	19:51
ZZZZZ	21G0292-04	NT1121080725.D	08/07/2021	20:22
ZZZZZ	21G0300-01	NT1121080726.D	08/07/2021	20:52
ZZZZZ	21G0300-02	NT1121080727.D	08/07/2021	21:22
ZZZZZ	21G0300-03	NT1121080728.D	08/07/2021	21:52
ZZZZZ	21G0300-04	NT1121080729.D	08/07/2021	22:22

Analytical Resources, Incorporated
Analytical Chemists and Consultants

MASS SPECTROMETER
INSTRUMENT PERFORMANCE CHECK
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Lab File ID:	NT1121080701.D	Injection Date:	08/07/21
Instrument ID:	NT11	Injection Time:	08:35
Sequence:	SJH0087	Lab Sample ID:	SJH0087-TUN1

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
68	Less than 2% of 69	0.755	PASS
69	Less than 100% of 198	49.5	PASS
70	Less than 2% of 69	0.38	PASS
197	Less than 2% of 198	0.152	PASS
198	Base peak, 100% relative abundance	100	PASS
199	5 - 9% of 198	8.35	PASS
365	1 - 100% of 198	4.43	PASS
441	Less than 150% of 443	74.7	PASS
442	1 - 200% of 198	105	PASS
443	15 - 24% of 442	23	PASS
4,4'-DDD	Less than 20% of		
4,4'-DDE	Less than 20% of 4,4'-DDT		
4,4'-DDT	Less than 200% of		

ZZZZZ	21G0300-05	NT1121080730.D	08/07/2021	22:52
ZZZZZ	21G0300-06	NT1121080731.D	08/07/2021	23:22
ZZZZZ	21G0300-07	NT1121080732.D	08/07/2021	23:53
Calibration Check	SJH0087-CCV1	NT1121080734.D	08/08/2021	0:53

Analytical Resources, Incorporated
Analytical Chemists and Consultants

MASS SPECTROMETER
INSTRUMENT PERFORMANCE CHECK
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Lab File ID:	NT1121080711.D	Injection Date:	08/07/21
Instrument ID:	NT11	Injection Time:	13:18
Sequence:	SJH0087	Lab Sample ID:	SJH0087-TUN2

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
68	Less than 2% of 69	0	PASS
69	Less than 100% of 198	48.3	PASS
70	Less than 2% of 69	0.584	PASS
197	Less than 2% of 198	0.427	PASS
198	Base peak, 100% relative abundance	100	PASS
199	5 - 9% of 198	8.42	PASS
365	1 - 100% of 198	4.59	PASS
441	Less than 150% of 443	75.1	PASS
442	1 - 200% of 198	107	PASS
443	15 - 24% of 442	23.5	PASS
4,4'-DDD	Less than 20% of		
4,4'-DDE	Less than 20% of 4,4'-DDT		
4,4'-DDT	Less than 200% of		

Client Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
MS Tune	SJH0087-TUN1	NT1121080701.D	08/07/2021	8:35
Cal Standard	SJH0087-CAL4	NT1121080702.D	08/07/2021	8:50
Cal Standard	SJH0087-CAL6	NT1121080703.D	08/07/2021	9:20
Cal Standard	SJH0087-CAL1	NT1121080704.D	08/07/2021	9:50
Cal Standard	SJH0087-CAL5	NT1121080705.D	08/07/2021	10:21
Cal Standard	SJH0087-CAL2	NT1121080706.D	08/07/2021	10:51
Cal Standard	SJH0087-CAL3	NT1121080707.D	08/07/2021	11:21
Initial Cal Blank	SJH0087-ICB1	NT1121080709.D	08/07/2021	12:21
Secondary Cal Check	SJH0087-SCV1	NT1121080710.D	08/07/2021	12:51
MS Tune	SJH0087-TUN2	NT1121080711.D	08/07/2021	13:18
Initial Cal Check	SJH0087-ICV1	NT1121080712.D	08/07/2021	13:43
Blank	BJG0598-BLK1	NT1121080713.D	08/07/2021	14:19
LCS	BJG0598-BS1	NT1121080714.D	08/07/2021	14:49
LCS Dup	BJG0598-BSD1	NT1121080715.D	08/07/2021	15:19
ZZZZZ	21G0257-01	NT1121080716.D	08/07/2021	15:49
ZZZZZ	21G0257-02	NT1121080717.D	08/07/2021	16:20
ZZZZZ	21G0257-03	NT1121080718.D	08/07/2021	16:50
ZZZZZ	21G0257-04	NT1121080719.D	08/07/2021	17:20
ZZZZZ	21G0292-01	NT1121080720.D	08/07/2021	17:50
ZZZZZ	21G0292-02	NT1121080721.D	08/07/2021	18:20
ZZZZZ	21G0292-03	NT1121080724.D	08/07/2021	19:51
ZZZZZ	21G0292-04	NT1121080725.D	08/07/2021	20:22
ZZZZZ	21G0300-01	NT1121080726.D	08/07/2021	20:52
ZZZZZ	21G0300-02	NT1121080727.D	08/07/2021	21:22
ZZZZZ	21G0300-03	NT1121080728.D	08/07/2021	21:52
ZZZZZ	21G0300-04	NT1121080729.D	08/07/2021	22:22

Analytical Resources, Incorporated
Analytical Chemists and Consultants

MASS SPECTROMETER
INSTRUMENT PERFORMANCE CHECK
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Lab File ID:	NT1121080711.D	Injection Date:	08/07/21
Instrument ID:	NT11	Injection Time:	13:18
Sequence:	SJH0087	Lab Sample ID:	SJH0087-TUN2

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
68	Less than 2% of 69	0	PASS
69	Less than 100% of 198	48.3	PASS
70	Less than 2% of 69	0.584	PASS
197	Less than 2% of 198	0.427	PASS
198	Base peak, 100% relative abundance	100	PASS
199	5 - 9% of 198	8.42	PASS
365	1 - 100% of 198	4.59	PASS
441	Less than 150% of 443	75.1	PASS
442	1 - 200% of 198	107	PASS
443	15 - 24% of 442	23.5	PASS
4,4'-DDD	Less than 20% of		
4,4'-DDE	Less than 20% of 4,4'-DDT		
4,4'-DDT	Less than 200% of		

ZZZZZ	21G0300-05	NT1121080730.D	08/07/2021	22:52
ZZZZZ	21G0300-06	NT1121080731.D	08/07/2021	23:22
ZZZZZ	21G0300-07	NT1121080732.D	08/07/2021	23:53
Calibration Check	SJH0087-CCV1	NT1121080734.D	08/08/2021	0:53

INITIAL CALIBRATION DATA

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EH00019	Instrument:	NT11
Calibration Date:	08/07/2021	Column (1):	RXi-17Sil-MS
Comments:	Low PAH 8270E/625.1 ICAL		

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
		RRF		**RRF**		**RRF**		**RRF**		**RRF**		**RRF**
Naphthalene	10	1.282204	50	1.198517	100	1.162978	250	1.133168	500	1.064829	1000	0.9706413
2-Methylnaphthalene	10	0.9142151	50	0.8928007	100	0.8929928	250	0.9114022	500	0.889889	1000	0.8165734
1-Methylnaphthalene	10	0.8654925	50	0.8321729	100	0.8365473	250	0.8403543	500	0.8192391	1000	0.7577869
Acenaphthylene	10	1.840076	50	1.692318	100	1.627429	250	1.690652	500	1.567106	1000	1.469718
Acenaphthene	10	1.317603	50	1.264121	100	1.231635	250	1.182381	500	1.129595	1000	1.039872
Dibenzofuran	10	1.835323	50	1.796177	100	1.765159	250	1.626981	500	1.507213	1000	1.342713
Fluorene	10	1.298194	50	1.257334	100	1.228273	250	1.274563	500	1.202257	1000	1.111458
Phenanthrene	10	1.233316	50	1.203265	100	1.216761	250	1.22745	500	1.146933	1000	0.9853614
Anthracene	10	1.195925	50	1.10734	100	1.120443	250	1.225095	500	1.136622	1000	0.9744065
Carbazole	10	1.411953	50	1.303835	100	1.30478	250	1.392256	500	1.275935	1000	1.10813
Fluoranthene	10	1.205336	50	1.168549	100	1.20165	250	1.287096	500	1.19869	1000	1.041709
Pyrene	10	1.247432	50	1.171078	100	1.196134	250	1.266569	500	1.181036	1000	1.041889
Benzo(a)anthracene	10	1.346509	50	1.198258	100	1.20689	250	1.336877	500	1.197304	1000	1.130916
Chrysene	10	1.587388	50	1.523598	100	1.509464	250	1.458818	500	1.371258	1000	1.233461
Benzo(b)fluoranthene	10	1.291371	50	1.190402	100	1.167869	250	1.202338	500	1.139204	1000	1.058198
Benzo(k)fluoranthene	10	1.303538	50	1.255946	100	1.268539	250	1.281587	500	1.2617	1000	1.138178
Benzo(j)fluoranthene	10	1.540688	50	1.58505	100	1.590855	250	1.387873	500	1.420593	1000	1.216188
Benzofluoranthenes, Total	30	1.378533	150	1.3438	300	1.342421	750	1.290599	1500	1.273832	3000	1.137522
Benzo(a)pyrene	10	1.100477	50	1.050943	100	1.069169	250	1.165121	500	1.141395	1000	1.064534
Perylene	10	1.368883	50	1.286949	100	1.280389	250	1.240188	500	1.220816	1000	1.113393
Indeno(1,2,3-cd)pyrene	10	1.027056	50	1.097063	100	1.122472	250	1.250619	500	1.233983	1000	1.223951
Dibenzo(a,h)anthracene	10	0.7908496	50	0.8975094	100	0.9287747	250	1.051521	500	1.036726	1000	1.034487
Benzo(g,h,i)perylene	10	1.171066	50	1.175901	100	1.174595	250	1.185467	500	1.162289	1000	1.110599
2-Methylnaphthalene-d10	10	0.8044755	50	0.7880811	100	0.7762065	250	0.7791906	500	0.7514505	1000	0.7023066
Dibenzo[a,h]anthracene-d14	10	0.6694951	50	0.7322765	100	0.7447551	250	0.8605809	500	0.8292005	1000	0.8291607
Fluoranthene-d10	10	0.9566222	50	0.9001436	100	0.90662	250	0.9726315	500	0.8979711	1000	0.8101855

INITIAL CALIBRATION DATA

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EH00019	Instrument:	NT11
Calibration Date:	08/07/2021	Column (1):	RXi-17Sil-MS
Comments:	Low PAH 8270E/625.1 ICAL		

COMPOUND	Mean RRF	RRF RSD	Linear COD	Quad COD	Limit Type & Limit	Q
Naphthalene	1.13539	9.5			RSD (15)	
2-Methylnaphthalene	0.8863122	4.0			RSD (15)	
1-Methylnaphthalene	0.8252655	4.4			RSD (15)	
Acenaphthylene	1.647883	7.6			RSD (15)	
Acenaphthene	1.194201	8.3			RSD (15)	
Dibenzofuran	1.645594	11.7			RSD (15)	
Fluorene	1.22868	5.4			RSD (15)	
Phenanthrene	1.168848	8.1			RSD (15)	
Anthracene	1.126639	7.8			RSD (15)	
Carbazole	1.299482	8.3			RSD (15)	
Fluoranthene	1.183838	6.8			RSD (15)	
Pyrene	1.184023	6.7			RSD (15)	
Benzo(a)anthracene	1.236126	7.0			RSD (15)	
Chrysene	1.447331	8.8			RSD (15)	
Benzo(b)fluoranthene	1.174897	6.5			RSD (15)	
Benzo(k)fluoranthene	1.251581	4.6			RSD (15)	
Benzo(j)fluoranthene	1.456875	10.0			RSD (15)	
Benzofluoranthenes, Total	1.294451	6.6			RSD (15)	
Benzo(a)pyrene	1.098606	4.2			RSD (15)	
Perylene	1.25177	6.8			RSD (15)	
Indeno(1,2,3-cd)pyrene	1.159191	7.8			RSD (15)	
Dibenzo(a,h)anthracene	0.9566446	10.8			RSD (15)	
Benzo(g,h,i)perylene	1.16332	2.3			RSD (15)	
2-Methylnaphthalene-d10	0.7669518	4.7			RSD (15)	
Dibenzo[a,h]anthracene-d14	0.7775781	9.5			RSD (15)	
Fluoranthene-d10	0.9073623	6.3			RSD (15)	

SECOND-SOURCE CALIBRATION VERIFICATION

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EH00019
Laboratory ID: SJH0087-SCV1
Sequence: SJH0087
Sequence Name: PAH 250 SCV
Standard ID: J008217

ANALYTE	EXPECTED (ng/mL)	FOUND (ng/mL)	% DRIFT	QC LIMIT
Naphthalene	250.00	234	-6.4	20.00
2-Methylnaphthalene	250.00	247	-1.4	20.00
1-Methylnaphthalene	250.00	255	2.1	20.00
Acenaphthylene	250.00	231	-7.6	20.00
Acenaphthene	250.00	237	-5.0	20.00
Dibenzofuran	250.00	266	6.6	20.00
Fluorene	250.00	261	4.6	20.00
Phenanthrene	250.00	246	-1.5	20.00
Anthracene	250.00	251	0.3	20.00
Carbazole	250.00	262	4.6	
Fluoranthene	250.00	223	-10.7	20.00
Pyrene	250.00	236	-5.6	20.00
Benzo(a)anthracene	250.00	238	-4.8	20.00
Chrysene	250.00	234	-6.4	20.00
Benzo(b)fluoranthene	250.00	228	-8.7	20.00
Benzo(k)fluoranthene	250.00	244	-2.4	20.00
Benzo(j)fluoranthene	250.00	274	9.7	20.00
Benzofluoranthenes, Total	1250.0	747	-40.3	
Benzo(a)pyrene	250.00	227	-9.0	20.00
Perylene	62.500	62.0	-0.8	20.00
Indeno(1,2,3-cd)pyrene	250.00	244	-2.4	20.00
Dibenzo(a,h)anthracene	250.00	223	-10.8	20.00
Benzo(g,h,i)perylene	250.00	229	-8.3	20.00

* Indicates values outside of QC limits

SECOND-SOURCE CALIBRATION VERIFICATION

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EH00019
Laboratory ID: SJH0087-SCV1
Sequence: SJH0087
Standard ID: J008217

ANALYTE	EXPECTED (ng/mL)	FOUND (ng/mL)	% DRIFT	QC LIMIT
Naphthalene	250.00	234	-6.4	20.00
2-Methylnaphthalene	250.00	247	-1.4	20.00
1-Methylnaphthalene	250.00	255	2.1	20.00
Acenaphthylene	250.00	231	-7.6	20.00
Acenaphthene	250.00	237	-5.0	20.00
Dibenzofuran	250.00	266	6.6	20.00
Fluorene	250.00	261	4.6	20.00
Phenanthrene	250.00	246	-1.5	20.00
Anthracene	250.00	251	0.3	20.00
Carbazole	250.00	262	4.6	
Fluoranthene	250.00	223	-10.7	20.00
Pyrene	250.00	236	-5.6	20.00
Benzo(a)anthracene	250.00	238	-4.8	20.00
Chrysene	250.00	234	-6.4	20.00
Benzo(b)fluoranthene	250.00	228	-8.7	20.00
Benzo(k)fluoranthene	250.00	244	-2.4	20.00
Benzo(j)fluoranthene	250.00	274	9.7	20.00
Benzofluoranthenes, Total	1250.0	747	-40.3	
Benzo(a)pyrene	250.00	227	-9.0	20.00
Perylene	62.500	62.0	-0.8	20.00
Indeno(1,2,3-cd)pyrene	250.00	244	-2.4	20.00
Dibenzo(a,h)anthracene	250.00	223	-10.8	20.00
Benzo(g,h,i)perylene	250.00	229	-8.3	20.00

* Values outside of QC limits

INITIAL CALIBRATION CHECK

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT11	Calibration:	EH00019
Lab File ID:	NT1121080712.D	Calibration Date:	08/07/2021
Sequence:	SJH0087	Injection Date:	08/07/21
Lab Sample ID:	SJH0087-ICV1	Injection Time:	13:43
Sequence Name:	Initial Cal Check		

		CONC. (ng/mL)		RESPONSE FACTOR			% DRIFT/DIFF	
COMPOUND	TYPE	STD	ICV	ICAL	ICV	MIN	ICV	LIMIT
Naphthalene	A	250.00	250	1.1353900	1.1371870		0.0	+/-20
2-Methylnaphthalene	A	250.00	257	0.8863122	0.9103273		2.8	+/-20
1-Methylnaphthalene	A	250.00	254	0.8252655	0.8372194		1.6	+/-20
Acenaphthylene	A	250.00	243	1.6478830	1.6014430		-2.8	+/-20
Acenaphthene	A	250.00	250	1.1942010	1.1961670		0.0	+/-20
Dibenzofuran	A	250.00	252	1.6455940	1.6601410		0.8	+/-20
Fluorene	A	250.00	250	1.2286800	1.2303390		0.0	+/-20
Phenanthrene	A	250.00	269	1.1688480	1.2584330		7.6	+/-20
Anthracene	A	250.00	264	1.1266390	1.1914620		5.6	+/-20
Carbazole	A	250.00	270	1.2994820	1.4045320		8.0	+/-20
Fluoranthene	A	250.00	275	1.1838380	1.3029170		10.0	+/-20
Pyrene	A	250.00	267	1.1840230	1.2640080		6.8	+/-20
Benzo(a)anthracene	A	250.00	244	1.2361260	1.2050950		-2.4	+/-20
Chrysene	A	250.00	257	1.4473310	1.4886150		2.8	+/-20
Benzo(b)fluoranthene	A	250.00	234	1.1748970	1.0989470		-6.4	+/-20
Benzo(k)fluoranthene	A	250.00	268	1.2515810	1.3394980		7.2	+/-20
Benzo(j)fluoranthene	A	250.00	287	1.4568750	1.6723660		14.8	+/-20
Benzofluoranthenes, Total	A	750.00	789	1.2944510	1.3702700		5.2	+/-20
Benzo(a)pyrene	A	250.00	268	1.0986060	1.1791980		7.2	+/-20
Perylene	A	250.00	260	1.2517700	1.3033920		4.0	+/-20
Indeno(1,2,3-cd)pyrene	A	250.00	258	1.1591910	1.1960780		3.2	+/-20
Dibenzo(a,h)anthracene	A	250.00	259	0.9566446	0.9926559		3.6	+/-20
Benzo(g,h,i)perylene	A	250.00	256	1.1633200	1.1918330		2.4	+/-20
2-Methylnaphthalene-d10	A	250.00	251	0.7669518	0.7706950		0.4	+/-20
Dibenzo[a,h]anthracene-d14	A	250.00	254	0.7775781	0.7893422		1.6	+/-20
Fluoranthene-d10	A	250.00	269	0.9073623	0.9761852		7.6	+/-20

* Values outside of QC limits

INITIAL CALIBRATION CHECK

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT11	Calibration:	EH00019
Lab File ID:	NT1121092202.D	Calibration Date:	08/07/2021
Sequence:	SJI0344	Injection Date:	09/22/21
Lab Sample ID:	SJI0344-ICV1	Injection Time:	10:13
Sequence Name:	Initial Cal Check		

		CONC. (ng/mL)		RESPONSE FACTOR			% DRIFT/DIFF	
COMPOUND	TYPE	STD	ICV	ICAL	ICV	MIN	ICV	LIMIT
Benzo(a)anthracene	A	250.00	248	1.2361260	1.2252890		-0.8	+/-20
Chrysene	A	250.00	251	1.4473310	1.4512790		0.4	+/-20
Benzo(b)fluoranthene	A	250.00	243	1.1748970	1.1435330		-2.8	+/-20
Benzo(k)fluoranthene	A	250.00	254	1.2515810	1.2728950		1.6	+/-20
Benzo(a)pyrene	A	250.00	262	1.0986060	1.1503670		4.8	+/-20
Indeno(1,2,3-cd)pyrene	A	250.00	251	1.1591910	1.1647730		0.4	+/-20
Dibenzo(a,h)anthracene	A	250.00	254	0.9566446	0.9714317		1.6	+/-20
2-Methylnaphthalene-d10	A	250.00	259	0.7669518	0.7931243		3.6	+/-20
Dibenzo[a,h]anthracene-d14	A	250.00	253	0.7775781	0.7862288		1.2	+/-20
Fluoranthene-d10	A	250.00	255	0.9073623	0.9248792		2.0	+/-20

* Values outside of QC limits

INITIAL CALIBRATION CHECK

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT11	Calibration:	EH00019
Lab File ID:	NT1121092302.D	Calibration Date:	08/07/2021
Sequence:	SJI0360	Injection Date:	09/23/21
Lab Sample ID:	SJI0360-ICV1	Injection Time:	10:09
Sequence Name:	Initial Cal Check		

		CONC. (ng/mL)		RESPONSE FACTOR			% DRIFT/DIFF	
COMPOUND	TYPE	STD	ICV	ICAL	ICV	MIN	ICV	LIMIT
Benzo(a)anthracene	A	250.00	271	1.2361260	1.3411710		8.4	+/-20
Chrysene	A	250.00	243	1.4473310	1.4086160		-2.8	+/-20
Benzo(b)fluoranthene	A	250.00	249	1.1748970	1.1715200		-0.4	+/-20
Benzo(k)fluoranthene	A	250.00	258	1.2515810	1.2903510		3.2	+/-20
Benzo(a)pyrene	A	250.00	263	1.0986060	1.1558320		5.2	+/-20
Indeno(1,2,3-cd)pyrene	A	250.00	288	1.1591910	1.3338600		15.2	+/-20
Dibenzo(a,h)anthracene	A	250.00	299	0.9566446	1.1427970		19.6	+/-20
2-Methylnaphthalene-d10	A	250.00	256	0.7669518	0.7863131		2.4	+/-20
Dibenzo[a,h]anthracene-d14	A	250.00	300	0.7775781	0.9345686		20.0	+/-20
Fluoranthene-d10	A	250.00	282	0.9073623	1.0249970		12.8	+/-20

* Values outside of QC limits

INITIAL CALIBRATION CHECK

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT11	Calibration:	EH00019
Lab File ID:	NT1121092402.D	Calibration Date:	08/07/2021
Sequence:	SJI0378	Injection Date:	09/24/21
Lab Sample ID:	SJI0378-ICV1	Injection Time:	13:27
Sequence Name:	Initial Cal Check		

		CONC. (ng/mL)		RESPONSE FACTOR			% DRIFT/DIFF	
COMPOUND	TYPE	STD	ICV	ICAL	ICV	MIN	ICV	LIMIT
Benzo(a)anthracene	A	250.00	261	1.2361260	1.2899950		4.4	+/-20
Chrysene	A	250.00	246	1.4473310	1.4247900		-1.6	+/-20
Benzo(b)fluoranthene	A	250.00	241	1.1748970	1.1314300		-3.6	+/-20
Benzo(k)fluoranthene	A	250.00	279	1.2515810	1.3980980		11.6	+/-20
Benzo(a)pyrene	A	250.00	268	1.0986060	1.1757070		7.2	+/-20
Indeno(1,2,3-cd)pyrene	A	250.00	287	1.1591910	1.3325340		14.8	+/-20
Dibenzo(a,h)anthracene	A	250.00	295	0.9566446	1.1302870		18.0	+/-20
2-Methylnaphthalene-d10	A	250.00	257	0.7669518	0.7895646		2.8	+/-20
Dibenzo[a,h]anthracene-d14	A	250.00	297	0.7775781	0.9222314		18.8	+/-20
Fluoranthene-d10	A	250.00	263	0.9073623	0.9545531		5.2	+/-20

* Values outside of QC limits

INITIAL CALIBRATION CHECK

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT11	Calibration:	EH00019
Lab File ID:	NT1121092502.D	Calibration Date:	08/07/2021
Sequence:	SJI0404	Injection Date:	09/25/21
Lab Sample ID:	SJI0404-ICV1	Injection Time:	10:49
Sequence Name:	Initial Cal Check		

		CONC. (ng/mL)		RESPONSE FACTOR			% DRIFT/DIFF	
COMPOUND	TYPE	STD	ICV	ICAL	ICV	MIN	ICV	LIMIT
Benzo(a)anthracene	A	250.00	267	1.2361260	1.3183660		6.8	+/-20
Chrysene	A	250.00	244	1.4473310	1.4104040		-2.4	+/-20
Benzo(b)fluoranthene	A	250.00	244	1.1748970	1.1447740		-2.4	+/-20
Benzo(k)fluoranthene	A	250.00	277	1.2515810	1.3882730		10.8	+/-20
Benzo(a)pyrene	A	250.00	265	1.0986060	1.1634400		6.0	+/-20
Indeno(1,2,3-cd)pyrene	A	250.00	281	1.1591910	1.3025790		12.4	+/-20
Dibenzo(a,h)anthracene	A	250.00	294	0.9566446	1.1265680		17.6	+/-20
2-Methylnaphthalene-d10	A	250.00	256	0.7669518	0.7856045		2.4	+/-20
Dibenzo[a,h]anthracene-d14	A	250.00	296	0.7775781	0.9207659		18.4	+/-20
Fluoranthene-d10	A	250.00	279	0.9073623	1.0118590		11.6	+/-20

* Values outside of QC limits

INITIAL CALIBRATION CHECK

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT11	Calibration:	EH00019
Lab File ID:	NT1121092802.D	Calibration Date:	08/07/2021
Sequence:	SJI0424	Injection Date:	09/28/21
Lab Sample ID:	SJI0424-ICV1	Injection Time:	09:46
Sequence Name:	Initial Cal Check		

		CONC. (ng/mL)		RESPONSE FACTOR			% DRIFT/DIFF		
COMPOUND	TYPE	STD	ICV	ICAL	ICV	MIN	ICV	LIMIT	
Benzo(a)anthracene	A	250.00	268	1.2361260	1.3231640		7.2	+/-20	
Chrysene	A	250.00	243	1.4473310	1.4095610		-2.8	+/-20	
Benzo(b)fluoranthene	A	250.00	246	1.1748970	1.1567110		-1.6	+/-20	
Benzo(k)fluoranthene	A	250.00	275	1.2515810	1.3758610		10.0	+/-20	
Benzo(a)pyrene	A	250.00	266	1.0986060	1.1697610		6.4	+/-20	
Indeno(1,2,3-cd)pyrene	A	250.00	291	1.1591910	1.3514350		16.4	+/-20	
Dibenzo(a,h)anthracene	A	250.00	303	0.9566446	1.1611080		21.2	+/-20	*
2-Methylnaphthalene-d10	A	250.00	257	0.7669518	0.7876285		2.8	+/-20	
Dibenzo[a,h]anthracene-d14	A	250.00	306	0.7775781	0.9507867		22.4	+/-20	*
Fluoranthene-d10	A	250.00	269	0.9073623	0.9764099		7.6	+/-20	

* Values outside of QC limits

CONTINUING CALIBRATION CHECK
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT11	Calibration:	EH00019
Lab File ID:	NT1121080734.D	Calibration Date:	08/07/2021
Sequence:	SJH0087	Injection Date:	08/08/21
Lab Sample ID:	SJH0087-CCV1	Injection Time:	00:53
Sequence Name:	Calibration Check		

		CONC. (ng/mL)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Naphthalene	A	250.00	249	1.1353900	1.1309120		-0.4	+/-50
2-Methylnaphthalene	A	250.00	257	0.8863122	0.9099228		2.7	+/-50
1-Methylnaphthalene	A	250.00	257	0.8252655	0.8490036		2.9	+/-50
Acenaphthylene	A	250.00	254	1.6478830	1.6753820		1.7	+/-50
Acenaphthene	A	250.00	250	1.1942010	1.1955630		0.1	+/-50
Dibenzofuran	A	250.00	248	1.6455940	1.6324920		-0.8	+/-50
Fluorene	A	250.00	255	1.2286800	1.2520440		1.9	+/-50
Phenanthrene	A	250.00	254	1.1688480	1.1890420		1.7	+/-50
Anthracene	A	250.00	261	1.1266390	1.1744550		4.2	+/-50
Carbazole	A	250.00	261	1.2994820	1.3574290		4.5	+/-50
Fluoranthene	A	250.00	258	1.1838380	1.2222290		3.2	+/-50
Pyrene	A	250.00	259	1.1840230	1.2253720		3.5	+/-50
Benzo(a)anthracene	A	250.00	253	1.2361260	1.2501500		1.1	+/-50
Chrysene	A	250.00	256	1.4473310	1.4798890		2.2	+/-50
Benzo(b)fluoranthene	A	250.00	244	1.1748970	1.1489770		-2.2	+/-50
Benzo(k)fluoranthene	A	250.00	260	1.2515810	1.3038160		4.2	+/-50
Benzo(j)fluoranthene	A	250.00	269	1.4568750	1.5704770		7.8	+/-50
Benzofluoranthenes, Total	A	750.00	774	1.2944510	1.3410900		3.3	+/-50
Benzo(a)pyrene	A	250.00	267	1.0986060	1.1727990		6.8	+/-50
Perylene	A	250.00	257	1.2517700	1.2867110		2.8	+/-50
Indeno(1,2,3-cd)pyrene	A	250.00	255	1.1591910	1.1840900		2.1	+/-50
Dibenzo(a,h)anthracene	A	250.00	255	0.9566446	0.9772657		2.2	+/-50
Benzo(g,h,i)perylene	A	250.00	248	1.1633200	1.1517680		-1.0	+/-50
2-Methylnaphthalene-d10	A	250.00	255	0.7669518	0.7819887		2.0	+/-50
Dibenzo[a,h]anthracene-d14	A	250.00	253	0.7775781	0.7875192		1.3	+/-50
Fluoranthene-d10	A	250.00	262	0.9073623	0.9527088		5.0	+/-50

* Values outside of QC limits

* Values outside of QC limits

Analytical Resources, Incorporated
Analytical Chemists and Consultants

SECOND-SOURCE
CONTINUING CALIBRATION CHECK
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT11	Calibration:	EH00019
Lab File ID:	NT1121080710.D	Calibration Date:	08/07/2021
Sequence:	SJH0087	Injection Date:	08/07/21
Lab Sample ID:	SJH0087-SCV1	Injection Time:	12:51
Sequence Name:	PAH 250 SCV		

		CONC. (ng/mL)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Naphthalene	A	250.00	234	1.1353900	1.0621730		-6.4	+/-20
2-Methylnaphthalene	A	250.00	247	0.8863122	0.8743214		-1.4	+/-20
1-Methylnaphthalene	A	250.00	255	0.8252655	0.8426899		2.1	+/-20
Acenaphthylene	A	250.00	231	1.6478830	1.5234200		-7.6	+/-20
Acenaphthene	A	250.00	237	1.1942010	1.1339790		-5.0	+/-20
Dibenzofuran	A	250.00	266	1.6455940	1.7535580		6.6	+/-20
Fluorene	A	250.00	261	1.2286800	1.2851330		4.6	+/-20
Phenanthrene	A	250.00	246	1.1688480	1.1511650		-1.5	+/-20
Anthracene	A	250.00	251	1.1266390	1.1294940		0.3	+/-20
Carbazole	A	250.00	262	1.2994820	1.3595040		4.6	
Fluoranthene	A	250.00	223	1.1838380	1.0574940		-10.7	+/-20
Pyrene	A	250.00	236	1.1840230	1.1179670		-5.6	+/-20
Benzo(a)anthracene	A	250.00	238	1.2361260	1.1767640		-4.8	+/-20
Chrysene	A	250.00	234	1.4473310	1.3550690		-6.4	+/-20
Benzo(b)fluoranthene	A	250.00	228	1.1748970	1.0726270		-8.7	+/-20
Benzo(k)fluoranthene	A	250.00	244	1.2515810	1.2218880		-2.4	+/-20
Benzo(j)fluoranthene	A	250.00	274	1.4568750	1.5987820		9.7	+/-20
Benzofluoranthenes, Total	A	1250.0	747	1.2944510	0.7786594		-40.3	
Benzo(a)pyrene	A	250.00	227	1.0986060	0.9994118		-9.0	+/-20
Perylene	A	62.500	62.0	1.2517700	1.2411430		-0.8	+/-20
Indeno(1,2,3-cd)pyrene	A	250.00	244	1.1591910	1.1313420		-2.4	+/-20
Dibenzo(a,h)anthracene	A	250.00	223	0.9566446	0.8535077		-10.8	+/-20
Benzo(g,h,i)perylene	A	250.00	229	1.1633200	1.0664650		-8.3	+/-20

* Values outside of QC limits

CONTINUING CALIBRATION CHECK
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT11	Calibration:	EH00019
Lab File ID:	NT1121092221.D	Calibration Date:	08/07/2021
Sequence:	SJI0344	Injection Date:	09/22/21
Lab Sample ID:	SJI0344-CCV1	Injection Time:	19:55
Sequence Name:	Calibration Check		

		CONC. (ng/mL)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Benzo(a)anthracene	A	250.00	275	1.2361260	1.3606290		10.1	+/-50
Chrysene	A	250.00	244	1.4473310	1.4143350		-2.3	+/-50
Benzo(b)fluoranthene	A	250.00	269	1.1748970	1.2623410		7.4	+/-50
Benzo(k)fluoranthene	A	250.00	256	1.2515810	1.2809110		2.3	+/-50
Benzo(a)pyrene	A	250.00	264	1.0986060	1.1583640		5.4	+/-50
Indeno(1,2,3-cd)pyrene	A	250.00	241	1.1591910	1.1193370		-3.4	+/-50
Dibenzo(a,h)anthracene	A	250.00	259	0.9566446	0.9909842		3.6	+/-50
2-Methylnaphthalene-d10	A	250.00	249	0.7669518	0.7648102		-0.3	+/-50
Dibenzo[a,h]anthracene-d14	A	250.00	267	0.7775781	0.8308886		6.9	+/-50
Fluoranthene-d10	A	250.00	273	0.9073623	0.9895558		9.1	+/-50

* Values outside of QC limits

CONTINUING CALIBRATION CHECK
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT11	Calibration:	EH00019
Lab File ID:	NT1121092320.D	Calibration Date:	08/07/2021
Sequence:	SJI0360	Injection Date:	09/23/21
Lab Sample ID:	SJI0360-CCV1	Injection Time:	19:11
Sequence Name:	Calibration Check		

		CONC. (ng/mL)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Benzo(a)anthracene	A	250.00	269	1.2361260	1.3313950		7.7	+/-50
Chrysene	A	250.00	246	1.4473310	1.4258820		-1.5	+/-50
Benzo(b)fluoranthene	A	250.00	259	1.1748970	1.2176020		3.6	+/-50
Benzo(k)fluoranthene	A	250.00	256	1.2515810	1.2820800		2.4	+/-50
Benzo(a)pyrene	A	250.00	265	1.0986060	1.1625570		5.8	+/-50
Indeno(1,2,3-cd)pyrene	A	250.00	287	1.1591910	1.3299320		14.7	+/-50
Dibenzo(a,h)anthracene	A	250.00	297	0.9566446	1.1363820		18.8	+/-50
2-Methylnaphthalene-d10	A	250.00	255	0.7669518	0.7828020		2.1	+/-50
Dibenzo[a,h]anthracene-d14	A	250.00	298	0.7775781	0.9273487		19.3	+/-50
Fluoranthene-d10	A	250.00	261	0.9073623	0.9484746		4.5	+/-50

* Values outside of QC limits

CONTINUING CALIBRATION CHECK
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT11	Calibration:	EH00019
Lab File ID:	NT1121092423.D	Calibration Date:	08/07/2021
Sequence:	SJI0378	Injection Date:	09/25/21
Lab Sample ID:	SJI0378-CCV1	Injection Time:	00:06
Sequence Name:	Calibration Check		

		CONC. (ng/mL)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Benzo(a)anthracene	A	250.00	270	1.2361260	1.3371680		8.2	+/-50
Chrysene	A	250.00	241	1.4473310	1.3959430		-3.6	+/-50
Benzo(b)fluoranthene	A	250.00	252	1.1748970	1.1862720		1.0	+/-50
Benzo(k)fluoranthene	A	250.00	270	1.2515810	1.3493550		7.8	+/-50
Benzo(a)pyrene	A	250.00	266	1.0986060	1.1700090		6.5	+/-50
Indeno(1,2,3-cd)pyrene	A	250.00	272	1.1591910	1.2612650		8.8	+/-50
Dibenzo(a,h)anthracene	A	250.00	289	0.9566446	1.1074170		15.8	+/-50
2-Methylnaphthalene-d10	A	250.00	254	0.7669518	0.7801637		1.7	+/-50
Dibenzo[a,h]anthracene-d14	A	250.00	292	0.7775781	0.9085918		16.8	+/-50
Fluoranthene-d10	A	250.00	267	0.9073623	0.9700728		6.9	+/-50

* Values outside of QC limits

CONTINUING CALIBRATION CHECK
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT11	Calibration:	EH00019
Lab File ID:	NT1121092520.D	Calibration Date:	08/07/2021
Sequence:	SJI0404	Injection Date:	09/25/21
Lab Sample ID:	SJI0404-CCV1	Injection Time:	20:09
Sequence Name:	Calibration Check		

		CONC. (ng/mL)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Benzo(a)anthracene	A	250.00	271	1.2361260	1.3421090		8.6	+/-50
Chrysene	A	250.00	239	1.4473310	1.3832590		-4.4	+/-50
Benzo(b)fluoranthene	A	250.00	252	1.1748970	1.1852850		0.9	+/-50
Benzo(k)fluoranthene	A	250.00	271	1.2515810	1.3572830		8.4	+/-50
Benzo(a)pyrene	A	250.00	269	1.0986060	1.1832020		7.7	+/-50
Indeno(1,2,3-cd)pyrene	A	250.00	278	1.1591910	1.2891160		11.2	+/-50
Dibenzo(a,h)anthracene	A	250.00	292	0.9566446	1.1159770		16.7	+/-50
2-Methylnaphthalene-d10	A	250.00	252	0.7669518	0.7726964		0.7	+/-50
Dibenzo[a,h]anthracene-d14	A	250.00	295	0.7775781	0.9190483		18.2	+/-50
Fluoranthene-d10	A	250.00	269	0.9073623	0.9758392		7.5	+/-50

* Values outside of QC limits

CONTINUING CALIBRATION CHECK
EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	NT11	Calibration:	EH00019
Lab File ID:	NT1121092822.D	Calibration Date:	08/07/2021
Sequence:	SJI0424	Injection Date:	09/28/21
Lab Sample ID:	SJI0424-CCV1	Injection Time:	20:01
Sequence Name:	Calibration Check		

		CONC. (ng/mL)		RESPONSE FACTOR (RRF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Benzo(a)anthracene	A	250.00	260	1.2361260	1.2857830		4.0	+/-50
Chrysene	A	250.00	247	1.4473310	1.4316250		-1.1	+/-50
Benzo(b)fluoranthene	A	250.00	243	1.1748970	1.1442830		-2.6	+/-50
Benzo(k)fluoranthene	A	250.00	266	1.2515810	1.3296000		6.2	+/-50
Benzo(a)pyrene	A	250.00	264	1.0986060	1.1622910		5.8	+/-50
Indeno(1,2,3-cd)pyrene	A	250.00	277	1.1591910	1.2858160		10.9	+/-50
Dibenzo(a,h)anthracene	A	250.00	286	0.9566446	1.0949280		14.5	+/-50
2-Methylnaphthalene-d10	A	250.00	256	0.7669518	0.7838554		2.2	+/-50
Dibenzo[a,h]anthracene-d14	A	250.00	287	0.7775781	0.8940989		15.0	+/-50
Fluoranthene-d10	A	250.00	263	0.9073623	0.9558196		5.3	+/-50

* Values outside of QC limits

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
Client: GeoEngineers
Sequence: SJH0087

SDG: 21I0042
Project: South State Street PRDI
Instrument: NT11
Calibration: EH00019

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
DFTPP	SJH0087-TUN1	NT1121080701.D	NA	08/07/21 08:35
PAH 250	SJH0087-CAL4	NT1121080702.D	NA	08/07/21 08:50
PAH 1000	SJH0087-CAL6	NT1121080703.D	NA	08/07/21 09:20
PAH 10	SJH0087-CAL1	NT1121080704.D	NA	08/07/21 09:50
PAH 500	SJH0087-CAL5	NT1121080705.D	NA	08/07/21 10:21
PAH 50	SJH0087-CAL2	NT1121080706.D	NA	08/07/21 10:51
PAH 100	SJH0087-CAL3	NT1121080707.D	NA	08/07/21 11:21
Initial Cal Blank	SJH0087-ICB1	NT1121080709.D	NA	08/07/21 12:21
PAH 250 SCV	SJH0087-SCV1	NT1121080710.D	NA	08/07/21 12:51
MS Tune	SJH0087-TUN2	NT1121080711.D	NA	08/07/21 13:18
Initial Cal Check	SJH0087-ICV1	NT1121080712.D	NA	08/07/21 13:43
ZZZZZ	BJG0598-BLK1	NT1121080713.D	Water	08/07/21 14:19
ZZZZZ	BJG0598-BS1	NT1121080714.D	Water	08/07/21 14:49
ZZZZZ	BJG0598-BSD1	NT1121080715.D	Water	08/07/21 15:19
ZZZZZ	21G0257-01	NT1121080716.D	Water	08/07/21 15:49
ZZZZZ	21G0257-02	NT1121080717.D	Water	08/07/21 16:20
ZZZZZ	21G0257-03	NT1121080718.D	Water	08/07/21 16:50
ZZZZZ	21G0257-04	NT1121080719.D	Water	08/07/21 17:20
ZZZZZ	21G0292-01	NT1121080720.D	Water	08/07/21 17:50
ZZZZZ	21G0292-02	NT1121080721.D	Water	08/07/21 18:20
ZZZZZ	21G0292-03	NT1121080724.D	Water	08/07/21 19:51
ZZZZZ	21G0292-04	NT1121080725.D	Water	08/07/21 20:22
ZZZZZ	21G0300-01	NT1121080726.D	Water	08/07/21 20:52
ZZZZZ	21G0300-02	NT1121080727.D	Water	08/07/21 21:22
ZZZZZ	21G0300-03	NT1121080728.D	Water	08/07/21 21:52
ZZZZZ	21G0300-04	NT1121080729.D	Water	08/07/21 22:22
ZZZZZ	21G0300-05	NT1121080730.D	Water	08/07/21 22:52
ZZZZZ	21G0300-06	NT1121080731.D	Water	08/07/21 23:22
ZZZZZ	21G0300-07	NT1121080732.D	Water	08/07/21 23:53

Analytical Resources, Incorporated
Analytical Chemists and Consultants

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Sequence:	SJH0087	Instrument:	NT11
		Calibration:	EH00019

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Calibration Check	SJH0087-CCV1	NT1121080734.D	NA	08/08/21 00:53

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
Client: GeoEngineers
Sequence: SJI0344

SDG: 21I0042
Project: South State Street PRDI
Instrument: NT11
Calibration: EH00019

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
DFTPP	SJI0344-TUN1	NT1121092201.D	NA	09/22/21 09:58
Initial Cal Check	SJI0344-ICV1	NT1121092202.D	NA	09/22/21 10:13
Blank	BJI0287-BLK1	NT1121092203.D	Solid	09/22/21 10:53
LCS	BJI0287-BS1	NT1121092204.D	Solid	09/22/21 11:23
LCS Dup	BJI0287-BSD1	NT1121092205.D	Solid	09/22/21 11:53
HA-15-0-1	21I0042-05	NT1121092206.D	Solid	09/22/21 12:23
HA-15-1-2	21I0042-06	NT1121092207.D	Solid	09/22/21 12:53
HA-17-1-2	21I0042-09	NT1121092210.D	Solid	09/22/21 14:24
HA-18-1-2	21I0042-10	NT1121092211.D	Solid	09/22/21 14:54
HA-19-0-1	21I0042-11	NT1121092212.D	Solid	09/22/21 15:24
HA-19-1-2	21I0042-12	NT1121092213.D	Solid	09/22/21 15:54
HA-20-0-1	21I0042-13	NT1121092214.D	Solid	09/22/21 16:24
HA-20-1-2	21I0042-14	NT1121092215.D	Solid	09/22/21 16:54
HA-21-1-2	21I0042-15	NT1121092216.D	Solid	09/22/21 17:24
HA-22-0-1	21I0042-16	NT1121092217.D	Solid	09/22/21 17:55
HA-22-1-2	21I0042-17	NT1121092218.D	Solid	09/22/21 18:25
HA-23-1-2	21I0042-18	NT1121092219.D	Solid	09/22/21 18:55
HA-24-0-1	21I0042-19	NT1121092220.D	Solid	09/22/21 19:25
Calibration Check	SJI0344-CCV1	NT1121092221.D	NA	09/22/21 19:55

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
Client: GeoEngineers
Sequence: SJI0360

SDG: 21I0042
Project: South State Street PRDI
Instrument: NT11
Calibration: EH00019

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
DFTPP	SJI0360-TUN1	NT1121092301.D	NA	09/23/21 09:54
Initial Cal Check	SJI0360-ICV1	NT1121092302.D	NA	09/23/21 10:09
Instrument Blank	SJI0360-IBL1	NT1121092303.D	NA	09/23/21 10:40
HA-16-0-1	21I0042-07	NT1121092304.D	Solid	09/23/21 11:10
HA-16-1-2	21I0042-08	NT1121092305.D	Solid	09/23/21 11:40
HA-15-0-1	21I0042-05RE1	NT1121092306.D	Solid	09/23/21 12:11
HA-15-1-2	21I0042-06RE1	NT1121092307.D	Solid	09/23/21 12:41
HA-24-1-2	21I0042-20	NT1121092308.D	Solid	09/23/21 13:11
HA-24-1-2	BJI0287-MS1	NT1121092309.D	Solid	09/23/21 13:41
HA-24-1-2	BJI0287-MSD1	NT1121092310.D	Solid	09/23/21 14:11
HA-25-0-1	21I0042-21	NT1121092311.D	Solid	09/23/21 14:41
HA-25-1-2	21I0042-22	NT1121092312.D	Solid	09/23/21 15:11
HA-16-0-1	21I0042-07RE1	NT1121092313.D	Solid	09/23/21 15:41
HA-16-1-2	21I0042-08RE1	NT1121092314.D	Solid	09/23/21 16:11
HA-18-1-2	21I0042-10RE1	NT1121092315.D	Solid	09/23/21 16:41
HA-21-1-2	21I0042-15RE1	NT1121092316.D	Solid	09/23/21 17:11
HA-22-0-1	21I0042-16RE1	NT1121092317.D	Solid	09/23/21 17:42
HA-22-1-2	21I0042-17RE1	NT1121092318.D	Solid	09/23/21 18:11
HA-23-1-2	21I0042-18RE1	NT1121092319.D	Solid	09/23/21 18:41
Calibration Check	SJI0360-CCV1	NT1121092320.D	NA	09/23/21 19:11

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
Client: GeoEngineers
Sequence: SJI0378

SDG: 21I0042
Project: South State Street PRDI
Instrument: NT11
Calibration: EH00019

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
DFTPP	SJI0378-TUN1	NT1121092401.D	NA	09/24/21 13:12
Initial Cal Check	SJI0378-ICV1	NT1121092402.D	NA	09/24/21 13:27
Blank	BJI0296-BLK1	NT1121092403.D	Solid	09/24/21 14:03
LCS	BJI0296-BS1	NT1121092404.D	Solid	09/24/21 14:33
LCS Dup	BJI0296-BSD1	NT1121092405.D	Solid	09/24/21 15:03
HA-26-0-1	21I0042-23	NT1121092406.D	Solid	09/24/21 15:33
HA-26-1-2	21I0042-24	NT1121092407.D	Solid	09/24/21 16:04
HA-27-0-1	21I0042-25	NT1121092408.D	Solid	09/24/21 16:34
HA-27-1-2	21I0042-26	NT1121092409.D	Solid	09/24/21 17:04
HA-28-0-1	21I0042-27	NT1121092410.D	Solid	09/24/21 17:34
HA-28-1-2	21I0042-28	NT1121092411.D	Solid	09/24/21 18:04
HA-29-0-1	21I0042-29	NT1121092412.D	Solid	09/24/21 18:34
HA-29-1-2	21I0042-30	NT1121092413.D	Solid	09/24/21 19:05
HA-30-1-2	21I0042-31	NT1121092414.D	Solid	09/24/21 19:35
HA-31-0-1	21I0042-32	NT1121092415.D	Solid	09/24/21 20:05
HA-31-0-1	BJI0296-MS1	NT1121092416.D	Solid	09/24/21 20:35
HA-31-0-1	BJI0296-MSD1	NT1121092417.D	Solid	09/24/21 21:05
HA-31-1-2	21I0042-33	NT1121092418.D	Solid	09/24/21 21:35
HA-32-0-1	21I0042-34	NT1121092419.D	Solid	09/24/21 22:05
HA-32-1-2	21I0042-35	NT1121092420.D	Solid	09/24/21 22:35
HA-33-0-1	21I0042-36	NT1121092421.D	Solid	09/24/21 23:06
HA-33-1-2	21I0042-37	NT1121092422.D	Solid	09/24/21 23:36
Calibration Check	SJI0378-CCV1	NT1121092423.D	NA	09/25/21 00:06

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
Client: GeoEngineers
Sequence: SJI0404

SDG: 21I0042
Project: South State Street PRDI
Instrument: NT11
Calibration: EH00019

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
DFTPP	SJI0404-TUN1	NT1121092501.D	NA	09/25/21 10:34
Initial Cal Check	SJI0404-ICV1	NT1121092502.D	NA	09/25/21 10:49
ZZZZZ	BJI0106-BLK1	NT1121092503.D	Water	09/25/21 11:36
ZZZZZ	BJI0106-BS1	NT1121092504.D	Water	09/25/21 12:06
ZZZZZ	BJI0106-BSD1	NT1121092505.D	Water	09/25/21 12:37
ZZZZZ	21H0367-07	NT1121092506.D	Water	09/25/21 13:07
ZZZZZ	21H0374-01	NT1121092507.D	Water	09/25/21 13:37
HA-26-0-1	21I0042-23RE1	NT1121092508.D	Solid	09/25/21 14:07
HA-29-1-2	21I0042-30RE1	NT1121092509.D	Solid	09/25/21 14:37
HA-31-0-1	21I0042-32RE1	NT1121092510.D	Solid	09/25/21 15:07
HA-32-0-1	21I0042-34RE1	NT1121092511.D	Solid	09/25/21 15:38
HA-26-1-2	21I0042-24RE1	NT1121092512.D	Solid	09/25/21 16:08
HA-27-1-2	21I0042-26RE1	NT1121092513.D	Solid	09/25/21 16:38
HA-30-1-2	21I0042-31RE1	NT1121092514.D	Solid	09/25/21 17:08
HA-31-1-2	21I0042-33RE1	NT1121092515.D	Solid	09/25/21 17:38
HA-32-1-2	21I0042-35RE1	NT1121092516.D	Solid	09/25/21 18:08
HA-34-1-2	21I0042-38	NT1121092517.D	Solid	09/25/21 18:39
DUP-01-1-2	21I0042-39	NT1121092518.D	Solid	09/25/21 19:09
DUP-02-1-2	21I0042-40	NT1121092519.D	Solid	09/25/21 19:39
Calibration Check	SJI0404-CCV1	NT1121092520.D	NA	09/25/21 20:09

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
Client: GeoEngineers
Sequence: SJI0424

SDG: 21I0042
Project: South State Street PRDI
Instrument: NT11
Calibration: EH00019

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
DFTPP	SJI0424-TUN1	NT1121092801.D	NA	09/28/21 09:32
Initial Cal Check	SJI0424-ICV1	NT1121092802.D	NA	09/28/21 09:46
Instrument Blank	SJI0424-IBL1	NT1121092803.D	NA	09/28/21 10:29
HA-34-1-2	21I0042-38RE1	NT1121092804.D	Solid	09/28/21 10:58
DUP-01-1-2	21I0042-39RE1	NT1121092805.D	Solid	09/28/21 11:29
DUP-02-1-2	21I0042-40RE1	NT1121092806.D	Solid	09/28/21 11:59
ZZZZZ	BJI0154-BLK1	NT1121092807.D	Water	09/28/21 12:29
ZZZZZ	BJI0154-BS1	NT1121092808.D	Water	09/28/21 12:59
ZZZZZ	21I0001-01	NT1121092809.D	Water	09/28/21 13:29
ZZZZZ	21I0001-05	NT1121092810.D	Water	09/28/21 13:59
ZZZZZ	21I0001-12	NT1121092811.D	Water	09/28/21 14:29
ZZZZZ	BJI0190-BLK1	NT1121092814.D	Water	09/28/21 16:00
ZZZZZ	BJI0190-BS1	NT1121092815.D	Water	09/28/21 16:30
ZZZZZ	BJI0190-BSD1	NT1121092816.D	Water	09/28/21 17:00
ZZZZZ	21I0012-01	NT1121092817.D	Water	09/28/21 17:30
ZZZZZ	21I0012-03	NT1121092818.D	Water	09/28/21 18:00
ZZZZZ	21I0012-08	NT1121092819.D	Water	09/28/21 18:31
ZZZZZ	21I0012-10	NT1121092820.D	Water	09/28/21 19:01
ZZZZZ	21I0012-12	NT1121092821.D	Water	09/28/21 19:31
Calibration Check	SJI0424-CCV1	NT1121092822.D	NA	09/28/21 20:01

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG/WO:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Sequence:	SJH0087	Instrument:	NT11
Calibration:	EH00019	Calibration Date:	08/07/2021

Surrogate Compound	Spike Level ng/mL	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
SJH0087-ICB1 (Water)			Lab File ID: NT1121080709.D			Analyzed: 08/07/21 12:21		
2-Methylnaphthalene-d10	250.00	96.9	42 - 120	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	250.00	102	29 - 120	22.361	22.36067	0.0003	N/A	
Fluoranthene-d10	250.00	99.7	57 - 120	14.558	14.558	0.0000	N/A	
SJH0087-ICV1 (Water)			Lab File ID: NT1121080712.D			Analyzed: 08/07/21 13:43		
2-Methylnaphthalene-d10	250.00	100	80 - 120	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	250.00	102	80 - 120	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	250.00	108	80 - 120	14.558	14.558	0.0000	N/A	
SJH0087-CCV1 (Water)			Lab File ID: NT1121080734.D			Analyzed: 08/08/21 00:53		
2-Methylnaphthalene-d10	250.00	102	50 - 150	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	250.00	101	50 - 150	22.36	22.36067	-0.0007	N/A	
Fluoranthene-d10	250.00	105	50 - 150	14.558	14.558	0.0000	N/A	

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0344
Instrument: NT11
Calibration: EH00019
Calibration Date: 08/07/2021

Surrogate Compound	Spike Level ng/mL	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
SJI0344-ICV1 (Solid)			Lab File ID: NT1121092202.D			Analyzed: 09/22/21 10:13		
2-Methylnaphthalene-d10	250.00	104	80 - 120	7.77	7.770667	-0.0007	N/A	
Dibenzo[a,h]anthracene-d14	250.00	101	80 - 120	22.36	22.36067	-0.0007	N/A	
Fluoranthene-d10	250.00	102	80 - 120	14.558	14.558	0.0000	N/A	
BJI0287-BLK1 (Solid)			Lab File ID: NT1121092203.D			Analyzed: 09/22/21 10:53		
2-Methylnaphthalene-d10	15.000	52.4	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	15.000	67.5	21 - 133	22.36	22.36067	-0.0007	N/A	
Fluoranthene-d10	15.000	72.5	36 - 134	14.558	14.558	0.0000	N/A	
BJI0287-BS1 (Solid)			Lab File ID: NT1121092204.D			Analyzed: 09/22/21 11:23		
2-Methylnaphthalene-d10	15.000	52.4	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	15.000	75.8	21 - 133	22.361	22.36067	0.0003	N/A	
Fluoranthene-d10	15.000	76.6	36 - 134	14.559	14.558	0.0010	N/A	
BJI0287-BSD1 (Solid)			Lab File ID: NT1121092205.D			Analyzed: 09/22/21 11:53		
2-Methylnaphthalene-d10	15.000	59.0	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	15.000	73.1	21 - 133	22.361	22.36067	0.0003	N/A	
Fluoranthene-d10	15.000	77.2	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-05 (Solid)			Lab File ID: NT1121092206.D			Analyzed: 09/22/21 12:23		
2-Methylnaphthalene-d10	14.999	56.1	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.999		21 - 133	22.471	22.36067	0.1103	N/A	NRS
Fluoranthene-d10	14.999	84.7	36 - 134	14.568	14.558	0.0100	N/A	
21I0042-06 (Solid)			Lab File ID: NT1121092207.D			Analyzed: 09/22/21 12:53		
2-Methylnaphthalene-d10	14.999	52.7	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.999		21 - 133	22.472	22.36067	0.1113	N/A	NRS
Fluoranthene-d10	14.999	76.4	36 - 134	14.568	14.558	0.0100	N/A	
21I0042-09 (Solid)			Lab File ID: NT1121092210.D			Analyzed: 09/22/21 14:24		
2-Methylnaphthalene-d10	15.003	51.8	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	15.003	92.8	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	15.003	86.1	36 - 134	14.558	14.558	0.0000	N/A	

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0344
Instrument: NT11
Calibration: EH00019
Calibration Date: 08/07/2021

Surrogate Compound	Spike Level ug/kg dry	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
21I0042-10 (Solid)			Lab File ID: NT1121092211.D			Analyzed: 09/22/21 14:54		
2-Methylnaphthalene-d10	14.985	56.9	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.985	86.4	21 - 133	22.371	22.36067	0.0103	N/A	
Fluoranthene-d10	14.985	88.2	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-11 (Solid)			Lab File ID: NT1121092212.D			Analyzed: 09/22/21 15:24		
2-Methylnaphthalene-d10	15.003	50.0	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	15.003	85.2	21 - 133	22.361	22.36067	0.0003	N/A	
Fluoranthene-d10	15.003	84.3	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-12 (Solid)			Lab File ID: NT1121092213.D			Analyzed: 09/22/21 15:54		
2-Methylnaphthalene-d10	14.964	53.0	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.964	88.0	21 - 133	22.361	22.36067	0.0003	N/A	
Fluoranthene-d10	14.964	88.8	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-13 (Solid)			Lab File ID: NT1121092214.D			Analyzed: 09/22/21 16:24		
2-Methylnaphthalene-d10	14.975	58.0	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.975	92.6	21 - 133	22.36	22.36067	-0.0007	N/A	
Fluoranthene-d10	14.975	90.7	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-14 (Solid)			Lab File ID: NT1121092215.D			Analyzed: 09/22/21 16:54		
2-Methylnaphthalene-d10	15.003	51.6	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	15.003	79.9	21 - 133	22.36	22.36067	-0.0007	N/A	
Fluoranthene-d10	15.003	83.7	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-15 (Solid)			Lab File ID: NT1121092216.D			Analyzed: 09/22/21 17:24		
2-Methylnaphthalene-d10	14.988	52.5	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.988	76.6	21 - 133	22.36	22.36067	-0.0007	N/A	
Fluoranthene-d10	14.988	79.2	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-16 (Solid)			Lab File ID: NT1121092217.D			Analyzed: 09/22/21 17:55		
2-Methylnaphthalene-d10	14.967	60.8	32 - 120	7.772	7.770667	0.0013	N/A	
Dibenzo[a,h]anthracene-d14	14.967	82.2	21 - 133	22.416	22.36067	0.0553	N/A	
Fluoranthene-d10	14.967	85.7	36 - 134	14.577	14.558	0.0190	N/A	

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0344
Instrument: NT11
Calibration: EH00019
Calibration Date: 08/07/2021

Surrogate Compound	Spike Level ug/kg dry	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
21I0042-17 (Solid)			Lab File ID: NT1121092218.D			Analyzed: 09/22/21 18:25		
2-Methylnaphthalene-d10	14.968	58.5	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.968	75.8	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	14.968	81.2	36 - 134	14.568	14.558	0.0100	N/A	
21I0042-18 (Solid)			Lab File ID: NT1121092219.D			Analyzed: 09/22/21 18:55		
2-Methylnaphthalene-d10	14.970	52.6	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.970	81.5	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.970	91.0	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-19 (Solid)			Lab File ID: NT1121092220.D			Analyzed: 09/22/21 19:25		
2-Methylnaphthalene-d10	14.994	50.8	32 - 120	7.761	7.770667	-0.0097	N/A	
Dibenzo[a,h]anthracene-d14	14.994	82.2	21 - 133	22.36	22.36067	-0.0007	N/A	
Fluoranthene-d10	14.994	85.0	36 - 134	14.558	14.558	0.0000	N/A	
SJI0344-CCV1 (Solid)			Lab File ID: NT1121092221.D			Analyzed: 09/22/21 19:55		
2-Methylnaphthalene-d10	250.00	99.7	50 - 120	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	250.00	107	50 - 133	22.361	22.36067	0.0003	N/A	
Fluoranthene-d10	250.00	109	50 - 134	14.558	14.558	0.0000	N/A	

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0360
Instrument: NT11
Calibration: EH00019
Calibration Date: 08/07/2021

Surrogate Compound	Spike Level ng/mL	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
SJI0360-ICV1 (Solid)			Lab File ID: NT1121092302.D			Analyzed: 09/23/21 10:09		
2-Methylnaphthalene-d10	250.00	102	80 - 120	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	250.00	120	80 - 120	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	250.00	113	80 - 120	14.558	14.558	0.0000	N/A	
SJI0360-IBL1 (Solid)			Lab File ID: NT1121092303.D			Analyzed: 09/23/21 10:40		
2-Methylnaphthalene-d10	250.00	94.7	30 - 160	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	250.00	114	30 - 160	22.361	22.36067	0.0003	N/A	
Fluoranthene-d10	250.00	105	30 - 160	14.558	14.558	0.0000	N/A	
21I0042-07 (Solid)			Lab File ID: NT1121092304.D			Analyzed: 09/23/21 11:10		
2-Methylnaphthalene-d10	14.971		32 - 120	7.771	7.770667	0.0003	N/A	D1
Dibenzo[a,h]anthracene-d14	14.971		21 - 133	22.383	22.36067	0.0223	N/A	D1
Fluoranthene-d10	14.971		36 - 134	14.558	14.558	0.0000	N/A	D1
21I0042-08 (Solid)			Lab File ID: NT1121092305.D			Analyzed: 09/23/21 11:40		
2-Methylnaphthalene-d10	14.999		32 - 120	7.771	7.770667	0.0003	N/A	D1
Dibenzo[a,h]anthracene-d14	14.999		21 - 133	22.438	22.36067	0.0773	N/A	D1
Fluoranthene-d10	14.999		36 - 134	14.558	14.558	0.0000	N/A	D1
21I0042-05RE1 (Solid)			Lab File ID: NT1121092306.D			Analyzed: 09/23/21 12:11		
2-Methylnaphthalene-d10	14.999		32 - 120	7.762	7.770667	-0.0087	N/A	D1
Dibenzo[a,h]anthracene-d14	14.999		21 - 133	22.438	22.36067	0.0773	N/A	D1
Fluoranthene-d10	14.999		36 - 134	14.559	14.558	0.0010	N/A	D1
21I0042-06RE1 (Solid)			Lab File ID: NT1121092307.D			Analyzed: 09/23/21 12:41		
2-Methylnaphthalene-d10	14.999		32 - 120	7.772	7.770667	0.0013	N/A	D1
Dibenzo[a,h]anthracene-d14	14.999		21 - 133	22.438	22.36067	0.0773	N/A	D1
Fluoranthene-d10	14.999		36 - 134	14.558	14.558	0.0000	N/A	D1
21I0042-20 (Solid)			Lab File ID: NT1121092308.D			Analyzed: 09/23/21 13:11		
2-Methylnaphthalene-d10	14.996	52.6	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.996	85.9	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.996	78.7	36 - 134	14.559	14.558	0.0010	N/A	

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0360
Instrument: NT11
Calibration: EH00019
Calibration Date: 08/07/2021

Surrogate Compound	Spike Level ug/kg dry	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
BJI0287-MS1 (Solid)			Lab File ID: NT1121092309.D			Analyzed: 09/23/21 13:41		
2-Methylnaphthalene-d10	14.996	57.0	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.996	88.0	21 - 133	22.371	22.36067	0.0103	N/A	
Fluoranthene-d10	14.996	85.1	36 - 134	14.558	14.558	0.0000	N/A	
BJI0287-MSD1 (Solid)			Lab File ID: NT1121092310.D			Analyzed: 09/23/21 14:11		
2-Methylnaphthalene-d10	14.996	37.0	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.996	11.8	21 - 133	22.372	22.36067	0.0113	N/A	*
Fluoranthene-d10	14.996	31.2	36 - 134	14.558	14.558	0.0000	N/A	*
21I0042-21 (Solid)			Lab File ID: NT1121092311.D			Analyzed: 09/23/21 14:41		
2-Methylnaphthalene-d10	14.990	55.9	32 - 120	7.772	7.770667	0.0013	N/A	
Dibenzo[a,h]anthracene-d14	14.990	87.3	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.990	75.2	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-22 (Solid)			Lab File ID: NT1121092312.D			Analyzed: 09/23/21 15:11		
2-Methylnaphthalene-d10	14.955	48.2	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.955	72.2	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	14.955	69.6	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-07RE1 (Solid)			Lab File ID: NT1121092313.D			Analyzed: 09/23/21 15:41		
2-Methylnaphthalene-d10	14.971		32 - 120	7.771	7.770667	0.0003	N/A	D1
Dibenzo[a,h]anthracene-d14	14.971		21 - 133	22.438	22.36067	0.0773	N/A	D1
Fluoranthene-d10	14.971		36 - 134	14.558	14.558	0.0000	N/A	D1
21I0042-08RE1 (Solid)			Lab File ID: NT1121092314.D			Analyzed: 09/23/21 16:11		
2-Methylnaphthalene-d10	14.999		32 - 120		7.770667	-7.7707	N/A	D1
Dibenzo[a,h]anthracene-d14	14.999		21 - 133	22.438	22.36067	0.0773	N/A	D1
Fluoranthene-d10	14.999		36 - 134	14.558	14.558	0.0000	N/A	D1
21I0042-10RE1 (Solid)			Lab File ID: NT1121092315.D			Analyzed: 09/23/21 16:41		
2-Methylnaphthalene-d10	14.985	55.3	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.985	85.7	21 - 133	22.361	22.36067	0.0003	N/A	
Fluoranthene-d10	14.985	85.0	36 - 134	14.558	14.558	0.0000	N/A	

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0360
Instrument: NT11
Calibration: EH00019
Calibration Date: 08/07/2021

Surrogate Compound	Spike Level ug/kg dry	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
21I0042-15RE1 (Solid)			Lab File ID: NT1121092316.D			Analyzed: 09/23/21 17:11		
2-Methylnaphthalene-d10	14.988	51.7	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.988	75.1	21 - 133	22.36	22.36067	-0.0007	N/A	
Fluoranthene-d10	14.988	75.3	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-16RE1 (Solid)			Lab File ID: NT1121092317.D			Analyzed: 09/23/21 17:42		
2-Methylnaphthalene-d10	14.967		32 - 120	7.771	7.770667	0.0003	N/A	D1
Dibenzo[a,h]anthracene-d14	14.967		21 - 133	22.361	22.36067	0.0003	N/A	D1
Fluoranthene-d10	14.967		36 - 134	14.558	14.558	0.0000	N/A	D1
21I0042-17RE1 (Solid)			Lab File ID: NT1121092318.D			Analyzed: 09/23/21 18:11		
2-Methylnaphthalene-d10	14.968	63.3	32 - 120	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	14.968	93.8	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.968	90.2	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-18RE1 (Solid)			Lab File ID: NT1121092319.D			Analyzed: 09/23/21 18:41		
2-Methylnaphthalene-d10	14.970	58.4	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.970	98.9	21 - 133	22.36	22.36067	-0.0007	N/A	
Fluoranthene-d10	14.970	96.8	36 - 134	14.558	14.558	0.0000	N/A	
SJI0360-CCV1 (Solid)			Lab File ID: NT1121092320.D			Analyzed: 09/23/21 19:11		
2-Methylnaphthalene-d10	250.00	102	50 - 150	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	250.00	119	50 - 150	22.361	22.36067	0.0003	N/A	
Fluoranthene-d10	250.00	105	50 - 150	14.558	14.558	0.0000	N/A	

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0378
Instrument: NT11
Calibration: EH00019
Calibration Date: 08/07/2021

Surrogate Compound	Spike Level ng/mL	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
SJI0378-ICV1 (Solid)			Lab File ID: NT1121092402.D			Analyzed: 09/24/21 13:27		
2-Methylnaphthalene-d10	250.00	103	80 - 120	7.772	7.770667	0.0013	N/A	
Dibenzo[a,h]anthracene-d14	250.00	119	80 - 120	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	250.00	105	80 - 120	14.568	14.558	0.0100	N/A	
BJI0296-BLK1 (Solid)			Lab File ID: NT1121092403.D			Analyzed: 09/24/21 14:03		
2-Methylnaphthalene-d10	15.000	56.9	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	15.000	88.5	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	15.000	78.1	36 - 134	14.568	14.558	0.0100	N/A	
BJI0296-BS1 (Solid)			Lab File ID: NT1121092404.D			Analyzed: 09/24/21 14:33		
2-Methylnaphthalene-d10	15.000	56.4	32 - 120	7.761	7.770667	-0.0097	N/A	
Dibenzo[a,h]anthracene-d14	15.000	84.6	21 - 133	22.371	22.36067	0.0103	N/A	
Fluoranthene-d10	15.000	74.9	36 - 134	14.558	14.558	0.0000	N/A	
BJI0296-BSD1 (Solid)			Lab File ID: NT1121092405.D			Analyzed: 09/24/21 15:03		
2-Methylnaphthalene-d10	15.000	57.9	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	15.000	83.1	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	15.000	76.2	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-23 (Solid)			Lab File ID: NT1121092406.D			Analyzed: 09/24/21 15:33		
2-Methylnaphthalene-d10	14.971	57.2	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.971	81.0	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	14.971	78.1	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-24 (Solid)			Lab File ID: NT1121092407.D			Analyzed: 09/24/21 16:04		
2-Methylnaphthalene-d10	15.003	58.4	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	15.003	82.8	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	15.003	85.4	36 - 134	14.568	14.558	0.0100	N/A	
21I0042-25 (Solid)			Lab File ID: NT1121092408.D			Analyzed: 09/24/21 16:34		
2-Methylnaphthalene-d10	14.974	48.7	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.974	47.4	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.974	52.8	36 - 134	14.558	14.558	0.0000	N/A	

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0378
Instrument: NT11
Calibration: EH00019
Calibration Date: 08/07/2021

Surrogate Compound	Spike Level ug/kg dry	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
21I0042-26 (Solid)			Lab File ID: NT1121092409.D			Analyzed: 09/24/21 17:04		
2-Methylnaphthalene-d10	14.980	58.4	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.980	88.4	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	14.980	77.0	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-27 (Solid)			Lab File ID: NT1121092410.D			Analyzed: 09/24/21 17:34		
2-Methylnaphthalene-d10	14.946	53.0	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.946	75.6	21 - 133	22.371	22.36067	0.0103	N/A	
Fluoranthene-d10	14.946	79.5	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-28 (Solid)			Lab File ID: NT1121092411.D			Analyzed: 09/24/21 18:04		
2-Methylnaphthalene-d10	14.976	50.8	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.976	87.2	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.976	82.4	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-29 (Solid)			Lab File ID: NT1121092412.D			Analyzed: 09/24/21 18:34		
2-Methylnaphthalene-d10	14.996	57.2	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.996	87.2	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	14.996	83.0	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-30 (Solid)			Lab File ID: NT1121092413.D			Analyzed: 09/24/21 19:05		
2-Methylnaphthalene-d10	14.953	57.7	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.953	87.8	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	14.953	87.3	36 - 134	14.568	14.558	0.0100	N/A	
21I0042-31 (Solid)			Lab File ID: NT1121092414.D			Analyzed: 09/24/21 19:35		
2-Methylnaphthalene-d10	14.970	55.0	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.970	85.3	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	14.970	85.8	36 - 134	14.568	14.558	0.0100	N/A	
21I0042-32 (Solid)			Lab File ID: NT1121092415.D			Analyzed: 09/24/21 20:05		
2-Methylnaphthalene-d10	14.972	50.6	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.972	80.6	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.972	77.4	36 - 134	14.558	14.558	0.0000	N/A	

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0378
Instrument: NT11
Calibration: EH00019
Calibration Date: 08/07/2021

Surrogate Compound	Spike Level ug/kg dry	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
BJI0296-MS1 (Solid)			Lab File ID: NT1121092416.D			Analyzed: 09/24/21 20:35		
2-Methylnaphthalene-d10	14.972	51.1	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.972	81.6	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	14.972	76.7	36 - 134	14.558	14.558	0.0000	N/A	
BJI0296-MSD1 (Solid)			Lab File ID: NT1121092417.D			Analyzed: 09/24/21 21:05		
2-Methylnaphthalene-d10	14.972	53.7	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.972	84.2	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.972	81.5	36 - 134	14.568	14.558	0.0100	N/A	
21I0042-33 (Solid)			Lab File ID: NT1121092418.D			Analyzed: 09/24/21 21:35		
2-Methylnaphthalene-d10	14.968	57.1	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.968	83.4	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	14.968	84.4	36 - 134	14.568	14.558	0.0100	N/A	
21I0042-34 (Solid)			Lab File ID: NT1121092419.D			Analyzed: 09/24/21 22:05		
2-Methylnaphthalene-d10	14.954	54.1	32 - 120	7.761	7.770667	-0.0097	N/A	
Dibenzo[a,h]anthracene-d14	14.954	86.9	21 - 133	22.371	22.36067	0.0103	N/A	
Fluoranthene-d10	14.954	83.8	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-35 (Solid)			Lab File ID: NT1121092420.D			Analyzed: 09/24/21 22:35		
2-Methylnaphthalene-d10	15.002	54.9	32 - 120	7.761	7.770667	-0.0097	N/A	
Dibenzo[a,h]anthracene-d14	15.002	86.9	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	15.002	86.5	36 - 134	14.568	14.558	0.0100	N/A	
21I0042-36 (Solid)			Lab File ID: NT1121092421.D			Analyzed: 09/24/21 23:06		
2-Methylnaphthalene-d10	14.973	50.0	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.973	83.9	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.973	80.1	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-37 (Solid)			Lab File ID: NT1121092422.D			Analyzed: 09/24/21 23:36		
2-Methylnaphthalene-d10	14.987	63.2	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.987	100	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	14.987	92.3	36 - 134	14.558	14.558	0.0000	N/A	

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG/WO:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Sequence:	SJI0378	Instrument:	NT11
Calibration:	EH00019	Calibration Date:	08/07/2021

Surrogate Compound	Spike Level ng/mL	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
SJI0378-CCV1 (Solid)			Lab File ID: NT1121092423.D				Analyzed: 09/25/21 00:06	
2-Methylnaphthalene-d10	250.00	102	50 - 150	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	250.00	117	50 - 150	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	250.00	107	50 - 150	14.558	14.558	0.0000	N/A	

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0404
Instrument: NT11
Calibration: EH00019
Calibration Date: 08/07/2021

Surrogate Compound	Spike Level ng/mL	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
SJI0404-ICV1 (Solid)			Lab File ID: NT1121092502.D			Analyzed: 09/25/21 10:49		
2-Methylnaphthalene-d10	250.00	102	80 - 120	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	250.00	118	80 - 120	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	250.00	112	80 - 120	14.568	14.558	0.0100	N/A	
21I0042-23RE1 (Solid)			Lab File ID: NT1121092508.D			Analyzed: 09/25/21 14:07		
2-Methylnaphthalene-d10	14.971	55.8	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.971	75.0	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.971	78.8	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-30RE1 (Solid)			Lab File ID: NT1121092509.D			Analyzed: 09/25/21 14:37		
2-Methylnaphthalene-d10	14.953	57.2	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.953	82.1	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.953	89.4	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-32RE1 (Solid)			Lab File ID: NT1121092510.D			Analyzed: 09/25/21 15:07		
2-Methylnaphthalene-d10	14.972	50.8	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.972	77.2	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.972	79.5	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-34RE1 (Solid)			Lab File ID: NT1121092511.D			Analyzed: 09/25/21 15:38		
2-Methylnaphthalene-d10	14.954	55.4	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.954	83.4	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.954	85.9	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-24RE1 (Solid)			Lab File ID: NT1121092512.D			Analyzed: 09/25/21 16:08		
2-Methylnaphthalene-d10	15.003	61.8	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	15.003	81.2	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	15.003	86.9	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-26RE1 (Solid)			Lab File ID: NT1121092513.D			Analyzed: 09/25/21 16:38		
2-Methylnaphthalene-d10	14.980	58.9	32 - 120	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	14.980	82.8	21 - 133	22.371	22.36067	0.0103	N/A	
Fluoranthene-d10	14.980	79.7	36 - 134	14.558	14.558	0.0000	N/A	

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0404
Instrument: NT11
Calibration: EH00019
Calibration Date: 08/07/2021

Surrogate Compound	Spike Level ug/kg dry	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
21I0042-31RE1 (Solid)			Lab File ID: NT1121092514.D			Analyzed: 09/25/21 17:08		
2-Methylnaphthalene-d10	14.970	53.4	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.970	81.2	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.970	89.3	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-33RE1 (Solid)			Lab File ID: NT1121092515.D			Analyzed: 09/25/21 17:38		
2-Methylnaphthalene-d10	14.968	59.8	32 - 120	7.762	7.770667	-0.0087	N/A	
Dibenzo[a,h]anthracene-d14	14.968	84.0	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.968	89.1	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-35RE1 (Solid)			Lab File ID: NT1121092516.D			Analyzed: 09/25/21 18:08		
2-Methylnaphthalene-d10	15.002	58.7	32 - 120	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	15.002	83.3	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	15.002	86.8	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-38 (Solid)			Lab File ID: NT1121092517.D			Analyzed: 09/25/21 18:39		
2-Methylnaphthalene-d10	15.005	54.2	32 - 120	7.761	7.770667	-0.0097	N/A	
Dibenzo[a,h]anthracene-d14	15.005	107	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	15.005	82.5	36 - 134	14.568	14.558	0.0100	N/A	
21I0042-39 (Solid)			Lab File ID: NT1121092518.D			Analyzed: 09/25/21 19:09		
2-Methylnaphthalene-d10	14.969	52.5	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.969	83.5	21 - 133	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	14.969	82.6	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-40 (Solid)			Lab File ID: NT1121092519.D			Analyzed: 09/25/21 19:39		
2-Methylnaphthalene-d10	15.005	58.7	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	15.005	128	21 - 133	22.394	22.36067	0.0333	N/A	
Fluoranthene-d10	15.005	89.4	36 - 134	14.568	14.558	0.0100	N/A	
SJI0404-CCV1 (Solid)			Lab File ID: NT1121092520.D			Analyzed: 09/25/21 20:09		
2-Methylnaphthalene-d10	250.00	101	50 - 150	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	250.00	118	50 - 150	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	250.00	108	50 - 150	14.558	14.558	0.0000	N/A	

SURROGATE RECOVERY AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG/WO: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0424
Instrument: NT11
Calibration: EH00019
Calibration Date: 08/07/2021

Surrogate Compound	Spike Level ng/mL	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
SJI0424-ICV1 (Solid)			Lab File ID: NT1121092802.D			Analyzed: 09/28/21 09:46		
2-Methylnaphthalene-d10	250.00	103	80 - 120	7.772	7.770667	0.0013	N/A	
Dibenzo[a,h]anthracene-d14	250.00	122	80 - 120	22.371	22.36067	0.0103	N/A	*
Fluoranthene-d10	250.00	108	80 - 120	14.568	14.558	0.0100	N/A	
SJI0424-IBL1 (Solid)			Lab File ID: NT1121092803.D			Analyzed: 09/28/21 10:29		
2-Methylnaphthalene-d10	250.00	94.7	30 - 160	7.772	7.770667	0.0013	N/A	
Dibenzo[a,h]anthracene-d14	250.00	117	30 - 160	22.383	22.36067	0.0223	N/A	
Fluoranthene-d10	250.00	103	30 - 160	14.568	14.558	0.0100	N/A	
21I0042-38RE1 (Solid)			Lab File ID: NT1121092804.D			Analyzed: 09/28/21 10:58		
2-Methylnaphthalene-d10	15.005	53.5	32 - 120	7.761	7.770667	-0.0097	N/A	
Dibenzo[a,h]anthracene-d14	15.005	87.7	21 - 133	22.371	22.36067	0.0103	N/A	
Fluoranthene-d10	15.005	83.7	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-39RE1 (Solid)			Lab File ID: NT1121092805.D			Analyzed: 09/28/21 11:29		
2-Methylnaphthalene-d10	14.969	51.8	32 - 120	7.76	7.770667	-0.0107	N/A	
Dibenzo[a,h]anthracene-d14	14.969	78.2	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	14.969	75.3	36 - 134	14.558	14.558	0.0000	N/A	
21I0042-40RE1 (Solid)			Lab File ID: NT1121092806.D			Analyzed: 09/28/21 11:59		
2-Methylnaphthalene-d10	15.005	58.2	32 - 120	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	15.005	102	21 - 133	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	15.005	86.3	36 - 134	14.558	14.558	0.0000	N/A	
SJI0424-CCV1 (Solid)			Lab File ID: NT1121092822.D			Analyzed: 09/28/21 20:01		
2-Methylnaphthalene-d10	250.00	102	50 - 150	7.771	7.770667	0.0003	N/A	
Dibenzo[a,h]anthracene-d14	250.00	115	50 - 150	22.372	22.36067	0.0113	N/A	
Fluoranthene-d10	250.00	105	50 - 150	14.558	14.558	0.0000	N/A	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJH0087
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
Initial Cal Blank (SJH0087-ICB1)		(Water)	Lab File ID: NT1121080709.D				Analyzed: 08/07/21 12:21		
Naphthalene-d8	294801	6.795	318895	6.804	92	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	142270	9.798	177787	9.798	80	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	224746	12.461	264976	12.471	85	50 - 200	-0.010	+/-0.50	
Chrysene-d12	158983	17.196	211098	17.196	75	50 - 200	0.000	+/-0.50	
Perylene-d12	165497	19.941	242598	19.941	68	50 - 200	0.000	+/-0.50	
Secondary Cal Check (SJH0087-SCV1)		(Water)	Lab File ID: NT1121080710.D				Analyzed: 08/07/21 12:51		
Naphthalene-d8	290242	6.795	318895	6.804	91	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	158726	9.798	177787	9.798	89	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	235743	12.461	264976	12.471	89	50 - 200	-0.010	+/-0.50	
Chrysene-d12	190411	17.196	211098	17.196	90	50 - 200	0.000	+/-0.50	
Perylene-d12	194484	19.941	242598	19.941	80	50 - 200	0.000	+/-0.50	
Initial Cal Check (SJH0087-ICV1)		(Water)	Lab File ID: NT1121080712.D				Analyzed: 08/07/21 13:43		
Naphthalene-d8	289698	6.804	318895	6.804	91	50 - 200	0.000	+/-0.50	
Acenaphthene-d10	158002	9.798	177787	9.798	89	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	232746	12.471	264976	12.471	88	50 - 200	0.000	+/-0.50	
Chrysene-d12	183149	17.196	211098	17.196	87	50 - 200	0.000	+/-0.50	
Perylene-d12	192235	19.941	242598	19.941	79	50 - 200	0.000	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0344
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
Initial Cal Check (SJI0344-ICV1)		(Solid)	Lab File ID: NT1121092202.D				Analyzed: 09/22/21 10:13		
Naphthalene-d8	262956	6.795	262956	6.795	100	50 - 200	0.000	+/-0.50	
Acenaphthene-d10	150433	9.798	150433	9.798	100	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	223653	12.46	223653	12.46	100	50 - 200	0.000	+/-0.50	
Chrysene-d12	169795	17.196	169795	17.196	100	50 - 200	0.000	+/-0.50	
Perylene-d12	185198	19.941	185198	19.941	100	50 - 200	0.000	+/-0.50	
Blank (BJI0287-BLK1)		(Solid)	Lab File ID: NT1121092203.D				Analyzed: 09/22/21 10:53		
Naphthalene-d8	317288	6.786	262956	6.795	121	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	169937	9.798	150433	9.798	113	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	259522	12.471	223653	12.46	116	50 - 200	0.011	+/-0.50	
Chrysene-d12	190937	17.196	169795	17.196	112	50 - 200	0.000	+/-0.50	
Perylene-d12	206426	19.941	185198	19.941	111	50 - 200	0.000	+/-0.50	
LCS (BJI0287-BS1)		(Solid)	Lab File ID: NT1121092204.D				Analyzed: 09/22/21 11:23		
Naphthalene-d8	292088	6.786	262956	6.795	111	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	166074	9.798	150433	9.798	110	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	251413	12.461	223653	12.46	112	50 - 200	0.001	+/-0.50	
Chrysene-d12	195329	17.188	169795	17.196	115	50 - 200	-0.008	+/-0.50	
Perylene-d12	208599	19.942	185198	19.941	113	50 - 200	0.001	+/-0.50	
LCS Dup (BJI0287-BSD1)		(Solid)	Lab File ID: NT1121092205.D				Analyzed: 09/22/21 11:53		
Naphthalene-d8	287304	6.786	262956	6.795	109	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	161490	9.798	150433	9.798	107	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	241900	12.461	223653	12.46	108	50 - 200	0.001	+/-0.50	
Chrysene-d12	183886	17.188	169795	17.196	108	50 - 200	-0.008	+/-0.50	
Perylene-d12	196430	19.942	185198	19.941	106	50 - 200	0.001	+/-0.50	
HA-15-0-1 (21I0042-05)		(Solid)	Lab File ID: NT1121092206.D				Analyzed: 09/22/21 12:23		
Naphthalene-d8	305655	6.795	262956	6.795	116	50 - 200	0.000	+/-0.50	
Acenaphthene-d10	208092	9.798	150433	9.798	138	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	277512	12.461	223653	12.46	124	50 - 200	0.001	+/-0.50	
Chrysene-d12	254800	17.205	169795	17.196	150	50 - 200	0.009	+/-0.50	
Perylene-d12	209586	19.961	185198	19.941	113	50 - 200	0.020	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0344
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
HA-15-1-2 (21I0042-06)		(Solid)	Lab File ID: NT1121092207.D				Analyzed: 09/22/21 12:53		
Naphthalene-d8	297402	6.795	262956	6.795	113	50 - 200	0.000	+/-0.50	
Acenaphthene-d10	199529	9.798	150433	9.798	133	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	268753	12.461	223653	12.46	120	50 - 200	0.001	+/-0.50	
Chrysene-d12	232979	17.205	169795	17.196	137	50 - 200	0.009	+/-0.50	
Perylene-d12	227334	19.961	185198	19.941	123	50 - 200	0.020	+/-0.50	
HA-17-1-2 (21I0042-09)		(Solid)	Lab File ID: NT1121092210.D				Analyzed: 09/22/21 14:24		
Naphthalene-d8	167439	6.786	262956	6.795	64	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	98831	9.798	150433	9.798	66	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	158464	12.461	223653	12.46	71	50 - 200	0.001	+/-0.50	
Chrysene-d12	133375	17.196	169795	17.196	79	50 - 200	0.000	+/-0.50	
Perylene-d12	161194	19.951	185198	19.941	87	50 - 200	0.010	+/-0.50	
HA-18-1-2 (21I0042-10)		(Solid)	Lab File ID: NT1121092211.D				Analyzed: 09/22/21 14:54		
Naphthalene-d8	170256	6.786	262956	6.795	65	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	99632	9.798	150433	9.798	66	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	155473	12.46	223653	12.46	70	50 - 200	0.000	+/-0.50	
Chrysene-d12	133762	17.196	169795	17.196	79	50 - 200	0.000	+/-0.50	
Perylene-d12	172102	19.951	185198	19.941	93	50 - 200	0.010	+/-0.50	
HA-19-0-1 (21I0042-11)		(Solid)	Lab File ID: NT1121092212.D				Analyzed: 09/22/21 15:24		
Naphthalene-d8	168990	6.786	262956	6.795	64	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	96264	9.798	150433	9.798	64	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	152522	12.461	223653	12.46	68	50 - 200	0.001	+/-0.50	
Chrysene-d12	128558	17.196	169795	17.196	76	50 - 200	0.000	+/-0.50	
Perylene-d12	156842	19.941	185198	19.941	85	50 - 200	0.000	+/-0.50	
HA-19-1-2 (21I0042-12)		(Solid)	Lab File ID: NT1121092213.D				Analyzed: 09/22/21 15:54		
Naphthalene-d8	173138	6.786	262956	6.795	66	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	99764	9.798	150433	9.798	66	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	158535	12.461	223653	12.46	71	50 - 200	0.001	+/-0.50	
Chrysene-d12	136790	17.197	169795	17.196	81	50 - 200	0.001	+/-0.50	
Perylene-d12	166025	19.942	185198	19.941	90	50 - 200	0.001	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0344
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
HA-20-0-1 (21I0042-13)		(Solid)	Lab File ID: NT1121092214.D				Analyzed: 09/22/21 16:24		
Naphthalene-d8	176249	6.786	262956	6.795	67	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	102491	9.798	150433	9.798	68	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	161368	12.461	223653	12.46	72	50 - 200	0.001	+/-0.50	
Chrysene-d12	139577	17.196	169795	17.196	82	50 - 200	0.000	+/-0.50	
Perylene-d12	165977	19.951	185198	19.941	90	50 - 200	0.010	+/-0.50	
HA-20-1-2 (21I0042-14)		(Solid)	Lab File ID: NT1121092215.D				Analyzed: 09/22/21 16:54		
Naphthalene-d8	176645	6.795	262956	6.795	67	50 - 200	0.000	+/-0.50	
Acenaphthene-d10	99884	9.798	150433	9.798	66	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	156550	12.461	223653	12.46	70	50 - 200	0.001	+/-0.50	
Chrysene-d12	130433	17.196	169795	17.196	77	50 - 200	0.000	+/-0.50	
Perylene-d12	156342	19.941	185198	19.941	84	50 - 200	0.000	+/-0.50	
HA-21-1-2 (21I0042-15)		(Solid)	Lab File ID: NT1121092216.D				Analyzed: 09/22/21 17:24		
Naphthalene-d8	175645	6.786	262956	6.795	67	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	104091	9.798	150433	9.798	69	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	159952	12.461	223653	12.46	72	50 - 200	0.001	+/-0.50	
Chrysene-d12	141216	17.196	169795	17.196	83	50 - 200	0.000	+/-0.50	
Perylene-d12	165164	19.941	185198	19.941	89	50 - 200	0.000	+/-0.50	
HA-22-0-1 (21I0042-16)		(Solid)	Lab File ID: NT1121092217.D				Analyzed: 09/22/21 17:55		
Naphthalene-d8	188592	6.795	262956	6.795	72	50 - 200	0.000	+/-0.50	
Acenaphthene-d10	185460	9.807	150433	9.798	123	50 - 200	0.009	+/-0.50	
Phenanthrene-d10	204568	12.482	223653	12.46	91	50 - 200	0.022	+/-0.50	
Chrysene-d12	163218	17.213	169795	17.196	96	50 - 200	0.017	+/-0.50	
Perylene-d12	106689	19.98	185198	19.941	58	50 - 200	0.039	+/-0.50	
HA-22-1-2 (21I0042-17)		(Solid)	Lab File ID: NT1121092218.D				Analyzed: 09/22/21 18:25		
Naphthalene-d8	171088	6.786	262956	6.795	65	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	107481	9.798	150433	9.798	71	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	168807	12.471	223653	12.46	75	50 - 200	0.011	+/-0.50	
Chrysene-d12	135945	17.205	169795	17.196	80	50 - 200	0.009	+/-0.50	
Perylene-d12	163259	19.961	185198	19.941	88	50 - 200	0.020	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0344
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
HA-23-1-2 (21I0042-18)		(Solid)	Lab File ID: NT1121092219.D				Analyzed: 09/22/21 18:55		
Naphthalene-d8	168899	6.786	262956	6.795	64	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	102649	9.798	150433	9.798	68	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	158963	12.461	223653	12.46	71	50 - 200	0.001	+/-0.50	
Chrysene-d12	134615	17.196	169795	17.196	79	50 - 200	0.000	+/-0.50	
Perylene-d12	172394	19.951	185198	19.941	93	50 - 200	0.010	+/-0.50	
HA-24-0-1 (21I0042-19)		(Solid)	Lab File ID: NT1121092220.D				Analyzed: 09/22/21 19:25		
Naphthalene-d8	167609	6.786	262956	6.795	64	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	93876	9.798	150433	9.798	62	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	148151	12.461	223653	12.46	66	50 - 200	0.001	+/-0.50	
Chrysene-d12	118955	17.196	169795	17.196	70	50 - 200	0.000	+/-0.50	
Perylene-d12	140470	19.941	185198	19.941	76	50 - 200	0.000	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0360
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
Initial Cal Check (SJI0360-ICV1)		(Solid)	Lab File ID: NT1121092302.D				Analyzed: 09/23/21 10:09		
Naphthalene-d8	353973	6.804	353973	6.804	100	50 - 200	0.000	+/-0.50	
Acenaphthene-d10	203897	9.798	203897	9.798	100	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	308736	12.471	308736	12.471	100	50 - 200	0.000	+/-0.50	
Chrysene-d12	260101	17.196	260101	17.196	100	50 - 200	0.000	+/-0.50	
Perylene-d12	303732	19.951	303732	19.951	100	50 - 200	0.000	+/-0.50	
Instrument Blank (SJI0360-IBL1)		(Solid)	Lab File ID: NT1121092303.D				Analyzed: 09/23/21 10:40		
Naphthalene-d8	374620	6.795	353973	6.804	106	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	197305	9.798	203897	9.798	97	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	314768	12.471	308736	12.471	102	50 - 200	0.000	+/-0.50	
Chrysene-d12	259145	17.197	260101	17.196	100	50 - 200	0.001	+/-0.50	
Perylene-d12	295635	19.951	303732	19.951	97	50 - 200	0.000	+/-0.50	
HA-16-0-1 (21I0042-07)		(Solid)	Lab File ID: NT1121092304.D				Analyzed: 09/23/21 11:10		
Naphthalene-d8	371575	6.795	353973	6.804	105	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	213610	9.798	203897	9.798	105	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	334878	12.461	308736	12.471	108	50 - 200	-0.010	+/-0.50	
Chrysene-d12	303795	17.196	260101	17.196	117	50 - 200	0.000	+/-0.50	
Perylene-d12	382984	19.941	303732	19.951	126	50 - 200	-0.010	+/-0.50	
HA-16-1-2 (21I0042-08)		(Solid)	Lab File ID: NT1121092305.D				Analyzed: 09/23/21 11:40		
Naphthalene-d8	384328	6.795	353973	6.804	109	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	216523	9.798	203897	9.798	106	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	338373	12.461	308736	12.471	110	50 - 200	-0.010	+/-0.50	
Chrysene-d12	323824	17.196	260101	17.196	124	50 - 200	0.000	+/-0.50	
Perylene-d12	381575	19.951	303732	19.951	126	50 - 200	0.000	+/-0.50	
HA-15-0-1 (21I0042-05RE1)		(Solid)	Lab File ID: NT1121092306.D				Analyzed: 09/23/21 12:11		
Naphthalene-d8	384871	6.795	353973	6.804	109	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	215593	9.798	203897	9.798	106	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	329943	12.472	308736	12.471	107	50 - 200	0.001	+/-0.50	
Chrysene-d12	293364	17.197	260101	17.196	113	50 - 200	0.001	+/-0.50	
Perylene-d12	343920	19.942	303732	19.951	113	50 - 200	-0.009	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0360
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
HA-15-1-2 (21I0042-06RE1)		(Solid)	Lab File ID: NT1121092307.D				Analyzed: 09/23/21 12:41		
Naphthalene-d8	368034	6.795	353973	6.804	104	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	205830	9.798	203897	9.798	101	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	326612	12.461	308736	12.471	106	50 - 200	-0.010	+/-0.50	
Chrysene-d12	279803	17.196	260101	17.196	108	50 - 200	0.000	+/-0.50	
Perylene-d12	330864	19.941	303732	19.951	109	50 - 200	-0.010	+/-0.50	
HA-24-1-2 (21I0042-20)		(Solid)	Lab File ID: NT1121092308.D				Analyzed: 09/23/21 13:11		
Naphthalene-d8	372248	6.786	353973	6.804	105	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	205532	9.798	203897	9.798	101	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	320160	12.461	308736	12.471	104	50 - 200	-0.010	+/-0.50	
Chrysene-d12	267412	17.197	260101	17.196	103	50 - 200	0.001	+/-0.50	
Perylene-d12	332899	19.951	303732	19.951	110	50 - 200	0.000	+/-0.50	
Matrix Spike (BJI0287-MS1)		(Solid)	Lab File ID: NT1121092309.D				Analyzed: 09/23/21 13:41		
Naphthalene-d8	399836	6.786	353973	6.804	113	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	235490	9.798	203897	9.798	115	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	367993	12.471	308736	12.471	119	50 - 200	0.000	+/-0.50	
Chrysene-d12	305408	17.196	260101	17.196	117	50 - 200	0.000	+/-0.50	
Perylene-d12	396394	19.951	303732	19.951	131	50 - 200	0.000	+/-0.50	
Matrix Spike Dup (BJI0287-MSD1)		(Solid)	Lab File ID: NT1121092310.D				Analyzed: 09/23/21 14:11		
Naphthalene-d8	393022	6.786	353973	6.804	111	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	226713	9.798	203897	9.798	111	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	354087	12.471	308736	12.471	115	50 - 200	0.000	+/-0.50	
Chrysene-d12	288973	17.196	260101	17.196	111	50 - 200	0.000	+/-0.50	
Perylene-d12	346929	19.951	303732	19.951	114	50 - 200	0.000	+/-0.50	
HA-25-0-1 (21I0042-21)		(Solid)	Lab File ID: NT1121092311.D				Analyzed: 09/23/21 14:41		
Naphthalene-d8	348000	6.795	353973	6.804	98	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	194486	9.798	203897	9.798	95	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	311448	12.471	308736	12.471	101	50 - 200	0.000	+/-0.50	
Chrysene-d12	266795	17.196	260101	17.196	103	50 - 200	0.000	+/-0.50	
Perylene-d12	324330	19.941	303732	19.951	107	50 - 200	-0.010	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0360
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
HA-25-1-2 (21I0042-22)		(Solid)	Lab File ID: NT1121092312.D				Analyzed: 09/23/21 15:11		
Naphthalene-d8	342183	6.795	353973	6.804	97	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	197783	9.798	203897	9.798	97	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	305922	12.471	308736	12.471	99	50 - 200	0.000	+/-0.50	
Chrysene-d12	274777	17.196	260101	17.196	106	50 - 200	0.000	+/-0.50	
Perylene-d12	342503	19.961	303732	19.951	113	50 - 200	0.010	+/-0.50	
HA-16-0-1 (21I0042-07RE1)		(Solid)	Lab File ID: NT1121092313.D				Analyzed: 09/23/21 15:41		
Naphthalene-d8	355814	6.795	353973	6.804	101	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	200529	9.798	203897	9.798	98	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	315877	12.471	308736	12.471	102	50 - 200	0.000	+/-0.50	
Chrysene-d12	275050	17.197	260101	17.196	106	50 - 200	0.001	+/-0.50	
Perylene-d12	335565	19.942	303732	19.951	110	50 - 200	-0.009	+/-0.50	
HA-16-1-2 (21I0042-08RE1)		(Solid)	Lab File ID: NT1121092314.D				Analyzed: 09/23/21 16:11		
Naphthalene-d8	340001	6.795	353973	6.804	96	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	187140	9.798	203897	9.798	92	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	295944	12.46	308736	12.471	96	50 - 200	-0.011	+/-0.50	
Chrysene-d12	260599	17.196	260101	17.196	100	50 - 200	0.000	+/-0.50	
Perylene-d12	301743	19.941	303732	19.951	99	50 - 200	-0.010	+/-0.50	
HA-18-1-2 (21I0042-10RE1)		(Solid)	Lab File ID: NT1121092315.D				Analyzed: 09/23/21 16:41		
Naphthalene-d8	352472	6.795	353973	6.804	100	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	192838	9.798	203897	9.798	95	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	303138	12.461	308736	12.471	98	50 - 200	-0.010	+/-0.50	
Chrysene-d12	268252	17.197	260101	17.196	103	50 - 200	0.001	+/-0.50	
Perylene-d12	316480	19.942	303732	19.951	104	50 - 200	-0.009	+/-0.50	
HA-21-1-2 (21I0042-15RE1)		(Solid)	Lab File ID: NT1121092316.D				Analyzed: 09/23/21 17:11		
Naphthalene-d8	345898	6.795	353973	6.804	98	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	193335	9.798	203897	9.798	95	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	310990	12.461	308736	12.471	101	50 - 200	-0.010	+/-0.50	
Chrysene-d12	265685	17.196	260101	17.196	102	50 - 200	0.000	+/-0.50	
Perylene-d12	308681	19.941	303732	19.951	102	50 - 200	-0.010	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0360
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
HA-22-0-1 (21I0042-16RE1)		(Solid)	Lab File ID: NT1121092317.D				Analyzed: 09/23/21 17:42		
Naphthalene-d8	345504	6.795	353973	6.804	98	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	200393	9.798	203897	9.798	98	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	304557	12.461	308736	12.471	99	50 - 200	-0.010	+/-0.50	
Chrysene-d12	254757	17.196	260101	17.196	98	50 - 200	0.000	+/-0.50	
Perylene-d12	294509	19.941	303732	19.951	97	50 - 200	-0.010	+/-0.50	
HA-22-1-2 (21I0042-17RE1)		(Solid)	Lab File ID: NT1121092318.D				Analyzed: 09/23/21 18:11		
Naphthalene-d8	344356	6.795	353973	6.804	97	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	191621	9.798	203897	9.798	94	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	308348	12.461	308736	12.471	100	50 - 200	-0.010	+/-0.50	
Chrysene-d12	260583	17.197	260101	17.196	100	50 - 200	0.001	+/-0.50	
Perylene-d12	313210	19.951	303732	19.951	103	50 - 200	0.000	+/-0.50	
HA-23-1-2 (21I0042-18RE1)		(Solid)	Lab File ID: NT1121092319.D				Analyzed: 09/23/21 18:41		
Naphthalene-d8	344520	6.795	353973	6.804	97	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	189050	9.798	203897	9.798	93	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	303255	12.461	308736	12.471	98	50 - 200	-0.010	+/-0.50	
Chrysene-d12	256563	17.196	260101	17.196	99	50 - 200	0.000	+/-0.50	
Perylene-d12	301193	19.941	303732	19.951	99	50 - 200	-0.010	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0378
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
Initial Cal Check (SJI0378-ICV1)		(Solid)	Lab File ID: NT1121092402.D				Analyzed: 09/24/21 13:27		
Naphthalene-d8	298828	6.804	298828	6.804	100	50 - 200	0.000	+/-0.50	
Acenaphthene-d10	172679	9.798	172679	9.798	100	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	269598	12.471	269598	12.471	100	50 - 200	0.000	+/-0.50	
Chrysene-d12	213527	17.196	213527	17.196	100	50 - 200	0.000	+/-0.50	
Perylene-d12	241424	19.951	241424	19.951	100	50 - 200	0.000	+/-0.50	
Blank (BJI0296-BLK1)		(Solid)	Lab File ID: NT1121092403.D				Analyzed: 09/24/21 14:03		
Naphthalene-d8	345027	6.786	298828	6.804	115	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	184791	9.798	172679	9.798	107	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	294767	12.471	269598	12.471	109	50 - 200	0.000	+/-0.50	
Chrysene-d12	225435	17.196	213527	17.196	106	50 - 200	0.000	+/-0.50	
Perylene-d12	256086	19.951	241424	19.951	106	50 - 200	0.000	+/-0.50	
LCS (BJI0296-BS1)		(Solid)	Lab File ID: NT1121092404.D				Analyzed: 09/24/21 14:33		
Naphthalene-d8	343128	6.786	298828	6.804	115	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	196191	9.798	172679	9.798	114	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	302910	12.46	269598	12.471	112	50 - 200	-0.011	+/-0.50	
Chrysene-d12	241975	17.196	213527	17.196	113	50 - 200	0.000	+/-0.50	
Perylene-d12	274417	19.951	241424	19.951	114	50 - 200	0.000	+/-0.50	
LCS Dup (BJI0296-BSD1)		(Solid)	Lab File ID: NT1121092405.D				Analyzed: 09/24/21 15:03		
Naphthalene-d8	342376	6.786	298828	6.804	115	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	195238	9.798	172679	9.798	113	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	299240	12.461	269598	12.471	111	50 - 200	-0.010	+/-0.50	
Chrysene-d12	238672	17.196	213527	17.196	112	50 - 200	0.000	+/-0.50	
Perylene-d12	267946	19.951	241424	19.951	111	50 - 200	0.000	+/-0.50	
HA-26-0-1 (21I0042-23)		(Solid)	Lab File ID: NT1121092406.D				Analyzed: 09/24/21 15:33		
Naphthalene-d8	341042	6.786	298828	6.804	114	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	197138	9.798	172679	9.798	114	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	307623	12.461	269598	12.471	114	50 - 200	-0.010	+/-0.50	
Chrysene-d12	264439	17.196	213527	17.196	124	50 - 200	0.000	+/-0.50	
Perylene-d12	340641	19.951	241424	19.951	141	50 - 200	0.000	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0378
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
HA-26-1-2 (21I0042-24)		(Solid)	Lab File ID: NT1121092407.D				Analyzed: 09/24/21 16:04		
Naphthalene-d8	357166	6.786	298828	6.804	120	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	215842	9.798	172679	9.798	125	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	335921	12.471	269598	12.471	125	50 - 200	0.000	+/-0.50	
Chrysene-d12	280756	17.205	213527	17.196	131	50 - 200	0.009	+/-0.50	
Perylene-d12	372174	19.961	241424	19.951	154	50 - 200	0.010	+/-0.50	
HA-27-0-1 (21I0042-25)		(Solid)	Lab File ID: NT1121092408.D				Analyzed: 09/24/21 16:34		
Naphthalene-d8	351444	6.786	298828	6.804	118	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	201000	9.798	172679	9.798	116	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	305865	12.471	269598	12.471	113	50 - 200	0.000	+/-0.50	
Chrysene-d12	252477	17.196	213527	17.196	118	50 - 200	0.000	+/-0.50	
Perylene-d12	306694	19.951	241424	19.951	127	50 - 200	0.000	+/-0.50	
HA-27-1-2 (21I0042-26)		(Solid)	Lab File ID: NT1121092409.D				Analyzed: 09/24/21 17:04		
Naphthalene-d8	349430	6.786	298828	6.804	117	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	216241	9.798	172679	9.798	125	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	323334	12.461	269598	12.471	120	50 - 200	-0.010	+/-0.50	
Chrysene-d12	269631	17.196	213527	17.196	126	50 - 200	0.000	+/-0.50	
Perylene-d12	367926	19.951	241424	19.951	152	50 - 200	0.000	+/-0.50	
HA-28-0-1 (21I0042-27)		(Solid)	Lab File ID: NT1121092410.D				Analyzed: 09/24/21 17:34		
Naphthalene-d8	344907	6.786	298828	6.804	115	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	195225	9.798	172679	9.798	113	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	303626	12.471	269598	12.471	113	50 - 200	0.000	+/-0.50	
Chrysene-d12	261610	17.196	213527	17.196	123	50 - 200	0.000	+/-0.50	
Perylene-d12	322239	19.951	241424	19.951	133	50 - 200	0.000	+/-0.50	
HA-28-1-2 (21I0042-28)		(Solid)	Lab File ID: NT1121092411.D				Analyzed: 09/24/21 18:04		
Naphthalene-d8	337041	6.786	298828	6.804	113	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	196094	9.798	172679	9.798	114	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	301224	12.471	269598	12.471	112	50 - 200	0.000	+/-0.50	
Chrysene-d12	264535	17.196	213527	17.196	124	50 - 200	0.000	+/-0.50	
Perylene-d12	315562	19.951	241424	19.951	131	50 - 200	0.000	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0378
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
HA-29-0-1 (21I0042-29)		(Solid)	Lab File ID: NT1121092412.D				Analyzed: 09/24/21 18:34		
Naphthalene-d8	338845	6.786	298828	6.804	113	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	195816	9.798	172679	9.798	113	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	304584	12.471	269598	12.471	113	50 - 200	0.000	+/-0.50	
Chrysene-d12	259278	17.196	213527	17.196	121	50 - 200	0.000	+/-0.50	
Perylene-d12	320436	19.951	241424	19.951	133	50 - 200	0.000	+/-0.50	
HA-29-1-2 (21I0042-30)		(Solid)	Lab File ID: NT1121092413.D				Analyzed: 09/24/21 19:05		
Naphthalene-d8	338733	6.786	298828	6.804	113	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	196624	9.798	172679	9.798	114	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	304965	12.471	269598	12.471	113	50 - 200	0.000	+/-0.50	
Chrysene-d12	258240	17.197	213527	17.196	121	50 - 200	0.001	+/-0.50	
Perylene-d12	328135	19.951	241424	19.951	136	50 - 200	0.000	+/-0.50	
HA-30-1-2 (21I0042-31)		(Solid)	Lab File ID: NT1121092414.D				Analyzed: 09/24/21 19:35		
Naphthalene-d8	336299	6.786	298828	6.804	113	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	199356	9.798	172679	9.798	115	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	313496	12.471	269598	12.471	116	50 - 200	0.000	+/-0.50	
Chrysene-d12	275845	17.205	213527	17.196	129	50 - 200	0.009	+/-0.50	
Perylene-d12	384617	19.951	241424	19.951	159	50 - 200	0.000	+/-0.50	
HA-31-0-1 (21I0042-32)		(Solid)	Lab File ID: NT1121092415.D				Analyzed: 09/24/21 20:05		
Naphthalene-d8	334138	6.786	298828	6.804	112	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	193690	9.798	172679	9.798	112	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	303608	12.471	269598	12.471	113	50 - 200	0.000	+/-0.50	
Chrysene-d12	267137	17.196	213527	17.196	125	50 - 200	0.000	+/-0.50	
Perylene-d12	321853	19.951	241424	19.951	133	50 - 200	0.000	+/-0.50	
Matrix Spike (BJI0296-MS1)		(Solid)	Lab File ID: NT1121092416.D				Analyzed: 09/24/21 20:35		
Naphthalene-d8	335963	6.786	298828	6.804	112	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	198539	9.798	172679	9.798	115	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	308719	12.471	269598	12.471	115	50 - 200	0.000	+/-0.50	
Chrysene-d12	266547	17.197	213527	17.196	125	50 - 200	0.001	+/-0.50	
Perylene-d12	322609	19.951	241424	19.951	134	50 - 200	0.000	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0378
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
Matrix Spike Dup (BJI0296-MSD1)		(Solid)	Lab File ID: NT1121092417.D				Analyzed: 09/24/21 21:05		
Naphthalene-d8	330345	6.786	298828	6.804	111	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	195711	9.798	172679	9.798	113	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	303894	12.471	269598	12.471	113	50 - 200	0.000	+/-0.50	
Chrysene-d12	265201	17.196	213527	17.196	124	50 - 200	0.000	+/-0.50	
Perylene-d12	342108	19.951	241424	19.951	142	50 - 200	0.000	+/-0.50	
HA-31-1-2 (21I0042-33)		(Solid)	Lab File ID: NT1121092418.D				Analyzed: 09/24/21 21:35		
Naphthalene-d8	328910	6.786	298828	6.804	110	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	220290	9.798	172679	9.798	128	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	324668	12.471	269598	12.471	120	50 - 200	0.000	+/-0.50	
Chrysene-d12	285090	17.205	213527	17.196	134	50 - 200	0.009	+/-0.50	
Perylene-d12	382985	19.951	241424	19.951	159	50 - 200	0.000	+/-0.50	
HA-32-0-1 (21I0042-34)		(Solid)	Lab File ID: NT1121092419.D				Analyzed: 09/24/21 22:05		
Naphthalene-d8	316379	6.786	298828	6.804	106	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	183283	9.798	172679	9.798	106	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	285819	12.471	269598	12.471	106	50 - 200	0.000	+/-0.50	
Chrysene-d12	249130	17.196	213527	17.196	117	50 - 200	0.000	+/-0.50	
Perylene-d12	302426	19.951	241424	19.951	125	50 - 200	0.000	+/-0.50	
HA-32-1-2 (21I0042-35)		(Solid)	Lab File ID: NT1121092420.D				Analyzed: 09/24/21 22:35		
Naphthalene-d8	311681	6.786	298828	6.804	104	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	180923	9.798	172679	9.798	105	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	286315	12.471	269598	12.471	106	50 - 200	0.000	+/-0.50	
Chrysene-d12	246879	17.196	213527	17.196	116	50 - 200	0.000	+/-0.50	
Perylene-d12	312764	19.951	241424	19.951	130	50 - 200	0.000	+/-0.50	
HA-33-0-1 (21I0042-36)		(Solid)	Lab File ID: NT1121092421.D				Analyzed: 09/24/21 23:06		
Naphthalene-d8	309243	6.786	298828	6.804	103	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	176102	9.798	172679	9.798	102	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	274935	12.471	269598	12.471	102	50 - 200	0.000	+/-0.50	
Chrysene-d12	231934	17.196	213527	17.196	109	50 - 200	0.000	+/-0.50	
Perylene-d12	277279	19.951	241424	19.951	115	50 - 200	0.000	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Sequence:	SJI0378	Instrument:	NT11
		Calibration:	EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
HA-33-1-2 (21I0042-37)		(Solid)	Lab File ID: NT1121092422.D				Analyzed: 09/24/21 23:36		
Naphthalene-d8	301924	6.786	298828	6.804	101	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	173126	9.798	172679	9.798	100	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	269891	12.471	269598	12.471	100	50 - 200	0.000	+/-0.50	
Chrysene-d12	224759	17.197	213527	17.196	105	50 - 200	0.001	+/-0.50	
Perylene-d12	270410	19.951	241424	19.951	112	50 - 200	0.000	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0404
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
Initial Cal Check (SJI0404-ICV1)		(Solid)	Lab File ID: NT1121092502.D				Analyzed: 09/25/21 10:49		
Naphthalene-d8	261415	6.804	261415	6.804	100	50 - 200	0.000	+/-0.50	
Acenaphthene-d10	152112	9.798	152112	9.798	100	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	229961	12.471	229961	12.471	100	50 - 200	0.000	+/-0.50	
Chrysene-d12	192920	17.196	192920	17.196	100	50 - 200	0.000	+/-0.50	
Perylene-d12	221281	19.951	221281	19.951	100	50 - 200	0.000	+/-0.50	
HA-26-0-1 (21I0042-23RE1)		(Solid)	Lab File ID: NT1121092508.D				Analyzed: 09/25/21 14:07		
Naphthalene-d8	285922	6.795	261415	6.804	109	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	161754	9.798	152112	9.798	106	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	251951	12.471	229961	12.471	110	50 - 200	0.000	+/-0.50	
Chrysene-d12	225452	17.197	192920	17.196	117	50 - 200	0.001	+/-0.50	
Perylene-d12	276618	19.951	221281	19.951	125	50 - 200	0.000	+/-0.50	
HA-29-1-2 (21I0042-30RE1)		(Solid)	Lab File ID: NT1121092509.D				Analyzed: 09/25/21 14:37		
Naphthalene-d8	300398	6.795	261415	6.804	115	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	167469	9.798	152112	9.798	110	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	260792	12.471	229961	12.471	113	50 - 200	0.000	+/-0.50	
Chrysene-d12	230399	17.196	192920	17.196	119	50 - 200	0.000	+/-0.50	
Perylene-d12	282156	19.951	221281	19.951	128	50 - 200	0.000	+/-0.50	
HA-31-0-1 (21I0042-32RE1)		(Solid)	Lab File ID: NT1121092510.D				Analyzed: 09/25/21 15:07		
Naphthalene-d8	299955	6.795	261415	6.804	115	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	170729	9.798	152112	9.798	112	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	262016	12.471	229961	12.471	114	50 - 200	0.000	+/-0.50	
Chrysene-d12	231011	17.196	192920	17.196	120	50 - 200	0.000	+/-0.50	
Perylene-d12	276584	19.951	221281	19.951	125	50 - 200	0.000	+/-0.50	
HA-32-0-1 (21I0042-34RE1)		(Solid)	Lab File ID: NT1121092511.D				Analyzed: 09/25/21 15:38		
Naphthalene-d8	296193	6.795	261415	6.804	113	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	165992	9.798	152112	9.798	109	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	260222	12.471	229961	12.471	113	50 - 200	0.000	+/-0.50	
Chrysene-d12	229304	17.196	192920	17.196	119	50 - 200	0.000	+/-0.50	
Perylene-d12	274455	19.951	221281	19.951	124	50 - 200	0.000	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0404
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
HA-26-1-2 (21I0042-24RE1)		(Solid)	Lab File ID: NT1121092512.D				Analyzed: 09/25/21 16:08		
Naphthalene-d8	292244	6.795	261415	6.804	112	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	162665	9.798	152112	9.798	107	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	264419	12.471	229961	12.471	115	50 - 200	0.000	+/-0.50	
Chrysene-d12	221474	17.196	192920	17.196	115	50 - 200	0.000	+/-0.50	
Perylene-d12	260077	19.951	221281	19.951	118	50 - 200	0.000	+/-0.50	
HA-27-1-2 (21I0042-26RE1)		(Solid)	Lab File ID: NT1121092513.D				Analyzed: 09/25/21 16:38		
Naphthalene-d8	291727	6.795	261415	6.804	112	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	163740	9.798	152112	9.798	108	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	258113	12.471	229961	12.471	112	50 - 200	0.000	+/-0.50	
Chrysene-d12	205919	17.196	192920	17.196	107	50 - 200	0.000	+/-0.50	
Perylene-d12	251234	19.951	221281	19.951	114	50 - 200	0.000	+/-0.50	
HA-30-1-2 (21I0042-31RE1)		(Solid)	Lab File ID: NT1121092514.D				Analyzed: 09/25/21 17:08		
Naphthalene-d8	289130	6.795	261415	6.804	111	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	160014	9.798	152112	9.798	105	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	243610	12.471	229961	12.471	106	50 - 200	0.000	+/-0.50	
Chrysene-d12	220777	17.197	192920	17.196	114	50 - 200	0.001	+/-0.50	
Perylene-d12	260876	19.951	221281	19.951	118	50 - 200	0.000	+/-0.50	
HA-31-1-2 (21I0042-33RE1)		(Solid)	Lab File ID: NT1121092515.D				Analyzed: 09/25/21 17:38		
Naphthalene-d8	285706	6.795	261415	6.804	109	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	163827	9.798	152112	9.798	108	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	251157	12.471	229961	12.471	109	50 - 200	0.000	+/-0.50	
Chrysene-d12	220625	17.196	192920	17.196	114	50 - 200	0.000	+/-0.50	
Perylene-d12	251590	19.951	221281	19.951	114	50 - 200	0.000	+/-0.50	
HA-32-1-2 (21I0042-35RE1)		(Solid)	Lab File ID: NT1121092516.D				Analyzed: 09/25/21 18:08		
Naphthalene-d8	288029	6.795	261415	6.804	110	50 - 200	-0.009	+/-0.50	
Acenaphthene-d10	154738	9.798	152112	9.798	102	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	253765	12.471	229961	12.471	110	50 - 200	0.000	+/-0.50	
Chrysene-d12	212423	17.196	192920	17.196	110	50 - 200	0.000	+/-0.50	
Perylene-d12	241277	19.951	221281	19.951	109	50 - 200	0.000	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0404
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
HA-34-1-2 (21I0042-38)		(Solid)	Lab File ID: NT1121092517.D				Analyzed: 09/25/21 18:39		
Naphthalene-d8	302121	6.786	261415	6.804	116	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	185591	9.798	152112	9.798	122	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	284088	12.471	229961	12.471	124	50 - 200	0.000	+/-0.50	
Chrysene-d12	253052	17.196	192920	17.196	131	50 - 200	0.000	+/-0.50	
Perylene-d12	275281	19.961	221281	19.951	124	50 - 200	0.010	+/-0.50	
DUP-01-1-2 (21I0042-39)		(Solid)	Lab File ID: NT1121092518.D				Analyzed: 09/25/21 19:09		
Naphthalene-d8	305269	6.786	261415	6.804	117	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	178016	9.798	152112	9.798	117	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	272898	12.471	229961	12.471	119	50 - 200	0.000	+/-0.50	
Chrysene-d12	234494	17.196	192920	17.196	122	50 - 200	0.000	+/-0.50	
Perylene-d12	294897	19.951	221281	19.951	133	50 - 200	0.000	+/-0.50	
DUP-02-1-2 (21I0042-40)		(Solid)	Lab File ID: NT1121092519.D				Analyzed: 09/25/21 19:39		
Naphthalene-d8	307281	6.786	261415	6.804	118	50 - 200	-0.018	+/-0.50	
Acenaphthene-d10	189171	9.798	152112	9.798	124	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	292522	12.471	229961	12.471	127	50 - 200	0.000	+/-0.50	
Chrysene-d12	262947	17.205	192920	17.196	136	50 - 200	0.009	+/-0.50	
Perylene-d12	259861	19.961	221281	19.951	117	50 - 200	0.010	+/-0.50	

INTERNAL STANDARD AREA AND RT SUMMARY

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0424
Instrument: NT11
Calibration: EH00019

Internal Standard	Response	RT	Reference Response	Reference RT	Area %	Area % Limits	RT Diff	RT Diff Limit	Q
Initial Cal Check (SJI0424-ICV1)		(Solid)	Lab File ID: NT1121092802.D				Analyzed: 09/28/21 09:46		
Naphthalene-d8	228461	6.795	228461	6.795	100	50 - 200	0.000	+/-0.50	
Acenaphthene-d10	133205	9.798	133205	9.798	100	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	210936	12.471	210936	12.471	100	50 - 200	0.000	+/-0.50	
Chrysene-d12	169209	17.196	169209	17.196	100	50 - 200	0.000	+/-0.50	
Perylene-d12	195004	19.951	195004	19.951	100	50 - 200	0.000	+/-0.50	
Instrument Blank (SJI0424-IBL1)		(Solid)	Lab File ID: NT1121092803.D				Analyzed: 09/28/21 10:29		
Naphthalene-d8	255003	6.804	228461	6.795	112	50 - 200	0.009	+/-0.50	
Acenaphthene-d10	136426	9.798	133205	9.798	102	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	220501	12.471	210936	12.471	105	50 - 200	0.000	+/-0.50	
Chrysene-d12	177192	17.196	169209	17.196	105	50 - 200	0.000	+/-0.50	
Perylene-d12	197121	19.951	195004	19.951	101	50 - 200	0.000	+/-0.50	
HA-34-1-2 (21I0042-38RE1)		(Solid)	Lab File ID: NT1121092804.D				Analyzed: 09/28/21 10:58		
Naphthalene-d8	262321	6.795	228461	6.795	115	50 - 200	0.000	+/-0.50	
Acenaphthene-d10	147126	9.798	133205	9.798	110	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	234359	12.471	210936	12.471	111	50 - 200	0.000	+/-0.50	
Chrysene-d12	202247	17.196	169209	17.196	120	50 - 200	0.000	+/-0.50	
Perylene-d12	242586	19.951	195004	19.951	124	50 - 200	0.000	+/-0.50	
DUP-01-1-2 (21I0042-39RE1)		(Solid)	Lab File ID: NT1121092805.D				Analyzed: 09/28/21 11:29		
Naphthalene-d8	270494	6.795	228461	6.795	118	50 - 200	0.000	+/-0.50	
Acenaphthene-d10	154140	9.798	133205	9.798	116	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	245590	12.471	210936	12.471	116	50 - 200	0.000	+/-0.50	
Chrysene-d12	212861	17.196	169209	17.196	126	50 - 200	0.000	+/-0.50	
Perylene-d12	267604	19.951	195004	19.951	137	50 - 200	0.000	+/-0.50	
DUP-02-1-2 (21I0042-40RE1)		(Solid)	Lab File ID: NT1121092806.D				Analyzed: 09/28/21 11:59		
Naphthalene-d8	271731	6.795	228461	6.795	119	50 - 200	0.000	+/-0.50	
Acenaphthene-d10	151679	9.798	133205	9.798	114	50 - 200	0.000	+/-0.50	
Phenanthrene-d10	241696	12.461	210936	12.471	115	50 - 200	-0.010	+/-0.50	
Chrysene-d12	207508	17.197	169209	17.196	123	50 - 200	0.001	+/-0.50	
Perylene-d12	248171	19.951	195004	19.951	127	50 - 200	0.000	+/-0.50	

HOLDING TIME SUMMARY

Analysis: EPA 8270E-SIM

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
HA-15-0-1 21I0042-05	09/01/21 12:40	09/02/21 10:52	09/10/21 13:18	9	14	09/22/21 12:23	12	40	
HA-15-0-1 21I0042-05RE1	09/01/21 12:40	09/02/21 10:52	09/10/21 13:18	9	14	09/23/21 12:11	13	40	
HA-15-1-2 21I0042-06	09/01/21 12:45	09/02/21 10:52	09/10/21 13:18	9	14	09/22/21 12:53	12	40	
HA-15-1-2 21I0042-06RE1	09/01/21 12:45	09/02/21 10:52	09/10/21 13:18	9	14	09/23/21 12:41	13	40	
HA-16-0-1 21I0042-07	09/01/21 10:40	09/02/21 10:52	09/10/21 13:18	9	14	09/23/21 11:10	13	40	
HA-16-0-1 21I0042-07RE1	09/01/21 10:40	09/02/21 10:52	09/10/21 13:18	9	14	09/23/21 15:41	13	40	
HA-16-1-2 21I0042-08	09/01/21 10:45	09/02/21 10:52	09/10/21 13:18	9	14	09/23/21 11:40	13	40	
HA-16-1-2 21I0042-08RE1	09/01/21 10:45	09/02/21 10:52	09/10/21 13:18	9	14	09/23/21 16:11	13	40	
HA-17-1-2 21I0042-09	09/01/21 09:00	09/02/21 10:52	09/10/21 13:18	9	14	09/22/21 14:24	12	40	
HA-18-1-2 21I0042-10	08/31/21 15:30	09/02/21 10:52	09/10/21 13:18	9	14	09/22/21 14:54	12	40	
HA-18-1-2 21I0042-10RE1	08/31/21 15:30	09/02/21 10:52	09/10/21 13:18	9	14	09/23/21 16:41	13	40	
HA-19-0-1 21I0042-11	08/31/21 15:10	09/02/21 10:52	09/10/21 13:18	9	14	09/22/21 15:24	12	40	
HA-19-1-2 21I0042-12	08/31/21 15:20	09/02/21 10:52	09/10/21 13:18	9	14	09/22/21 15:54	12	40	
HA-20-0-1 21I0042-13	08/31/21 15:45	09/02/21 10:52	09/10/21 13:18	9	14	09/22/21 16:24	12	40	
HA-20-1-2 21I0042-14	08/31/21 16:00	09/02/21 10:52	09/10/21 13:18	9	14	09/22/21 16:54	12	40	
HA-21-1-2 21I0042-15	09/01/21 09:20	09/02/21 10:52	09/10/21 13:18	9	14	09/22/21 17:24	12	40	
HA-21-1-2 21I0042-15RE1	09/01/21 09:20	09/02/21 10:52	09/10/21 13:18	9	14	09/23/21 17:11	13	40	
HA-22-0-1 21I0042-16	09/01/21 09:35	09/02/21 10:52	09/10/21 13:18	9	14	09/22/21 17:55	12	40	
HA-22-0-1 21I0042-16RE1	09/01/21 09:35	09/02/21 10:52	09/10/21 13:18	9	14	09/23/21 17:42	13	40	
HA-22-1-2 21I0042-17	09/01/21 09:40	09/02/21 10:52	09/10/21 13:18	9	14	09/22/21 18:25	12	40	
HA-22-1-2 21I0042-17RE1	09/01/21 09:40	09/02/21 10:52	09/10/21 13:18	9	14	09/23/21 18:11	13	40	
HA-23-1-2 21I0042-18	09/01/21 11:10	09/02/21 10:52	09/10/21 13:18	9	14	09/22/21 18:55	12	40	

HOLDING TIME SUMMARY

Analysis: EPA 8270E-SIM

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
HA-23-1-2 21I0042-18RE1	09/01/21 11:10	09/02/21 10:52	09/10/21 13:18	9	14	09/23/21 18:41	13	40	
HA-24-0-1 21I0042-19	08/31/21 11:15	09/02/21 10:52	09/10/21 13:18	10	14	09/22/21 19:25	12	40	
HA-24-1-2 21I0042-20	08/31/21 11:20	09/02/21 10:52	09/10/21 13:18	10	14	09/23/21 13:11	13	40	
HA-25-0-1 21I0042-21	08/31/21 10:40	09/02/21 10:52	09/10/21 13:18	10	14	09/23/21 14:41	13	40	
HA-25-1-2 21I0042-22	08/31/21 10:50	09/02/21 10:52	09/10/21 13:18	10	14	09/23/21 15:11	13	40	
HA-26-0-1 21I0042-23	08/31/21 11:35	09/02/21 10:52	09/10/21 13:18	10	14	09/24/21 15:33	14	40	
HA-26-0-1 21I0042-23RE1	08/31/21 11:35	09/02/21 10:52	09/10/21 13:18	10	14	09/25/21 14:07	15	40	
HA-26-1-2 21I0042-24	08/31/21 11:45	09/02/21 10:52	09/10/21 13:18	10	14	09/24/21 16:04	14	40	
HA-26-1-2 21I0042-24RE1	08/31/21 11:45	09/02/21 10:52	09/10/21 13:18	10	14	09/25/21 16:08	15	40	
HA-27-0-1 21I0042-25	08/31/21 12:20	09/02/21 10:52	09/10/21 13:18	10	14	09/24/21 16:34	14	40	
HA-27-1-2 21I0042-26	08/31/21 12:25	09/02/21 10:52	09/10/21 13:18	10	14	09/24/21 17:04	14	40	
HA-27-1-2 21I0042-26RE1	08/31/21 12:25	09/02/21 10:52	09/10/21 13:18	10	14	09/25/21 16:38	15	40	
HA-28-0-1 21I0042-27	08/31/21 12:55	09/02/21 10:52	09/10/21 13:18	10	14	09/24/21 17:34	14	40	
HA-28-1-2 21I0042-28	08/31/21 13:00	09/02/21 10:52	09/10/21 13:18	10	14	09/24/21 18:04	14	40	
HA-29-0-1 21I0042-29	08/31/21 13:45	09/02/21 10:52	09/10/21 13:18	9	14	09/24/21 18:34	14	40	
HA-29-1-2 21I0042-30	08/31/21 13:50	09/02/21 10:52	09/10/21 13:18	9	14	09/24/21 19:05	14	40	
HA-29-1-2 21I0042-30RE1	08/31/21 13:50	09/02/21 10:52	09/10/21 13:18	9	14	09/25/21 14:37	15	40	
HA-30-1-2 21I0042-31	08/31/21 14:15	09/02/21 10:52	09/10/21 13:18	9	14	09/24/21 19:35	14	40	
HA-30-1-2 21I0042-31RE1	08/31/21 14:15	09/02/21 10:52	09/10/21 13:18	9	14	09/25/21 17:08	15	40	
HA-31-0-1 21I0042-32	08/31/21 14:40	09/02/21 10:52	09/10/21 13:18	9	14	09/24/21 20:05	14	40	
HA-31-0-1 21I0042-32RE1	08/31/21 14:40	09/02/21 10:52	09/10/21 13:18	9	14	09/25/21 15:07	15	40	
HA-31-1-2 21I0042-33	08/31/21 14:45	09/02/21 10:52	09/10/21 13:18	9	14	09/24/21 21:35	14	40	

HOLDING TIME SUMMARY

Analysis: EPA 8270E-SIM

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
HA-31-1-2 21I0042-33RE1	08/31/21 14:45	09/02/21 10:52	09/10/21 13:18	9	14	09/25/21 17:38	15	40	
HA-32-0-1 21I0042-34	08/31/21 13:25	09/02/21 10:52	09/10/21 13:18	9	14	09/24/21 22:05	14	40	
HA-32-0-1 21I0042-34RE1	08/31/21 13:25	09/02/21 10:52	09/10/21 13:18	9	14	09/25/21 15:38	15	40	
HA-32-1-2 21I0042-35	08/31/21 13:30	09/02/21 10:52	09/10/21 13:18	9	14	09/24/21 22:35	14	40	
HA-32-1-2 21I0042-35RE1	08/31/21 13:30	09/02/21 10:52	09/10/21 13:18	9	14	09/25/21 18:08	15	40	
HA-33-0-1 21I0042-36	08/31/21 12:00	09/02/21 10:52	09/10/21 13:18	10	14	09/24/21 23:06	14	40	
HA-33-1-2 21I0042-37	08/31/21 12:10	09/02/21 10:52	09/10/21 13:18	10	14	09/24/21 23:36	14	40	
HA-34-1-2 21I0042-38	08/31/21 10:15	09/02/21 10:52	09/10/21 13:18	10	14	09/25/21 18:39	15	40	
HA-34-1-2 21I0042-38RE1	08/31/21 10:15	09/02/21 10:52	09/10/21 13:18	10	14	09/28/21 10:58	18	40	
DUP-01-1-2 21I0042-39	09/01/21 11:15	09/02/21 10:52	09/10/21 13:18	9	14	09/25/21 19:09	15	40	
DUP-01-1-2 21I0042-39RE1	09/01/21 11:15	09/02/21 10:52	09/10/21 13:18	9	14	09/28/21 11:29	18	40	
DUP-02-1-2 21I0042-40	08/31/21 14:00	09/02/21 10:52	09/10/21 13:18	9	14	09/25/21 19:39	15	40	
DUP-02-1-2 21I0042-40RE1	08/31/21 14:00	09/02/21 10:52	09/10/21 13:18	9	14	09/28/21 11:59	18	40	
Matrix Spike BJI0287-MS1	08/31/21 11:20	09/02/21 10:52	09/10/21 13:18	10	14	09/23/21 13:41	13	40	
Matrix Spike Dup BJI0287-MSD1	08/31/21 11:20	09/02/21 10:52	09/10/21 13:18	10	14	09/23/21 14:11	13	40	
Matrix Spike BJI0296-MS1	08/31/21 14:40	09/02/21 10:52	09/10/21 13:18	9	14	09/24/21 20:35	14	40	
Matrix Spike Dup BJI0296-MSD1	08/31/21 14:40	09/02/21 10:52	09/10/21 13:18	9	14	09/24/21 21:05	14	40	

* Indicates hold time exceedance.

METHOD DETECTION AND REPORTING LIMITS

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Matrix: Solid Instrument: NT11

Analyte	MDL	RL	Units
Benzo(a)anthracene	0.07	0.50	ug/kg
Chrysene	0.07	0.50	ug/kg
Benzo(b)fluoranthene	0.07	0.50	ug/kg
Benzo(k)fluoranthene	0.10	0.50	ug/kg
Benzo(a)pyrene	0.09	0.50	ug/kg
Indeno(1,2,3-cd)pyrene	0.09	0.50	ug/kg
Dibenzo(a,h)anthracene	0.11	0.50	ug/kg

METHOD DETECTION AND REPORTING LIMITS

EPA 8270E-SIM

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Matrix: Water Instrument: NT11

Analyte	MDL	RL	Units
Naphthalene	0.001	0.010	ug/L
2-Methylnaphthalene	0.001	0.010	ug/L
1-Methylnaphthalene	0.0009	0.010	ug/L
Acenaphthylene	0.002	0.010	ug/L
Acenaphthene	0.003	0.010	ug/L
Dibenzofuran	0.002	0.010	ug/L
Fluorene	0.002	0.010	ug/L
Phenanthrene	0.001	0.010	ug/L
Anthracene	0.001	0.010	ug/L
Carbazole	0.001	0.010	ug/L
Fluoranthene	0.002	0.010	ug/L
Pyrene	0.001	0.010	ug/L
Benzo(a)anthracene	0.0008	0.010	ug/L
Chrysene	0.0009	0.010	ug/L
Benzo(b)fluoranthene	0.0005	0.010	ug/L
Benzo(k)fluoranthene	0.003	0.010	ug/L
Benzo(j)fluoranthene	0.002	0.010	ug/L
Benzofluoranthenes, Total	0.004	0.010	ug/L
Benzo(a)pyrene	0.002	0.010	ug/L
Perylene	0.006	0.010	ug/L
Indeno(1,2,3-cd)pyrene	0.001	0.010	ug/L
Dibenzo(a,h)anthracene	0.001	0.010	ug/L
Benzo(g,h,i)perylene	0.001	0.010	ug/L

Certificate of Analysis

SIGMA-ALDRICH

Product Name	2,4,6-Tribromophenol, 99%
Product Number	137715
Product Brand	ALDRICH
CAS Number	118-79-6
Molecular Formula	$Br_3C_6H_2OH$
Molecular Weight	330.80

B000562
SVOA-Tribromophenol-NEAT
Expires 11/25/2029
Prepared By Van Spohn 12/31/2012

TEST	SPECIFICATION	LOT 03410KL RESULTS
APPEARANCE	WHITE TO OFF-WHITE TO PINK FLAKES, CHUNKS,	OFF-WHITE CHIPS
INFRARED SPECTRUM	CONFORMS TO STRUCTURE.	CONFORMS TO STRUCTURE
MELTING POINT		93 DEGREES CELSIUS
GAS LIQUID CHROMATOGRAPHY		99.4 %

Barbara Rajzer, Supervisor
Quality Control
Milwaukee, Wisconsin USA

Please wait...

I 8244

Analytical Resources, Incorporated

Analytical Standard Record
Analytical Resources, Inc.
Standard ID: B002054

Printed: 10/4/2013 6:32:21PM

Description:	SVOA 1-Methylnaphthalene	Expires:	02-Apr-14
Standard Type:	Analyte Spike	Prepared:	13-Dec-12
Solvent:	NA	Prepared By:	Jianqing Zhou
Final Volume (mls):	1	Department:	Organics
Vials:	1	Last Edit:	04-Oct-13 18:32 by JZ
Vendor:	Chem Service	Lot #:	62-5B
Vendor Catalog #:			

Comments

Neat, Purity @ 99%

Analyte	CAS Number	Concentration	Units
1-Methylnaphthalene	90-12-0	1000000	ug/mL

B002054
SVOAǑ-Met ,In! ᵞ t ! lene
SolventǑǑLot:ǑNA
ᵣeᵞ:Ǒr̃ /1k̃/r̃ w̃1r̃ Ǒ, ǑZ
¯Kᵞ:Ǒr̃ /k̃ 1/r̃ w̃r̃ G
Lo"! t#n:Ǒ

Reviewed By

Date

Appendix 20.1

ALTERNATE CERTIFICATE OF ANALYSIS

The manufacturer of the below chemical was unable to provide a Certificate of Analysis at the time of request by ARI.

Date Requested from Manufacturer:_____

Chemical: 1-Methyl naphthalene

Manufacturer: Chem Service

Product #: 0787

Lot #: 67-53

Purity: 99%

Analyst: AZ

660 Tower Lane • P.O. Box 599 • West Chester, PA 19381-0599
1-800-452-9994 • 1-610-692-3026 • Fax 1-610-692-8729
info@chemservice.com • www.chemservice.com

CERTIFICATE OF ANALYSIS

2-Chloronaphthalene

CATALOG NUMBER	N-10323-100MG
LOT NUMBER	7762100
DATE CERTIFIED	05/22/18
EXPIRATION DATE	05/31/24
CAS NUMBER	91-58-7
MOLECULAR FORMULA	C10H7Cl
MOLECULAR WEIGHT	162.62
STORAGE	Store in a cool dry place.
HANDLING	See Safety Data Sheet
INTENDED USE	For laboratory use only.
ISO GUIDE 34 CERTIFIED	[ ]

G010438
2-Chloronaphthalene NEAT
Expires 5/31/2024
Prepared By Van Spohn 11/10/2018

Analytical Test	Value
% PURITY (GC/FID)	99.5

Chem Service, Inc. guarantees the purity to be +/- 0.5% deviation prior to the expiration date shown on the label and exclusive of any customer contamination.

Certified By:

Mary Beth O'Donnell

Mary Beth O'Donnell
CSM/TC

COA Form
Revision 3 (3/2015)

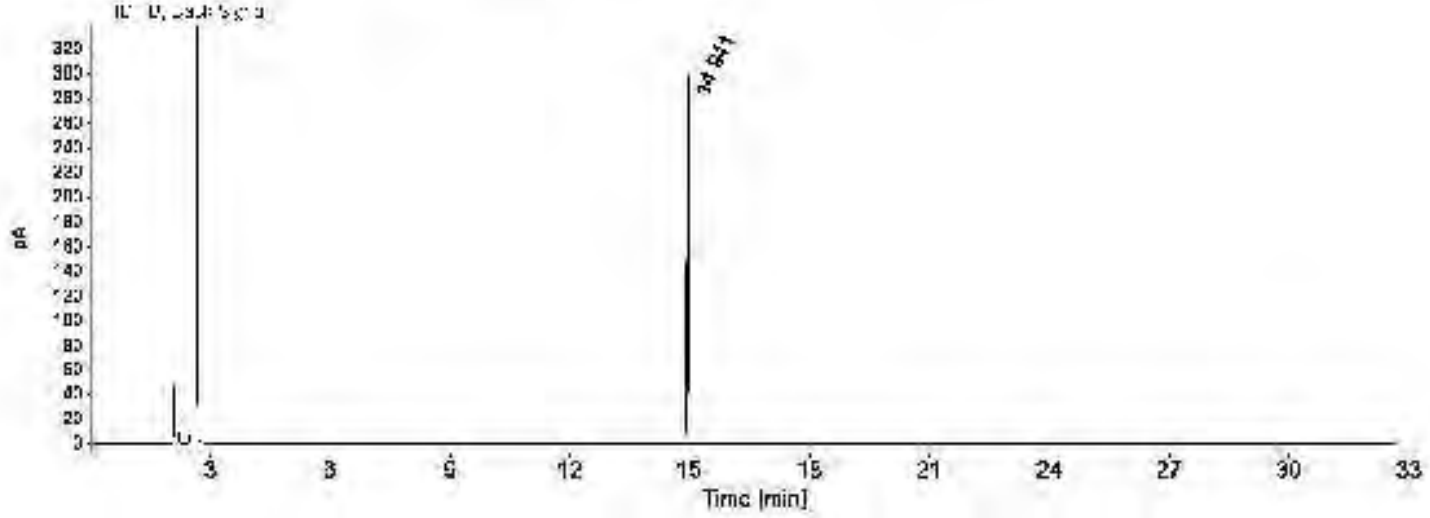
660 Tower Lane • P.O. Box 599 • West Chester, PA 19381-0599
1-800-452-9994 • 1-610-692-3026 • Fax 1-610-692-8729
info@chemservice.com • www.chemservice.com

CERTIFICATE OF ANALYSIS

Gas Chromatography / Flame Ionization Detector (GC/FID)

Data file: C:\Chem32\1\Data\2018 Data\0518\2-Chloronaphthalene.D
Sample name: 2-Chloronaphthalene

Instrument: GC3
Injection date: 5/22/2018 1:12:52 PM
Acq. method: REAR_SCREEN.M
Location: 209
Injection volume: 1.0uL
Col Type: pn# 7HG-G006-17-C **Diameter** 250.000 **Length** 30.000



Signal: FID1 B, Back Signal

RT [min]	Type	Width [min]	Area	Height	Area%
14.941	BB	0.0410	808.8124	308.5675	100.0000
		Sum	808.8124		

Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

Product Name: DIBENZ[A,H]ANTHRACENE (D14, 98%)
(Isotopic Label & Enrichment Specification)

Lot Number: PR-30906

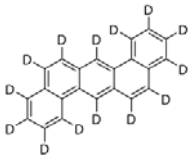
Catalog Number: DLM-677-0

I004874
DIBENZ[A,H]ANTHRACENE D14
Expires 12/31/2079
Prepared By Joshua Rains 6/3/2020

Product Information

Chemical Purity Specification: ≥ 98%

MW*: 292.43
** For isotopically labeled compounds, MW listed is for the fully enriched product.*



Labeled CAS Number: 13250-98-1

Unlabeled CAS Number: 53-70-3

Chemical Formula: C22D14

Storage: Store at room temperature away from light and moisture.

Certification

Cambridge Isotope Laboratories, Inc. guarantees that this material meets or exceeds the specifications stated. Absolute identity as well as chemical and isotopic purities are assured by the use of unambiguous synthetic routes and multiple chemical analyses whenever possible. Results are representative of QC testing at time of release from Quality Control unless otherwise stated.

The retest date for this chemical has been designated based on CIL's experience in working with chemical standards for over 30 years, and includes review of actual analytical results and relevant literature references. The retest date is valid only for unopened vials or ampoules that have been stored as recommended.

Approved by: Sashi Sivendran-Basak

Sashi Sivendran-Basak, Ph.D., Quality Review

Quality Control Tests and Results

1H NMR for Chemical Purity	Pass
1H NMR for Isotopic Enrichment	99.4%
2H NMR for Chemical Purity	Pass
GC/FID for Chemical Purity	99.4%
GC/MS for Identification	Conforms

(continued on next page)

Product Name: DIBENZ[A,H]ANTHRACENE
(Isotopic Label & Enrichment Specification) (D14, 98%)

Lot Number: PR-30906

Catalog Number: DLM-677-0

Quality Control Tests and Results (continued)

Melting Point Range Determination	261-267°C

Additional Testing Information:

Retest/Review Date: 06/21/29

RESTEK®
110 Benner Circle
Bellefonte, PA 16823-8812
Tel: (800)356-1688
Fax: (814)353-1309

www.restek.com

CERTIFIED REFERENCE MATERIAL

Certificate of Analysis

ISO 17034 Accredited
Reference Material Producer
Certificate #3222.01

ISO/IEC 17025 Accredited
Testing Laboratory
Certificate #3222.02

FOR LABORATORY USE ONLY-READ SDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

Catalog No. : 33913 **Lot No.:** A0161454

Description : SOM01.0 SIM Analysis Standard

SOM01.0 SIM Analysis Standard 2000µg/mL, Methylene chloride, 1mL /ampul

I005177
SOMO 1.0 SIM DMC
Expires 5/31/2026
Prepared By Joshua Rains 6/15/2020

Container Size : 2 mL **Pkg Amt:** > 1 mL

Expiration Date : May 31, 2026 **Storage:** 10°C or colder

Handling: Sonication required. Mix is photosensitive.

C E R T I F I E D V A L U E S

Elution Order	Compound		Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	2-Methylnaphthalene-d10		2,013.1 µg/mL	+/- 11.8141	µg/mL	Gravimetric
	CAS # 7297-45-2	(Lot EF-135)		+/- 90.6864	µg/mL	Unstressed
	Purity 96%			+/- 100.6247	µg/mL	Stressed
2	Fluoranthene-d10		2,002.1 µg/mL	+/- 11.7497	µg/mL	Gravimetric
	CAS # 93951-69-0	(Lot PR-20668)		+/- 90.1917	µg/mL	Unstressed
	Purity 98%			+/- 100.0759	µg/mL	Stressed

Solvent: Methylene chloride
CAS # 75-09-2
Purity 99%

Column:
!"#$#!%&""#$#!%&'("
)*$+'#,-. *%/0!&& 1

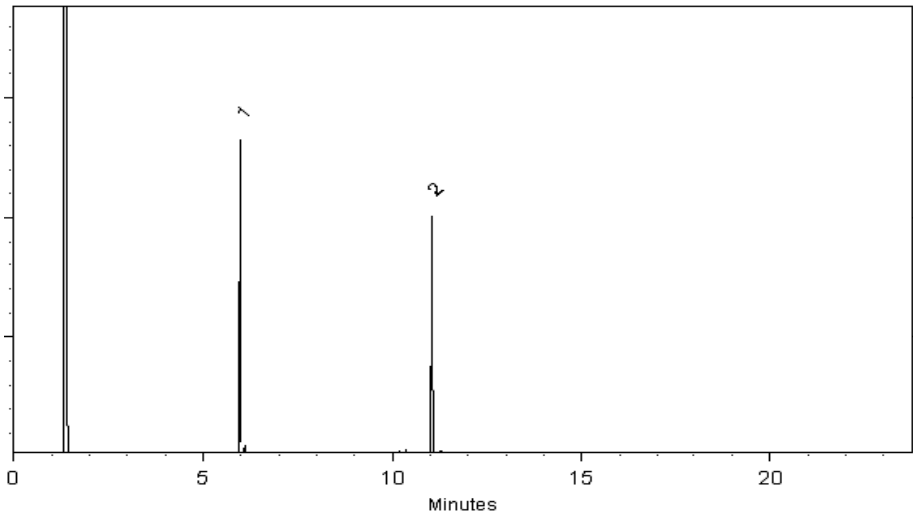
Carrier Gas:
23456789+-69: *:9 *#;<=::<58#0!#;=%

Temp. Program:
>'?@#,26A4#0#"=9%#.#?@
B#&!?@C"=9%#,26A4#0!#"=9%1

Inj. Temp:
&'!?@

Det. Temp:
!?@

Det. Type:
DEF



This chromatogram represents a general set of testing conditions chosen for product acceptance. For optimal results in your lab, conditions should be adjusted for your specific instrument, method, and application.

Kylie Struble - Operations Technician I

Date Mixed: 04-Jun-2020 **Balance:** 1128360905

Fang-Yun Lo - QC Analyst

Date Passed: 08-Jun-2020

Manufactured under Restek's ISO 9001:2015 Registered Quality System Certificate #FM 80397

General Certified Reference Material Notes

Expiration Notes:

- Expiration date valid for unopened ampul stored in compliance with the recommended conditions.
- Uncertainty, concentration, and expiration of the CRM are based on the unopened product being stored according to the recommended condition found in the storage field.

Purity Notes:

- Purity and/or chemical identity are determined by one or more of the following techniques: GC/FID, HPLC, GC/μECD, GC/MS, LC/MS, RI, and/or melting point.
- Compounds with a listed purity of less than 99% have been weight corrected to compensate for impurities and/or salts. A correction factor is used to calculate the amount of compound necessary to achieve the desired concentration of the parent compound in solution.
- Purity of isomeric compounds is reported as the sum of the isomers.
- Purity values are rounded to the nearest whole number.

Certified Uncertainty Value Notes:

- The uncertainties are determined in accordance with ISO 17034 and Guide 35. The certified combined stressed uncertainty value (includes gravimetric uncertainty, homogeneity between-ampul uncertainty, storage stability uncertainty and shipping stability uncertainty and were combined using the following formula:

$$U_{combined\ stressed} = k\sqrt{U^2_{gravimetric} + U^2_{homogeneity} + U^2_{storage\ stability} + U^2_{shipping\ stability}}$$

k is a coverage factor of 2, which gives a level of confidence of approximately 95%.

- It is important to note that the shipping stability uncertainty was obtained under temperature extremes for specific time intervals; therefore, the certified combined stressed uncertainty value should only be applied to the product if it was stored at non-standard temperature conditions up to and including 7 days. Contact Restek Technical Service at www.restek.com/Contact-Us for use recommendations if your shipment was in-transit for more than 7 days at non-standard temperature conditions.
- Apply the certified combined unstressed uncertainty value if the product was received under standard shipping conditions. Apply the certified combined stressed uncertainty value if the product was received under non-standard conditions as specified below.

Label Conditions	Standard Conditions	Non-Standard Conditions
25°C Nominal (Room Temperature)	< 60°C	≥ 60°C up to 7 days
10°C or colder (Refrigerate)	< 40°C	≥ 40°C up to 7 days
0°C or colder (Freezer) -20°C or colder (Deep Freezer)	< 25°C	≥ 25°C up to 7 days

- Separate (not combined) uncertainty values for gravimetric uncertainty are also displayed on the certificate, if needed, separate homogeneity between-ampul uncertainty, storage stability uncertainty and shipping stability uncertainty values are available by contacting Restek Technical Service at www.restek.com/Contact-Us.
- The packaged amount is the minimum sample size for which uncertainty is valid. The ampules are over-filled to ensure that the minimum packaged amount can be sufficiently transferred.

Manufacturing Notes:

- Concentration is based upon gravimetric preparation using either a balance whose calibration has been verified daily using NIST traceable weights, and/or dilutions with Class A glassware.

Handling Notes:

- Stability of the unopened product, when stored in compliance with the recommended conditions, is guaranteed through the expiration displayed on the product label and certificate. Contact Restek for additional opened product stability information, with the knowledge/understanding that open product stability is subject to the specific handling and environmental conditions to which the product is exposed. For your convenience Restek supplies deactivated vials with most standards packed in 2mL ampules. Larger volume deactivated vials are available through Restek as a custom ordered item. Additionally, Restek sells DMDCS for the purpose of glassware deactivation as catalog number 31861, which includes complete instructions.

Certificate of Analysis

Produced by Phenova
6390 Joyce Drive STE 100, Golden, CO 80403 USA ▪ Tel: 303-940-0033 ▪ Fax: 303-940-0043 ▪ info@phenova.com
Access your Safety Data Sheets and digital Certificates at **www.phenova.com/documents.**

Certified Reference Material

This product is certified in accordance with Phenova's ISO 17034 accreditation and supported by Phenova's ISO/IEC 17025 chemical testing accreditation

Catalog No.: AL0-101244
Description: Benzidines Standard
Storage: 4 °C
Provided As: 1 mL in 2 mL Ampoule in Methylene Chloride

Lot Number: CL15236
Certification Date: April 28, 2020
Expiration Date: April 30, 2030

I007617
Benzidines std @2000ug/ml
Expires 4/30/2030
Prepared By Jianqing Zhou 8/27/2020

Andrea L Gill
Andrea Gill, Certified Reference Materials Manager

Component	CAS #	Certified Value µg/mL	Expanded Uncertainty
Benzidine	92-87-5	2000	± 0.231%
3,3'-Dichlorobenzidine	91-94-1	2000	± 0.116%

ACCREDITED
Reference Material Producer
Certicate No. 2427.02

Phenova is an accredited ISO/IEC 17034 Reference Material Producer and ISO/IEC 17025 accredited Chemical Testing Laboratory.

ACCREDITED
Chemical Testing Laboratory
Certicate No. 2427.03

IL64691018_us

Produced by Phenova
6390 Joyce Drive STE 100, Golden, CO 80403 USA ▪ Tel: 303-940-0033 ▪ Fax: 303-940-0043 ▪ info@phenova.com
Access your Safety Data Sheets and digital Certificates at **www.phenova.com/documents.**

1. Quality Document: This Certificate of Analysis has been created in accordance with ISO Guide 31[1] and ISO Guide 35.[2]

2. Quality Standards: Phenova is accredited by A2LA to ISO 17034[3] and ISO/IEC 17025[4] as a producer of Certified Reference Materials and Reference Materials. This ensures that our manufacturing processes have been accredited to and meet strict international standards.

3. Intended Use: The product is manufactured for use in calibration, calibration verification, quantification, identification and other appropriate analytical control applications. The product is intended for routine laboratory analysis and research purposes only. Only trained personnel should handle this product.

4. Handling and Usage Notes: Store according to recommended conditions listed and avoid prolonged exposure to light. Visually inspect the solution inside the ampoule for any un-dissolved material. If particulate is visible, sonicate the unopened ampoule until material is fully dissolved. Dilute as required, use only class A glassware and diluents compatible with all analytes in the mixture. Considerations should be made related to repeated use of the opened product. Once opened, exposure to light, air, heat, objects, and additional transfer vessels may cause evaporation, degradation or contamination resulting in changes in concentration, uncertainty and stability duration. Store opened standards in a clean, tightly capped vessel under the recommended temperature. Appropriate controls, such as the use of additional verification standards should be used to confirm the opened product is fit for purpose under repeated use conditions.

5. Hazardous Situation: The product is intended for use by experienced professional personnel. A Safety Data Sheet (SDS) is available at www.phenova.com/documents.

6. Level of Homogeneity: The product has been certified to guarantee the certified values and their uncertainties at a volume of 2 µL.

7. Certified Value: Certified Value is based upon gravimetric and volumetric preparation using calibrated balances and Class A glassware.

8. Raw Materials and Purity: Phenova reference standard products are prepared from the highest quality starting materials. The purity of this material was verified using an ISO/IEC 17025 methodology.

9. Expanded Uncertainty: The expanded uncertainty (uCRM) as stated is determined in accordance with ISO/IEC Guide 98[5] and ISO Guide 35 incorporating Type A standard uncertainty at a 95% confidence level. The uncertainty contains elements of manufacturing (uM), homogeneity analysis (uH) and long-term stability testing (uLTS). The uncertainty is calculated based on the root-sum-of-squares equation times a coverage factor (k=2).

$$uCRM = k\sqrt{uM^2 + uH^2 + uLTS^2}$$

   Transport conditions (short-term stability) have been tested such that there is no contribution to the uncertainty reported. The expanded uncertainty applies to the product as received.

10. Metrological Traceability: The property value (certified value and its uncertainty) are traceable through an unbroken chain of calibration to the SI base unit kg through a NIST traceable weight in accordance with ISO 17034. This is achieved through calibration of balances, verification of weights, use of national methodology for glassware calibration and product homogeneity and stability testing utilizing an ISO/IEC 17025 methodology.

11. Values Obtained During Product Testing: This product is subjected to verification, homogeneity and stability testing using an ISO/IEC 17025 chromatographic methodology. All values obtained during testing meet criteria in accordance with ISO 17034.

12. Period of Validity: The Certified Values, Uncertainties and Expiration Date are based on the unopened product being stored according to the recommended storage condition listed and are guaranteed until the expiration date. This product will be monitored during the period of validity and customers notified of any significant changes in stability.

References:

[1] ISO Guide 31 – Reference Materials – Contents of Certificates and Labels.
[2] ISO Guide 35 – Reference Material – General and Statistical Principles for Certification.
[3] ISO 17034 – General Requirements for the Competence of Reference Material Producers.
[4] ISO/IEC 17025 – General Requirements for the Competence of Testing and Calibration Laboratories.
[5] ISO/IEC Guide 98-3:2008(E) – Uncertainty of Measurement – Part 3: Guide to Expression of Uncertainty in Measurement (GUM: 1995)

Absolute Standards, Inc.
800-368-1131
www.absolutestandards.com

Certified Reference Material CRM

ANAB ISO 17034 Accredited
AR-1539 Certificate Number
https://Absolutestandards.com

CERTIFIED WEIGHT REPORT

Part Number: 93462
Lot Number: 092220
Description: PAH Standard
30 components
Expiration Date: 092225
Recommended Storage: Refrigerate (4 ºC)
Nominal Concentration (µg/mL): 1000
NIST Test ID#: 23060

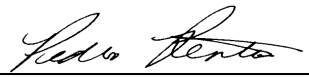
Solvent(s): Methylene chloride **Lot#** 102669

I009060

5E-05 Balance Uncertainty

Volume(s) shown below were combined and diluted to (mL): 20.0 0.003 Flask Uncertainty

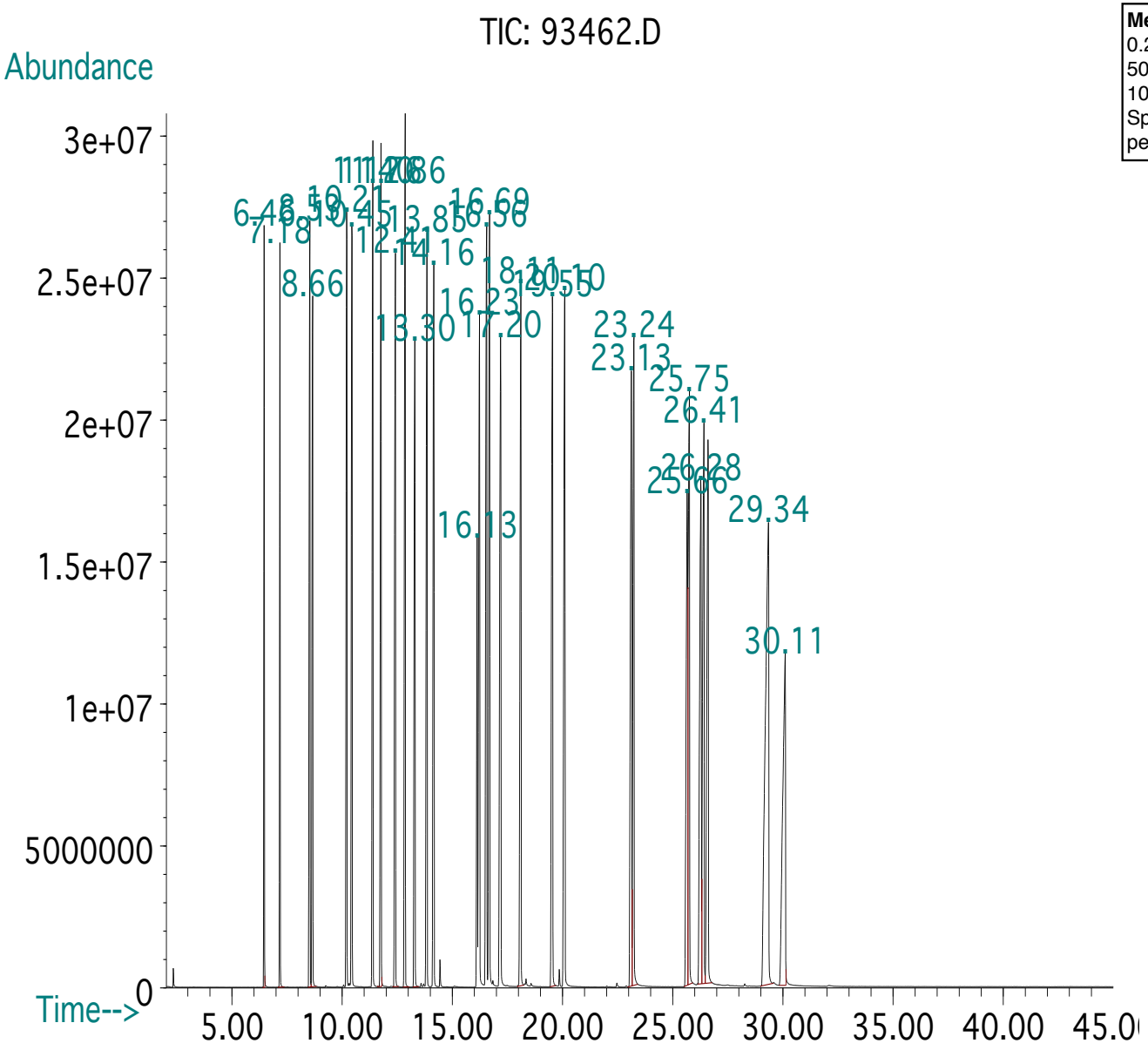
092220
Formulated By: Benson Chan DATE



092220
Reviewed By: Pedro L. Rentas DATE

	Compound	Part Number	Lot Number	Dil. Factor	Initial Vol. (mL)	Uncertainty Pipette (mL)	Initial Conc.(ug/mL)	Final Conc.(ug/mL)	Expanded Uncertainty (+/-) (µg/mL)	SDS Information (Solvent Safety Info. On Attached pg.) CAS#	OSHA PEL (TWA)	LD50
1.	Acenaphthene	10007	060118	0.50	10.00	0.042	2000.1	999.5	9.3	83-32-9	N/A	ipr-rat 600mg/kg
2.	Acenaphthylene	10007	060118	0.50	10.00	0.042	2000.2	999.5	9.4	208-96-8	N/A	N/A
3.	Anthracene	10007	060118	0.50	10.00	0.042	2000.3	999.5	9.3	120-12-7	0.2mg/m3 (8H)	ipr-mus 430mg/kg
4.	Benzo(a)anthracene	10007	060118	0.50	10.00	0.042	2000.9	999.9	9.4	56-55-3	N/A	N/A
5.	Benzo(a)pyrene	10007	060118	0.50	10.00	0.042	2000.3	999.6	9.3	50-32-8	0.2mg/m3 (8H)	scu-rat 50mg/kg
6.	Benzo(b)fluoranthene	10007	060118	0.50	10.00	0.042	2000.7	999.8	9.4	205-99-2	N/A	N/A
7.	Benzo(k)fluoranthene	10007	060118	0.50	10.00	0.042	2000.6	999.7	9.4	207-08-9	N/A	N/A
8.	Benzo(g,h,i)perylene	10007	060118	0.50	10.00	0.042	2000.4	999.6	9.3	191-24-2	N/A	N/A
9.	Carbazole	10007	060118	0.50	10.00	0.042	2000.7	999.7	9.4	86-74-8	N/A	ipr-mus 200mg/kg
10.	Chrysene	10007	060118	0.50	10.00	0.042	2000.4	999.6	9.4	218-01-9	0.2mg/m3	N/A
11.	Dibenzo(a,h)anthracene	10007	060118	0.50	10.00	0.042	2000.5	999.7	9.4	53-70-3	0.2mg/m3	N/A
12.	Fluoranthene	10007	060118	0.50	10.00	0.042	2000.5	999.6	9.4	206-44-0	N/A	orl-rat 2000mg/kg
13.	Fluorene	10007	060118	0.50	10.00	0.042	2000.4	999.6	9.4	86-73-7	N/A	ipr-mus 2 g/kg
14.	Indeno(1,2,3-cd)pyrene	10007	060118	0.50	10.00	0.042	2000.3	999.5	9.4	193-39-5	N/A	N/A
15.	Naphthalene	10007	060118	0.50	10.00	0.042	2000.8	999.8	9.4	91-20-3	10 ppm (50mg/m3/8H)	orl-rat 490mg/kg
16.	Phenanthrene	10007	060118	0.50	10.00	0.042	2000.8	999.8	9.4	85-01-8	0.2mg/m3/8H	orl-mus 700mg/kg
17.	Pyrene	10007	060118	0.50	10.00	0.042	2000.0	999.4	9.4	129-00-0	0.2mg/m3/8H	orl-rat 2700mg/kg
18.	Benzo(e)pyrene	94851	021119	0.50	10.00	0.042	2001.6	1000.2	9.4	192-97-2	N/A	N/A
19.	Biphenyl	94851	021119	0.50	10.00	0.042	2003.6	1001.2	9.4	92-52-4	0.2 ppm(1mg/m3/8H)	orl-rat 2400mg/kg
20.	Decalin (49% cis, 51% trans)	94851	021119	0.50	10.00	0.042	2004.1	1001.4	9.4	91-17-8	N/A	N/A
21.	Dibenzofuran	94851	021119	0.50	10.00	0.042	2000.9	999.9	9.4	132-64-9	N/A	N/A
22.	Dibenzothiophene	94851	021119	0.50	10.00	0.042	2002.7	1000.7	9.4	132-65-0	N/A	orl-mus 470 mg/kg
23.	2,6-Dimethylnaphthalene	94851	021119	0.50	10.00	0.042	2000.7	999.8	9.4	581-42-0	N/A	N/A
24.	1-Methylnaphthalene	94851	021119	0.50	10.00	0.042	2001.0	999.9	9.4	90-12-0	N/A	orl-rat 1840mg/kg
25.	2-Methylnaphthalene	94851	021119	0.50	10.00	0.042	2001.6	1000.2	9.4	91-57-6	N/A	orl-rat 1630mg/kg
26.	1-Methylphenanthrene	94851	021119	0.50	10.00	0.042	2003.3	1001.1	13.2	832-69-9	N/A	N/A
27.	Pentachlorophenol	94851	021119	0.50	10.00	0.042	2003.0	1000.9	9.4	87-86-5	0.5mg/m3/8H (skin)	orl-rat 27mg/kg
28.	Perylene	94851	021119	0.50	10.00	0.042	2003.3	1001.0	9.4	198-55-0	N/A	N/A
29.	Thianaphthene	94851	021119	0.50	10.00	0.042	2000.3	999.6	9.4	95-15-8	N/A	N/A
30.	2,3,5-Trimethylnaphthalene	94851	021119	0.50	10.00	0.042	2003.3	1001.0	9.5	2245-38-7	N/A	N/A

- **The certified value is the concentration calculated from gravimetric and volumetric measurements unless otherwise stated.**
- **Standards are prepared gravimetrically using balances that are calibrated with weights traceable to NIST (see above).**
- **Standards are certifed (+/-) 0.5% of the stated value, unless otherwise stated.**
- **All Standards, after opening ampule, should be stored with caps tight and under appropriate laboratory conditions.**
- **Uncertainty Reference: Taylor, B.N. and Kuyat, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Result," NIST Technical Note 1297, U.S. Government Printing Office, Washington, DC, (1994).**



Method GC8MSD-2Long: Column:SPB-5 (30m X 0.25mm ID X 0.25μm film thickness) Temp 1 = 50°C (1min.), Temp 2 = 300°C (14min.), Rate = 10°C/min., Injector B= 250°C, Detector B = 275°C, Split Ratio = 100:1, Scan Rate = 2. Analysis performed by: Gina McLane.

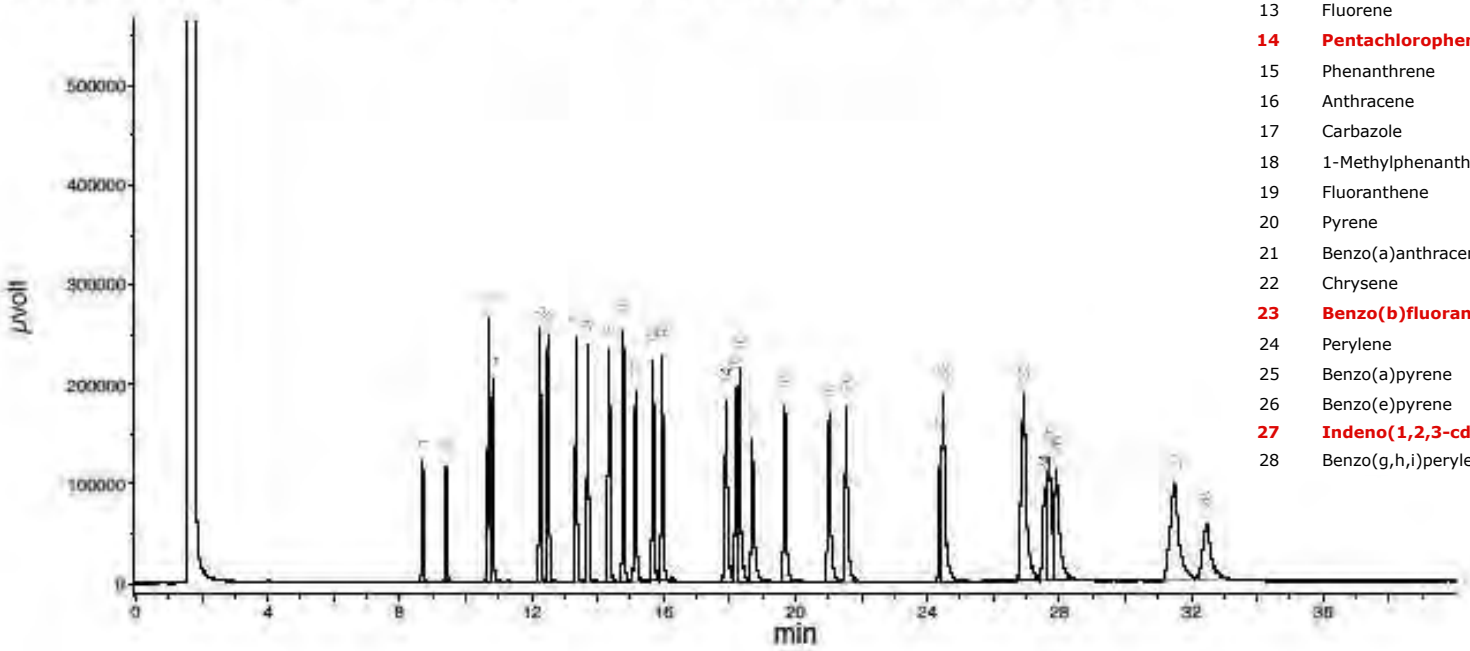
Retention Time (min.)	
Decahydronaphthalene (Decalin) (isomer)	6.46
Decahydronaphthalene (Decalin) (isomer)	7.18
Naphthalene	8.53
Thianaphthene	8.66
2-Methylnaphthalene	10.21
1-Methylnaphthalene	10.45
Biphenyl	11.4
2,6-Dimethylnaphthalene	11.76
Acenaphthylene	12.41
Acenaphthene	12.86
Dibenzofuran	13.3
2,3,5-Trimethylnaphthalene	13.85
Fluorene	14.16
Pentachlorophenol	16.13
Dibenzothiophene	16.23
Phenanthrene	16.56
Anthracene	16.69
Carbazole	17.2
1-Methylphenanthrene	18.11
Fluoranthene	19.55
Pyrene	20.1
Benzo(a)anthracene	23.13
Chrysene	23.24
Benzo(b)fluoranthene	25.66
Benzo(k)fluoranthene	25.75
Perylene	26.28
Benzo(a)pyrene	26.41
Benzo(e)pyrene	26.61
Indeno(1,2,3-cd)pyrene	29.34
Dibenzo(a,h)anthracene	29.34
Benzo(g,h,i)perylene	30.11

Run 37, "P93462 L092220 [1000µg/mL in MeCl2]"

Run Length: 40.00 min, 23999 points at 10 points/second.
Created: Thu, Sep 24, 2020 at 7:13:32 AM.
Sampled: Sequence "092120-GC9M2", Method "GC9-M2".
Analyzed using Method "GC9-M2".

Comments

GC9-M2 Analysis by Melissa Stonier
Column ID SPB-5 30 meter x 0.53mm x 1.5um Film Thickness.
Flow rates; Total Flow = 300 ml/min, Helium (carrier) = 6.5 mL, Helium (make-up) = 25 mL.
Hydrogen (detector) = 30 mL, Air (detector) =360 mLOven Temp 1 = 50°C (1 min).
Rate = 10°C/min, Oven Temp 2 = 300°C (14 min), Total Run Time = 40 Minutes. Injector Temp = 250°C.
FID Temp = 300°C, FID Signal = eDaq Channel 1.
Gas Chromatograph = HP 5890, Auto Sampler = HP 7673, Standard Injection = 0.5 uL, Range = 3



Peak No.	Name	FID RT (min.)
1	Decahydronaphthalene (Decalin) (isomer)	8.71
2	Decahydronaphthalene (Decalin) (isomer)	9.41
3	Naphthalene	10.69
4	Thianaphthene	10.82
5	2-Methylnaphthalene	12.25
6	1-Methylnaphthalene	12.50
7	Biphenyl	13.35
8	2,6-Dimethylnaphthalene	13.71
9	Acenaphthylene	14.35
10	Acenaphthene	14.78
11	Dibenzofuran	15.15
12	2,3,5-Trimethylnaphthalene	15.69
13	Fluorene	15.96
14	**Pentachlorophenol/Dibenzothiophene**	**17.91**
15	Phenanthrene	18.20
16	Anthracene	18.30
17	Carbazole	18.70
18	1-Methylphenanthrene	19.68
19	Fluoranthene	21.02
20	Pyrene	21.54
21	Benzo(a)anthracene	24.39
22	Chrysene	24.48
23	**Benzo(b)fluoranthene/Benzo(k)fluoranthene**	**26.92**
24	Perylene	27.56
25	Benzo(a)pyrene	27.68
26	Benzo(e)pyrene	27.91
27	**Indeno(1,2,3-cd)pyrene/Dibenzo(a,h)anthracene**	**31.49**
28	Benzo(g,h,i)perylene	32.47

Absolute Standards, Inc.
800-368-1131
www.absolutestandards.com

Certified Reference Material CRM

ANAB ISO 17034 Accredited
AR-1539 Certificate Number
https://Absolutestandards.com

CERTIFIED WEIGHT REPORT

Part Number:	70476	**Solvent(s):**	**Lot#**
Lot Number:	092220	Methylene chloride	104929
Description:	Benzo(j)fluoranthene		
Expiration Date:	092225		
Recommended Storage:	Refrigerate (4 °C)		
Nominal Concentration (µg/mL):	1000		
NIST Test ID#:	23060	5E-05	Balance Uncertainty
Weight(s) shown below were combined and diluted to (mL):	25.0	0.001	Flask Uncertainty

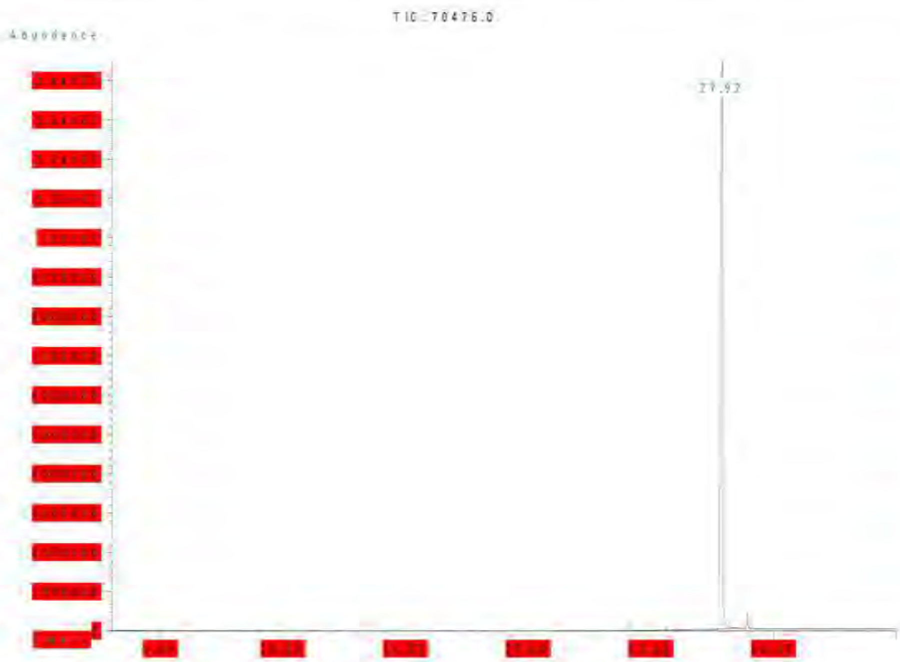
I009061
Brnzo(j)fl o ! nt" r nr Ǒkkk #ř$ L
Solvr ntǑǑot:Ǒ9222k
Ƈ r Y:Ǒkř3ř2k2kǑǑǑS
¯KY:Ǒř22ř2k2w
Lo% t&n:Ǒ

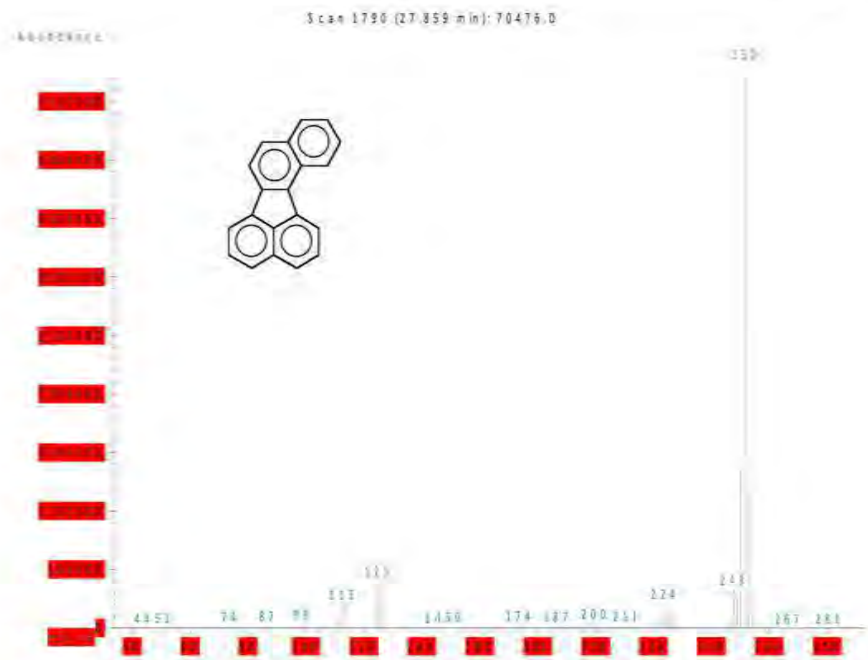
Formulated By:	Benson Chan	092220 DATE
Reviewed By:	Pedro L. Rentas	092220 DATE

Compound	RM#	Lot Number	Nominal Conc (µg/mL)	Purity (%)	Uncertainty Purity	Target Weight(g)	Actual Weight(g)	Actual Conc (µg/mL)	Expanded Uncertainty (+/-) (µg/mL)	CAS#	OSHA PEL (TWA)	LD50
1. Benzo(j)fluoranthene	476	3-CSZ-153-20	1000	98.1	0.2	0.02547	0.02552	1001.8	5.7	205-82-3	0.2mg/m3	N/A

SDS Information (Solvent Safety Info. On Attached pg.)

Method GC8MSD1M: Column:SBB-5 (30m X 0.25mm ID X 0.25µm film thickness) Temp 1 = 50°C (1min.), Temp 2 = 300°C (9 min.), Rate = 10°C/min., Injector B= 200°C, Detector B = 290°C, Split Ratio = 100:1, Scan Rate = 2. Analysis performed by Candice Warren.





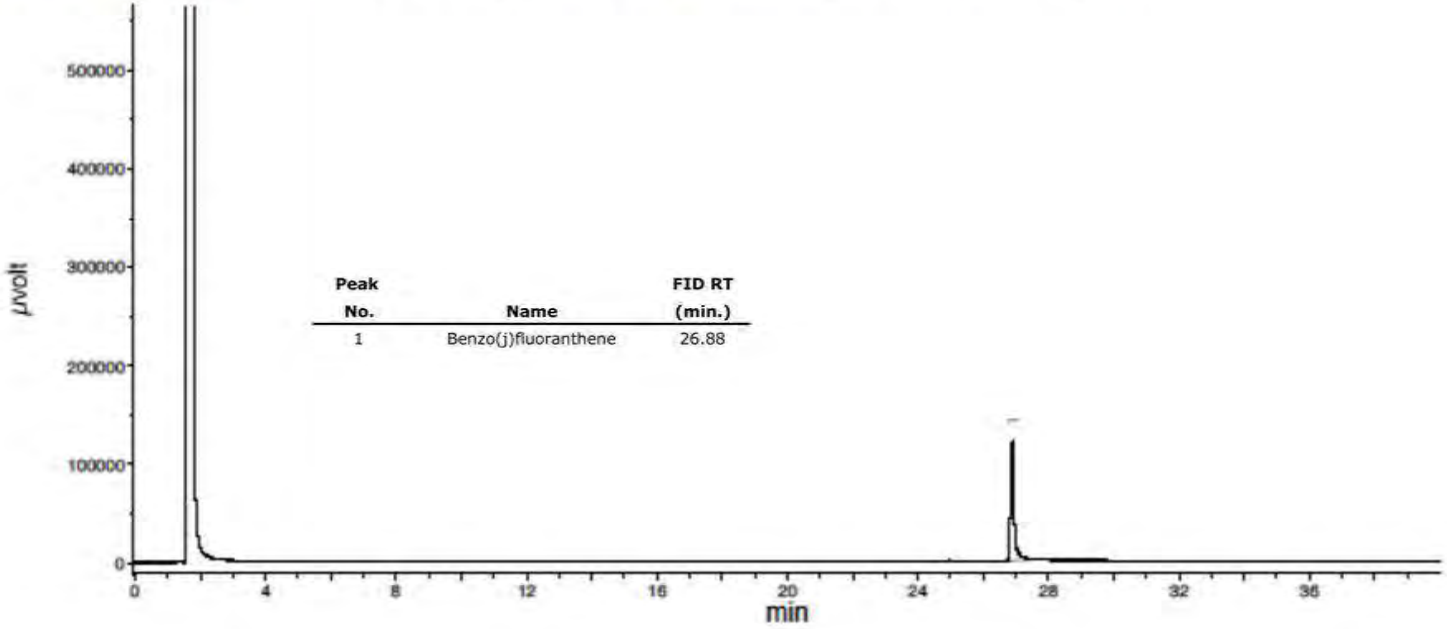
- The certified value is the concentration calculated from gravimetric and volumetric measurements unless otherwise stated.
- Standards are prepared gravimetrically using balances that are calibrated with weights traceable to NIST (see above).
- Standards are certifed (+/-) 0.5% of the stated value, unless otherwise stated.
- All Standards, after opening ampule, should be stored with caps tight and under appropriate laboratory conditions.
- Uncertainty Reference: Taylor, B.N. and Kuyat, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Result," NIST Technical Note 1297, U.S. Government Printing Office, Washington, DC, (1994).

Run 31, "P70476 L092220 [1000µg/mL in MeCl2]"

Run Length: 40.00 min, 23999 points at 10 points/second.
Created: Thu, Sep 24, 2020 at 2:33:43 AM.
Sampled: Sequence "092120-GC9M2", Method "GC9-M2".
Analyzed using Method "GC9-M2".

Comments

GC9-M2 Analysis by Melissa Stonier
Column ID SPB-5 30 meter x 0.53mm x 1.5um Film Thickness.
Flow rates; Total Flow = 300 ml/min, Helium (carrier) = 6.5 mL, Helium (make-up) = 25 mL.
Hydrogen (detector) = 30 mL, Air (detector) =360 mLOven Temp 1 = 50°C (1 min).
Rate = 10°C/min, Oven Temp 2 = 300°C (14 min), Total Run Time = 40 Minutes. Injector Temp = 250°C.
FID Temp = 300°C, FID Signal = eDaq Channel 1.
Gas Chromatograph = HP 5890, Auto Sampler = HP 7673, Standard Injection = 0.5 uL, Range = 3



Peak No.	Name	FID RT (min.)
1	Benzo(j)fluoranthene	26.88

Certificate of Analysis

TCL HAZARDOUS SUBSTANCES MIX
2,1X1ML,2000UG/ML,DICHLOROMETHA

Certified Reference Material

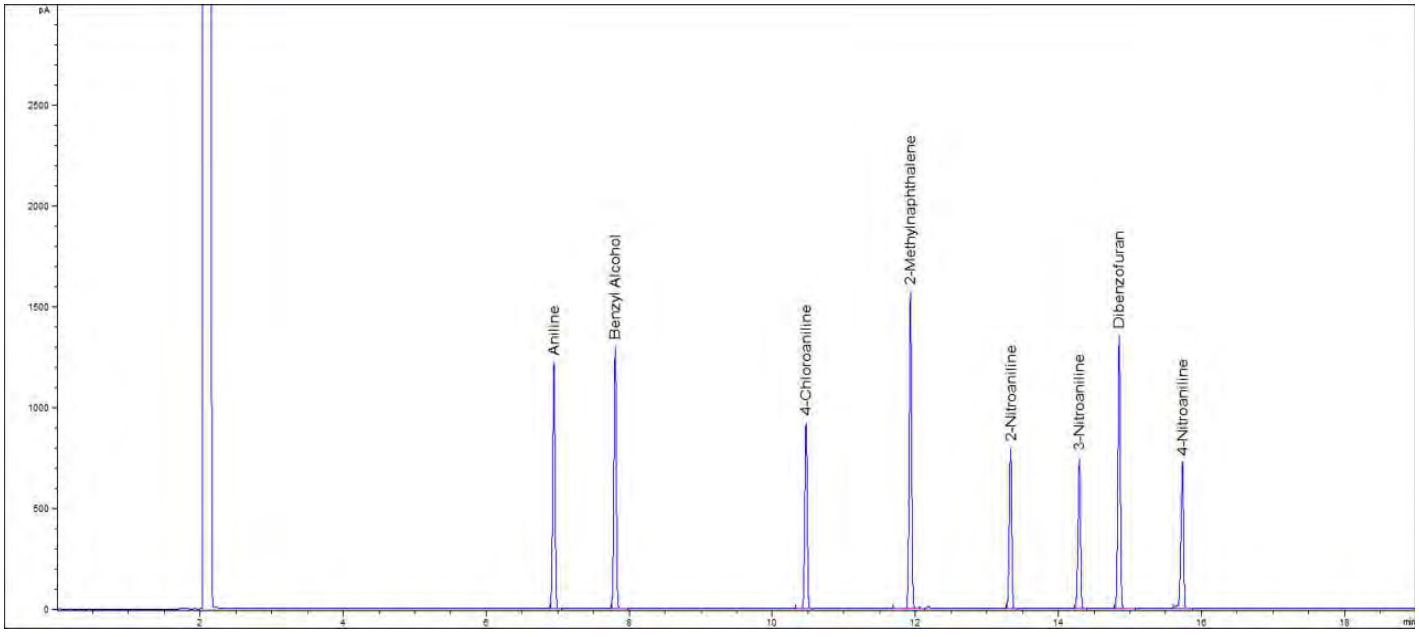
Description

Product ID 48908
Lot **LRAC2138**
Expiration Date February 2022
Manufacturing Date March 2019
Storage Conditions Refrigerate
Solvent/Matrix Dichloromethane/Benzene 80:20

I009199
toxic sub mix#2
Expires 2/28/2022
Prepared By Van Spohn 10/6/2020

Certified Values

Analyte	*Units*	*Certified Value* [1,4]	*Raw Material Purity,%*	*Analytical Value*	*Elution order*	*Raw Material Lot*	*CAS*
ANILINE	µg/mL	2008 ± 89	99.9%	1990	1	LA41596	62-53-3
BENZYL ALCOHOL	µg/mL	2008 ± 87	98.2%	2020	2	LC07608	100-51-6
4-CHLOROANILINE	µg/mL	2008 ± 84	99.5%	1990	3	P500200	106-47-8
2-METHYLNAPHTHALENE	µg/mL	2008 ± 87	98.2%	2005	4	LB97828	91-57-6
2-NITROANILINE	µg/mL	2008 ± 82	99.9%	2021	5	07411KN	88-74-4
3-NITROANILINE	µg/mL	2008 ± 86	100%	2009	6	MKBX1283V	99-09-2
DIBENZOFURAN	µg/mL	2008 ± 80	98.8%	1988	7	LB78814	132-64-9
4-NITROANILINE	µg/mL	2008 ± 91	99.9%	2025	8	LC11400	100-01-6



Additional Information:
Analytical Method Parameters:

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER
ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

SIGMA-ALDRICH
2931 Soldier Springs Rd. Laramie, Wyoming 82070 USA
307-742-5452
rtctechgroup@sial.com www.sigma-aldrich.com

Description

Lot **LRAC2138**
Expiration Date February 2022
Manufacturing Date March 2019
Storage Conditions Refrigerate
Solvent/Matrix Dichloromethane/Benzene 80:20

Column: SPB-5, 30 m x 0.53 mm x 1.5 µm df
80°C (2 min) to 250°C at 10°C/min
Detector: FID, 300°C
Injection Volume: 1 µL

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1 **Metrological traceability:** Traceable to the SI and higher order standards from NIST through an unbroken chain of comparisons. The balance used to weigh raw materials is accurate to +/-0.0001 g and calibrated regularly using mass standards traceable to NIST. All dilutions were performed gravimetrically. Additionally, individual analytes are traceable to NIST SRMs where available and specified above.
4 Ucrm - Uncertainty values in this document are expressed as Expanded Uncertainty (Ucrm) corresponding to the 95% confidence interval. Ucrm is derived from the combined standard uncertainty multiplied by the coverage factor k, which is obtained from a *t*-distribution and degrees of freedom. The components of combined standard uncertainty include the uncertainties due to characterization, homogeneity, long term stability, and short term stability (transport). The components due to stability are generally considered to be negligible unless otherwise indicated by stability studies. The mathematical representation of the Ucrm calculation is as follows:

$$u_{CRM} = \sqrt{u_{char}^2 + u_{\text{hom}\ ogeneity}^2 + u_{stability}^2}$$

***k*:** Coverage factor derived from a t-distribution table, based on the degrees of freedom of the data set. Assume 2.0 for a **Confidence interval = 95%**

Traceability: The standard was manufactured under an ISO/IEC 17025:2017 certified quality system. The balance used to weigh raw materials is accurate to +/- 0.0001g and calibrated regularly using mass standards traceable to NIST. All dilutions were preformed gravimetrically. Additionally, individual analytes are traceable to NIST SRMs where available and specified above.

Homogeneity: Homogeneity was assessed in accordance with ISO 17034:2016. Completed units were sampled using a random stratified sampling protocol. The results of chemical analysis were then compared using a one-way analysis of variance approach as described by TNI EL-V3-2009 Appendix A.2. See Instructions for minimum sub-sample size.

Expiration is at end of month given on certificate and label.

THIS PRODUCT WAS DESIGNED, PRODUCED AND VERIFIED FOR ACCURACY AND STABILITY IN ACCORDANCE WITH **ISO/IEC 17025:2017 (ANAB Cert AT-1467)** and **ISO 17034:2016 (ANAB Cert AR-1470).**

MSDS reports for components comprising greater than 1.0% of the solution or 0.1% for components known to be carcinogens are available upon request.

Andy Ommen - QC Manager

Mark Pooler - QA Supervisor

Certification Date March 25, 2019
Version 0-3252019

Certificate of Composition

12 Comp. at Varied Concentrations in Dichloromethane

ANALYTICAL STANDARD

Product ID 22523051
Lot **LRAC8251**
Expiration Date October 2022
Storage Conditions Refrigerate
Solvent/Matrix Dichloromethane

I010140
SVOA-ABN BASE STOCK-200-800ug/ml
Expires 10/31/2022
Prepared By Joshua Rains 10/29/2020

Analyte	*Assigned Value* [1]	*Units*	*Raw Material Purity,%*	*Raw Material Lot*	*CAS*
3,3'-DICHLOROBENZIDINE	800 ± 24.0	µg/mL	99.9	LC27068	91-94-1
2,4-DINITROTOLUENE	798 ± 23.9	µg/mL	98.9	12316HF	121-14-2
2,6-DINITROTOLUENE	800 ± 24.0	µg/mL	99.9	LB79891	606-20-2
HEXACHLOROCYCLOPENTADIENE	804 ± 24.1	µg/mL	96.0	LB95525	77-47-4
N-NITROSODIMETHYLAMINE	804 ± 24.1	µg/mL	99.5	9815100	62-75-9
PERYLENE	201 ± 6.04	µg/mL	99.6	04101PG	198-55-0
ANILINE	804 ± 24.1	µg/mL	100.0	10126MG	62-53-3
4-CHLOROANILINE	800 ± 24.0	µg/mL	100.0	MKBZ6909V	106-47-8
2-NITROANILINE	801 ± 24.0	µg/mL	99.9	LC05068	88-74-4
3-NITROANILINE	799 ± 24.0	µg/mL	99.9	LC09264	99-09-2
4-NITROANILINE	800 ± 24.0	µg/mL	99.9	LC11400	100-01-6
PYRIDINE (LOW WATER)	816 ± 24.5	µg/mL	100.0	SHBJ4964	110-86-1

Additional Information

1 Assigned value - the gravimetrically prepared value. Uncertainty is based on gravimetric preparation.

Traceability: The standard was manufactured under an ISO/IEC 17025:2017 certified quality system. The balance used to weigh raw materials is accurate to +/- 0.0001g and calibrated regularly using mass standards traceable to NIST. All dilutions were preformed gravimetrically.

MSDS reports for components comprising greater than 1.0% of the solution or 0.1% for components known to be carcinogens are available upon request.

Robert O'Brien - Program Manager

Mark Pooler - QA Supervisor

Certification Date October 12, 2020
Version -10122020

MilliporeSigma
2931 Soldier Springs Rd. Laramie, Wyoming 82070 USA
800-325-3010
www.sigma-aldrich.com

Reference Materials Producer
Cert #2495.01

Certificate of Analysis

Chemical Testing
Cert #2495.02

Catalog Number: ECS-A-030 **Lot No.** GS200603005

Description: Base/Neutrals Mix 1

Matrix: Methylene Chloride

Manufactured Date: 6-3-2020

Expiration Date: 6-3-2023

This **SPEXOrganics**® Certified Reference Material, CRM, is intended primarily for use as a calibration standard or quality control standard for organic chromatography instrumentation such as GC, GC-MS, LC, and LC-MS. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Compounds:

Compound	CAS #	Labeled	Purity	Certified†	Uncertainty
1,2,4-Trichlorobenzene	120-82-1	2000 µg/mL	99%	2012 µg/mL	± 50 µg/mL
1,2-Dichlorobenzene	95-50-1	2000 µg/mL	99%	2003 µg/mL	± 50 µg/mL
1,4-Dichlorobenzene	106-46-7	2000 µg/mL	99%	1994 µg/mL	± 50 µg/mL
2,4-Dinitrotoluene	121-14-2	2000 µg/mL	97%	2012 µg/mL	± 50 µg/mL
2,6-Dinitrotoluene	606-20-2	2000 µg/mL	99.6%	1984 µg/mL	± 50 µg/mL
2-Chloronaphthalene	91-58-7	2000 µg/mL	98%	1979 µg/mL	± 49 µg/mL
4-Bromodiphenyl ether	101-55-3	2000 µg/mL	99%	1979 µg/mL	± 49 µg/mL
4-Chlorophenyl-phenyl ether	7005-72-3	2000 µg/mL	98%	2012 µg/mL	± 50 µg/mL
Azobenzene	103-33-3	2000 µg/mL	98%	1977 µg/mL	± 49 µg/mL
Bis(2-chloro-1-methylethyl) ether	108-60-1	2000 µg/mL	98.9%	2004 µg/mL	± 50 µg/mL
bis(2-Chloroethoxy)methane	111-91-1	2000 µg/mL	97%	2011 µg/mL	± 50 µg/mL
bis(2-Chloroethyl)ether	111-44-4	2000 µg/mL	99%	2020 µg/mL	± 50 µg/mL
Butylbenzyl phthalate	85-68-7	2000 µg/mL	98%	2017 µg/mL	± 50 µg/mL
Carbazole	86-74-8	2000 µg/mL	95%	1977 µg/mL	± 49 µg/mL
Di-n-butyl phthalate	84-74-2	2000 µg/mL	99%	1972 µg/mL	± 49 µg/mL
Di-n-octyl phthalate	117-84-0	2000 µg/mL	98%	2014 µg/mL	± 50 µg/mL
Diethyl phthalate	84-66-2	2000 µg/mL	99.5%	1980 µg/mL	± 50 µg/mL
Dimethyl phthalate	131-11-3	2000 µg/mL	99%	2019 µg/mL	± 50 µg/mL
Hexachlorobutadiene	87-68-3	2000 µg/mL	97%	2040 µg/mL	± 51 µg/mL
Hexachloroethane	67-72-1	2000 µg/mL	99%	2038 µg/mL	± 51 µg/mL
N-Nitrosodi-n-propylamine	621-64-7	2000 µg/mL	98%	1985 µg/mL	± 50 µg/mL
N-Nitrosodimethylamine	62-75-9	2000 µg/mL	99.5%	1975 µg/mL	± 49 µg/mL
Nitrobenzene	98-95-3	2000 µg/mL	99%	1987 µg/mL	± 50 µg/mL
Pyridine	110-86-1	2000 µg/mL	99%	1984 µg/mL	± 50 µg/mL
1,3-Dichlorobenzene	541-73-1	2000 µg/mL	98%	2001 µg/mL	± 50 µg/mL
Bis(2-Ethylhexyl)phthalate	117-81-7	2000 µg/mL	99%	1990 µg/mL	± 50 µg/mL
Hexachlorobenzene	118-74-1	2000 µg/mL	99%	2035 µg/mL	± 51 µg/mL
Isophorone	78-59-1	2000 µg/mL	97%	1999 µg/mL	± 50 µg/mL
N-Nitrosodiphenylamine	86-30-6	2000 µg/mL	97%	2040 µg/mL	± 51 µg/mL
Hexachlorocyclopentadiene	77-47-4	2000 µg/mL	99.2%	2040 µg/mL	± 51 µg/mL

J005222

EPA 625 B/N MIX 1
Expires 6/3/2023
Prepared By Jianqing Zhou 5/18/2021

Certificate of Reference Material

Catalog Number: ECS-A-030 **Lot No.** GS200603005

Description: Base/Neutrals Mix 1

Matrix: Methylene Chloride

Manufactured Date: 6-3-2020

Expiration Date: 6-3-2023

Final Solution Verification:

Final solution integrity verified by Gas Chromatography/Mass Spectrometry. The mass spectrum of each compound was confirmed against the NIST mass spectral database.

† Certified concentration based on gravimetric weights and corrected for the purity of the compound(s) used to prepare the standard. Analytical balance calibration is verified daily with C1 weight set #23-190006 which is registered with Atlantic Scale, and traceable to NIST and NJ Division of Weights and Measures.

This CRM is guaranteed stable and accurate to within the uncertainty listed for the certified value. This includes uncertainty components due to preparation, homogeneity, short term and long term stability. During the stated period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution. For further information, contact the Sales Support Department at crmsales@spexcsp.com.

Date of Certification: 6-3-2020 Certifying Officer: Shannon Mora

Report of Certification

Catalog Number: ECS-A-030 **Lot No.** GS200603005

Description: Base/Neutrals Mix 1

Matrix: Methylene Chloride

Manufactured Date: 6-3-2020

Expiration Date: 6-3-2023

This Certified Reference Material (CRM) has been prepared and certified under an ISO 9001:2008, ISO 17025:2005, and ISO Guide 34:2009 Quality System consistent with the following standards:

- ISO 9001:2008: Quality management systems - Requirements - Certified by UL-DQS
- ISO 17025:2005: General Requirements for the Competence of Testing and Calibration Laboratories - Accredited by A2LA
- ISO Guide 34:2009: General Requirements for the Competence of Reference Material Producers - Accredited by A2LA
- ISO Guide 31:2000: Reference Materials - Contents of Certificates and Labels
- ISO Guide 35:2006: Reference Materials - General and statistical principals for certification
- Guide to the Expression of Uncertainty in Measurement 1997
- EURACHEM/CITAC Guide: Qualifying Uncertainty in Analytical Measurements - Second Edition
- ASTM Guide D6362-98
- NIST Technical Note 1297
- ILAC-G12-2000: Guidelines for the requirements for the competence of reference material producers
- ISO/REMCO N280

Storage Requirements:

To ensure the stability of the product once it arrives in your laboratory , please store this product in a refrigerator (2°C to 8°C). Note: Shipping conditions may differ from storage conditions. The EXPIRATION DATE is calculated from the MANUFACTURED DATE using our stability data and is applicable only if the product is unopened and stored under the prescribed conditions.

Instructions for Use:

Let material come to room temperature before use. Check for precipitate and if necessary sonicate for one minute. If compounds do not dissolve after one minute then sonicate further until the product is dissolved. A clear appearance is acceptable. The minimum recommended amount that should be removed from this vial is 5µL with a 25µL gas tight syringe. All solutions should be thoroughly mixed, by shaking, prior to use. All surfaces that come in contact with the solution must be thoroughly cleaned prior to use. Dilutions should be performed only with Class A volumetric glassware.

Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For assistance, please contact sales support at crmsales@spexcsp.com.

Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, and analytical instrumentation have been qualified prior to use. The highest purity solvents and Class A / calibrated volumetrics have been been used in all preparations.

Homogeneity:

The homogeneity of this CRM has been confirmed by procedures consistent with ISO 17025:2005, ISO Guide 34:2009, and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed to prove homogeneity in accordance with our internal procedure 4300-HOMOGEN-1A. This is consistent with the intended use of this CRM. The Degree of Homogeneity, as expressed as maximum between-bottle variation, is 1.2%

Statistical Estimator and Confidence Limits:

The Certified value 'X' as listed on the reverse of this document is at the 95% level of confidence and can be expressed as:

- $X = x \pm U$ where X=certified value, U=expanded uncertainty, x=property value
- $U = ku_c$ where k=2 is the coverage factor at the 95% confidence level
- u_c = combined standard uncertainty obtained by combining the individual compound standard uncertainty components u_i, where $u_c = \sqrt{\sum u_i^2}$

Legal Notice:

SPEX CertiPrep Certified Reference Materials are not for any cosmetic, drug, or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep of any kind whatsoever, whether based on breech of warranty, alleged negligence, or otherwise, with respect to this Reference Material shall be greater than the purchase price. In no event shall SPEX CertiPrep be liable for any loss of profits or any incidental, special, or consequential damages.

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Accredited to 17025 & Guide 34 ISO Certified to 9001

Certificate of Analysis

Phenova Certified Reference Materials are sold by Phenomenex.
411 Madrid Ave., Torrance, CA 90501 USA ▪ Tel: 310-212-0555 ▪ Fax: 310-328-7768 ▪ info@phenomenex.com
Access your MSDS and digital C of A at **www.phenomenex.com/mysupport. Re-order at www.phenomenex.com/standards**

Certified Reference Material

This product is included in Phenova's ISO/IEC 17025 and ISO Guide 34 Scopes of Accreditation

Catalog No.: AL0-101291
Description: GC/MS Tuning Mix
Storage: 4 °C
Provided As: 1 mL in 2 mL Ampoule in Methylene chloride

Lot Number: CL10999
Certification Date: May 9, 2014
Expiration Date: December 31, 2023
Revision Date: June 19, 2015

Andrea L Gill

Andrea Gill, Certified Reference Materials Manager

Component	CAS #	Certified Value µg/mL	Expanded Uncertainty (%)
Benzidine	92-87-5	1000	± 4.575%
Decafluorotriphenylphosphine (DFTPP)	5074-71-5	1000	± 2.420%
4,4'-DDT	50-29-3	1000	± 2.772%
Pentachlorophenol	87-86-5	1000	± 2.616%

J006111
GC/MS Tune solution-1000ug/ml
Expires 12/31/2023
Prepared By Van Spohn 6/9/2021

ACCREDITED
Reference Material Producer
Certificate No. 2427.02

phenova® Certified Reference Materials
Manufactured by Phenova, Inc.
Phenova's testing and calibration results are internationally recognized through the ILAC MRA. Phenova is an accredited ISO Guide 34 Reference Material Provider and ISO/IEC 17025 accredited Chemical Testing Laboratory.

ilac-MRA ACCREDITED
Chemical Testing Laboratory
Certificate No. 2427.03

IL11110613_us

Certificate of Analysis

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Access your MSDS and digital C of A at **www.phenomenex.com/mysupport. Re-order at www.phenomenex.com/standards**

1. Quality Document: This Certificate of Analysis has been created in accordance with ISO Guide 31[1] and ISO Guide 35.[2]

2. Quality Standards: Phenova is accredited by A2LA to ISO Guide 34[3] and ISO/IEC 17025[4] as a producer of Certified Reference Materials and Reference Materials. This ensures that our manufacturing processes have been accredited to and meet strict international standards.

3. Intended Use: The product is manufactured for use in the calibration and calibration verification of chromatographic instrumentation performed in routine laboratory analysis.

4. Instruction: Visually inspect the solution inside the ampoule for any un-dissolved material. If particulate is visible, sonicate the unopened ampoule until material is fully dissolved. Dilute as required, use only class A glassware and diluents compatible with all certified analytes in the mixture.

5. Hazardous Situation: The product is intended for use by experienced professional personnel. A Material Safety Data Sheet (MSDS) is available at www.phenomenex.com/mysupport.

6. Level of Homogeneity: The product has been certified to guarantee the certified values and their uncertainties at a volume of 2 µL.

7. Certified Value: Certified Value is based upon gravimetric and volumetric preparation using calibrated balances and Class A glassware.

8. Raw Materials and Purity: Phenova reference standard products are prepared from the highest quality starting materials. The purity of this material was verified using an ISO/IEC Guide 17025 methodology.

9. Expanded Uncertainty: The expanded uncertainty (uCRM) as stated is determined in accordance with ISO/IEC Guide 98[5] and ISO Guide 35 incorporating Type A standard uncertainty at a 95% confidence level. The uncertainty contains elements of manufacturing (uM), homogeneity analysis (uH) and long-term stability testing (uLTS). The uncertainty is calculated based on the root-sum-of-squares equation times a coverage factor (k=2).

   $$uCRM = k\sqrt{uM^2 + uH^2 + uLTS^2}$$

   Transport conditions (short-term stability) have been tested such that there is no contribution to the uncertainty reported. The expanded uncertainty applies to the product as received.

10. Metrological Traceability: The property value (certified value and its uncertainty) are traceable through an unbroken chain of calibration to the SI base unit kg through a NIST traceable weight in accordance with ISO Guide 34. This is achieved through calibration of balances, verification of weights, use of national methodology for glassware calibration and product homogeneity and stability testing utilizing an ISO/IEC Guide 17025 methodology.

11. Values Obtained During Product Testing: This product is subjected to verification, homogeneity and stability testing using an ISO/IEC Guide 17025 chromatographic methodology. All values obtained during testing meet criteria in accordance with ISO Guide 34.

12. Period of Validity: The Certified Values and their uncertainties are guaranteed until the expiration date. This product will be monitored during the period of validity and customers notified of any significant changes in stability.

References:

[1] ISO Guide 31:2000(E) – Reference Materials – Contents of Certificates and Labels.
[2] ISO Guide 35:2006(E) – Reference Material – General and Statistical Principles for Certification.
[3] ISO Guide 34:2009(E) – General Requirements for the Competence of Reference Material Producers.
[4] ISO/IEC Guide 17025:2005(E) – General Requirements for the Competence of Testing and Calibration Laboratories.
[5] ISO/IEC Guide 98-3:2008(E) – Uncertainty of Measurement – Part 3: Guide to Expression of Uncertainty in Measurement (GUM: 1995)

Agilent

Certificate of Analysis

Product Name: PAH Standard

Product Number: US-106N-1

Lot Issue Date: 11-Jun-2020

Lot Number: 0006540449

Expiration Date: 30-Jun-2023

Description:

This analytical reference material (RM) was manufactured and verified in accordance with an ISO 9001 registered quality system, and analyte concentrations were verified by an ISO 17025 accredited laboratory. The concentration and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below.

Analyte	CAS#	Analyte Lot	Concentration ± Uncertainty
acenaphthene	000083-32-9	RM10879	2008 ± 10 µg/mL
acenaphthylene	000208-96-8	RM10891	2003 ± 10 µg/mL
anthracene	000120-12-7	RM14212	2006 ± 10 µg/mL
benz[a]anthracene	000056-55-3	RM16072	2006 ± 10 µg/mL
benzo[b]fluoranthene	000205-99-2	RM14571	2005 ± 10 µg/mL
benzo[k]fluoranthene	000207-08-9	RM14321	2009 ± 10 µg/mL
benzo[ghi]perylene	000191-24-2	RM15761	2008 ± 10 µg/mL
benzo[a]pyrene	000050-32-8	RM12669	2009 ± 10 µg/mL
chrysene	000218-01-9	RM12260	2009 ± 10 µg/mL
dibenz[a,h]anthracene	000053-70-3	RM06786	2009 ± 10 µg/mL
fluoranthene	000206-44-0	RM12277	2004 ± 10 µg/mL
fluorene	000086-73-7	RM09441	2009 ± 10 µg/mL
indeno[1,2,3-cd]pyrene	000193-39-5	RM14192	2009 ± 10 µg/mL
naphthalene	000091-20-3	NT00970	2008 ± 10 µg/mL
phenanthrene	000085-01-8	RM10495	2009 ± 10 µg/mL
pyrene	000129-00-0	RM03479	2008 ± 10 µg/mL

Matrix: methylene chloride/benzene (1:1)

J006136

SVOA CAHS T [illegible]

Solvent Lot: [illegible]654[illegible]449

[illegible]

[illegible]

Lo[illegible]n: [illegible]

ISO 17034 Cert No. AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026

www.agilent.com/quality/

ISO 17025 Cert No. AT-1937

Certificate of Analysis

Product Number: US-106N-1 **Lot Number:** 0006540449

Storage Conditions: Store at Room Temperature (15° to 30°C).

Traceability:
The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z540.3, ISO 9001, ISO 17025, and ISO 17034. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 1088.

Homogeneity:
This RM was unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:
This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods, and continuing calibration verification.

Instructions for Use:
Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening the container and should be processed without delay for the certified values to be valid within the stated uncertainties.

Hazards:
Refer to the Safety Data Sheet on www.agilent.com for information regarding this RM.

Expiration of Certification:
The certification of this RM is valid until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

Maintenance of Certification:
If substantive changes are noted that affect the certification before the expiration of this certificate, Agilent will notify the purchaser.

Sample lot approver:

Monica Bourgeois
QMS Representative

ISO 17034 Cert No.
AR-1936

RM was produced in accordance with TUV USA Inc registered ISO 9001 Quality Management System. Cert # 56 100 18560026

www.agilent.com/quality/

ISO 17025 Cert
No. AT-1937

250 Smith Street North Kingstown, Rhode Island 02852 www.agilent.com/quality

CERTIFIED WEIGHT REPORT

Part Number: 70476
Lot Number: 071521
Description: Benzo(j)fluoranthene

Expiration Date: 071526
Recommended Storage: Refrigerate (4 °C)
Nominal Concentration (µg/mL): 1000
NIST Test ID#: 6UTB

Solvent(s): **Lot#**
Methylene chloride 105345

Gabriel Helland		071521
Formulated By:	Gabriel Helland	DATE
Pedro Rentas		071521
Reviewed By:	Pedro L. Rentas	DATE

5E-05 Balance Uncertainty

Weight(s) shown below were combined and diluted to (mL): 10.0 0.001 Flask Uncertainty

Compound	RM#	Lot Number	Nominal Conc (µg/mL)	Purity (%)	Uncertainty Purity	Target Weight(g)	Actual Weight(g)	Actual Conc (µg/mL)	Expanded Uncertainty (+/-) (µg/mL)	SDS Information (Solvent Safety Info. On Attached pg.) CAS#	OSHA PEL (TWA)	LD50
1. Benzo(j)fluoranthene	476	0022011	1000	99.94	0.2	0.01003	0.01008	1005.4	10.8	205-82-3	0.2mg/m3	N/A

Method GC18MSD-2M: Column:SBB-5 (30m X 0.25mm ID X 0.25µm film thickness) Temp 1 = 50°C (1min.), Temp 2 = 300°C (14 min.), Rate = 10°C/min., Injector B= 250°C, Detector B = 290°C, Split Ratio = 100:1, Scan Rate = 2. Analysis performed by Melissa Stonier.

J7844

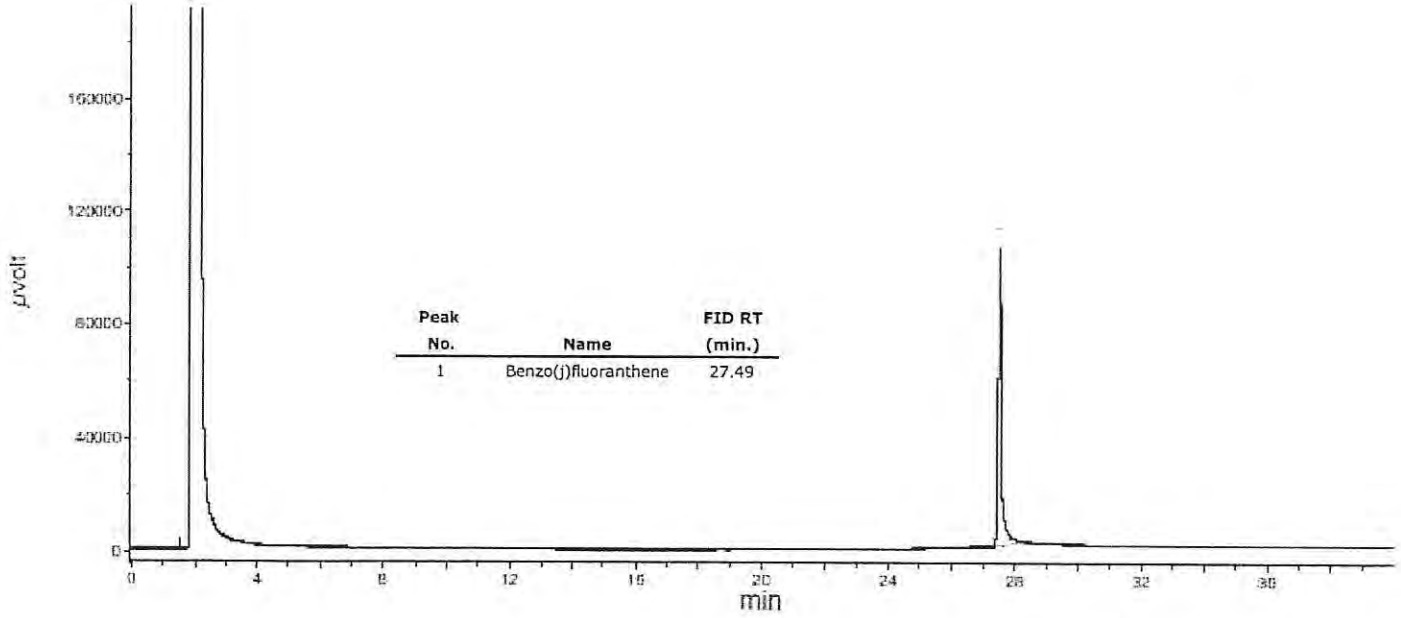
- The certified value is the concentration calculated from gravimetric and volumetric measurements unless otherwise stated.
- Standards are prepared gravimetrically using balances that are calibrated with weights traceable to NIST (see above).
- Standards are certifed (+/-) 0.5% of the stated value, unless otherwise stated.
- All Standards, after opening ampule, should be stored with caps tight and under appropriate laboratory conditions.
- Uncertainty Reference: Taylor, B.N. and Kuyat, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Result," NIST Technical Note 1297, U.S. Government Printing Office, Washington, DC, (1994).

Run 34, "P70476 L071521 [1000µg/mL in MeCl2]"

Run Length: 40.00 min, 23999 points at 10 points/second.
Created: Sat, Jul 17, 2021 at 5:24:13 PM.
Sampled: Sequence "071621-GC4M2", Method "GC4-M2".
Analyzed using Method "GC4-M2".

Comments

GC4-M2 Analysis by Melissa Stonier
Column ID SPB-5 L#60062-01A 30 meter x 0.53mm x 1.5um Film Thickness.
Flow rates; Total Flow = 300 ml/min, Helium (carrier) = 6.5 mL, Helium (make-up) = 25 mL.
Hydrogen (detector) = 30 mL, Air (detector) =360 mLOven Temp 1 = 50°C (1 min).
Rate = 10°C/min, Oven Temp 2 = 300°C (14 min), Total Run Time = 40 Minutes. Injector Temp = 250°C.
FID Temp = 300°C, FID Signal = eDaq Channel 1.
Gas Chromatograph = HP 5890, Auto Sampler = HP 7673, Standard Injection = 0.5 uL, Range =4



Peak No.	Name	FID RT (min.)
1	Benzo(j)fluoranthene	27.49

HSA-62-13-14

Form I

ORGANIC ANALYSIS DATA SHEET

NWTPH-Dx

TPH (Extractables) low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-03 A	SDG:	21I0042
Sampled:	08/31/21 11:00	Prepared:	09/13/21 10:05	File ID:	421I1418.D
% Solids:	75.23	Preparation:	EPA 3546 (Microwave)	Analyzed:	09/14/21 16:20
Batch:	BJI0334	Sequence:	SJI0201	Initial/Final:	10.01 g Wet / 10 mL
Instrument:	FID4	Column:	RTX-1	Calibration:	EI00027

CAS NO.	COMPOUND	DILUTION	CONC: (mg/kg dry)	Q	DL	RL
DRO	Diesel Range Organics (C12-C24)	5	9730	D	155	332
RRO	Motor Oil Range Organics (C24-C38)	5	2880	D	199	664

SURROGATES	ADDED: (mg/kg dry)	FOUND: (mg/kg dry)	% REC	QC LIMITS	Q
o-Terphenyl	14.939			50 - 150	D1

Analytical Resources, Incorporated
Analytical Chemists and Consultants

DUP-1-083121

Form I

ORGANIC ANALYSIS DATA SHEET

NWTPH-Dx

TPH (Extractables) low level

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-04 A	SDG:	21I0042
Sampled:	08/31/21 11:30	Prepared:	09/13/21 10:05	File ID:	421I1419.D
% Solids:	78.49	Preparation:	EPA 3546 (Microwave)	Analyzed:	09/14/21 16:41
Batch:	BJI0334	Sequence:	SJI0201	Initial/Final:	10 g Wet / 10 mL
Instrument:	FID4	Column:	RTX-1	Calibration:	EI00027

CAS NO.	COMPOUND	DILUTION	CONC: (mg/kg dry)	Q	DL	RL
DRO	Diesel Range Organics (C12-C24)	5	9850	D	149	319
RRO	Motor Oil Range Organics (C24-C38)	5	2770	D	190	637

SURROGATES	ADDED: (mg/kg dry)	FOUND: (mg/kg dry)	% REC	QC LIMITS	Q
o-Terphenyl	14.333			50 - 150	D1

PREPARATION BATCH SUMMARY

NWTPH-Dx

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Batch: BJI0334 Batch Matrix: Solid Preparation: EPA 3546 (Microwave)

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
HSA-62-13-14	21I0042-03	421I1418.D	09/13/21 10:05	Version
DUP-1-083121	21I0042-04	421I1419.D	09/13/21 10:05	Version
Blank	BJI0334-BLK1	421I1408.D	09/13/21 10:05	
LCS	BJI0334-BS1	421I1409.D	09/13/21 10:05	
LCS Dup	BJI0334-BSD1	421I1410.D	09/13/21 10:05	
DUP-1-083121	BJI0334-MS1	421I1420.D	09/13/21 10:05	
DUP-1-083121	BJI0334-MSD1	421I1421.D	09/13/21 10:05	

Form I

METHOD BLANK DATA SHEET

NWTPH-Dx

Blank

Laboratory:	Analytical Resources, Inc.			SDG:	21I0042
Client:	GeoEngineers			Project:	South State Street PRDI
Matrix:	Solid	Laboratory ID:	BJI0334-BLK1	File ID:	421I1408.D
Sampled:	N/A	Prepared:	09/13/21 10:05	Analyzed:	09/14/21 12:59
Solids:		Preparation:	EPA 3546 (Microwave)	Initial/Final:	10 g / 1 mL
Batch:	BJI0334	Sequence:	SJI0201	Calibration:	EI00027
Instrument:	FID4	Column:	RTX-1		

CAS NO.	COMPOUND	DILUTION	CONC: (mg/kg wet)	Q	DL	RL
DRO	Diesel Range Organics (C12-C24)	1	5.00	U	2.34	5.00
RRO	Motor Oil Range Organics (C24-C38)	1	10.0	U	2.99	10.0

SURROGATES	ADDED: (mg/kg wet)	FOUND: (mg/kg wet)	% REC	QC LIMITS	Q
o-Terphenyl	11.250	12.5	111	50 - 150	

LCS / LCS DUPLICATE RECOVERY

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/14/21 13:19
Batch:	BJI0334	Laboratory ID:	BJI0334-BS1
Preparation:	EPA 3546 (Microwave)	Sequence Name:	LCS
Initial/Final:	10 g / 1 mL		

COMPOUND	SPIKE ADDED (mg/kg wet)	LCS CONCENTRATION (mg/kg wet)	Q	LCS % REC. #	QC LIMITS REC.
Diesel Range Organics (C12-C24)	150	191		127	50 - 150

* Indicates values outside of QC limits

COMPOUND	SPIKE ADDED (mg/kg wet)	LCSD CONCENTRATION (mg/kg wet)	Q	LCSD % REC. #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Diesel Range Organics (C12-C24)	150	166		110	14.1	30	50 - 150

* Indicates values outside of QC limits

DUP-1-083121

MS / MS DUPLICATE RECOVERY
NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/14/21 17:01
Batch:	BJI0334	Laboratory ID:	BJI0334-MS1
Preparation:	EPA 3546 (Microwave)	Sequence Name:	Matrix Spike
Initial/Final:	10 g / 10 mL	Source Sample:	DUP-1-083121

COMPOUND	SPIKE ADDED (mg/kg dry)	SAMPLE CONCENTRATION (mg/kg dry)	Q	MS CONCENTRATION (mg/kg dry)	Q	MS % REC. #	QC LIMITS REC.
Diesel Range Organics (C12-C24)	191	9850	D	11500	*, D	870 *	50 - 150

* Values outside of QC limits

DUP-1-083121

MS / MS DUPLICATE RECOVERY
NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/14/21 17:21
Batch:	BJI0334	Laboratory ID:	BJI0334-MSD1
Preparation:	EPA 3546 (Microwave)	Sequence Name:	Matrix Spike Dup
Initial/Final:	10 g / 10 mL	Source Sample:	DUP-1-083121

COMPOUND	SPIKE ADDED (mg/kg dry)	MSD CONCENTRATION (mg/kg dry)	Q	MSD % REC. #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Diesel Range Organics (C12-C24)	191	16200	*, D, E	3330 *	33.9 *	30	50 - 150

* Values outside of QC limits

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	ED00037	Instrument:	FID4
Calibration Date:	04/13/2021	Column (1):	RTX-1

Comments: CTO 4/19/21 Added A/S Creosote Curve
CTO 4/21/21 Added A/S LAI Bunker C

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
		RF		RF		RF		RF		RF		RF
Diesel Range Organics (C12-C24)	50	185091.5	100	192889.4	250	190655.4	500	180854	1000	186039.7	2500	161458
o-Terphenyl	9	255700.8	18	256232.4	45	251136.4	90	247098.2	180	257460.6	450	226439.8

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	ED00037	Instrument:	FID4
Calibration Date:	04/13/2021	Column (1):	RTX-1

Comments: CTO 4/19/21 Added A/S Creosote Curve
CTO 4/21/21 Added A/S LAI Bunker C

Compound	Level 07		Level 08		Level 09		Level 10		Level 11		Level 12	
		RF		RF		RF		RF		RF		RF
Motor Oil Range Organics (C24-C38)	100	141072.4	250	134029.6	500	128843.9	1000	129766.7	2500	127391.3	5000	127540.4

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	ED00037	Instrument:	FID4
Calibration Date:	04/13/2021	Column (1):	RTX-1

Comments: CTO 4/19/21 Added A/S Creosote Curve
CTO 4/21/21 Added A/S LAI Bunker C

Compound	Level 13		Level 14		Level 15		Level 16		Level 17		Level 18	

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	ED00037	Instrument:	FID4
Calibration Date:	04/13/2021	Column (1):	RTX-1

Comments: CTO 4/19/21 Added A/S Creosote Curve
CTO 4/21/21 Added A/S LAI Bunker C

Compound	Level 19		Level 20		Level 21		Level 22		Level 23		Level 24	
		RF		RF		RF		RF		RF		RF
Creosote Range Organics (C12-C22)	100	43842.26	250	36736.52	500	36068.84	1000	42528.1	2500	36907.96	5000	38011.38

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	ED00037	Instrument:	FID4
Calibration Date:	04/13/2021	Column (1):	RTX-1

Comments: CTO 4/19/21 Added A/S Creosote Curve
CTO 4/21/21 Added A/S LAI Bunker C

Compound	Level 25		Level 26		Level 27		Level 28		Level 29		Level 30	
		RF		RF		RF		RF		RF		RF
Bunker C Range Organics (C10-C38)	100	42522.64	250	42298	500	41787.4	1000	44367.74	2500	49793.08	5000	48586.3

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	ED00037	Instrument:	FID4
Calibration Date:	04/13/2021	Column (1):	RTX-1

Comments: CTO 4/19/21 Added A/S Creosote Curve
CTO 4/21/21 Added A/S LAI Bunker C

Compound	Level 31		Level 32		Level 33		Level 34		Level 35		Level 36	
		RF		RF		RF		RF		RF		RF
Jet-A Range Organics (C10-C18)	500	191501.4										

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	ED00037	Instrument:	FID4
Calibration Date:	04/13/2021	Column (1):	RTX-1
Comments:	CTO 4/19/21 Added A/S Creosote Curve CTO 4/21/21 Added A/S LAI Bunker C		

COMPOUND	Mean RF	RF RSD	Linear COD	Quad COD	Limit Type & Limit	Q
Diesel Range Organics (C12-C24)	182831.3	6.2			RSD (20)	
Motor Oil Range Organics (C24-C38)	131440.7	4.0			RSD (20)	
Jet-A Range Organics (C10-C18)		0.0			RSD (20)	
Creosote Range Organics (C12-C22)	39015.84	8.5			RSD (20)	
Bunker C Range Organics (C10-C38)	44892.53	7.7			RSD (20)	
o-Terphenyl	249011.4	4.7			RSD (20)	

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00027	Instrument:	FID4
Calibration Date:	09/07/2021	Column (1):	RTX-1

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
		RF		RF		RF		RF		RF		RF
Diesel Range Organics (C12-C24)	50	162230.6	100	164298.7	250	160828.4	500	159172.2	1000	157401.2	2500	147718.5
o-Terphenyl	9	167596	18	185306.8	45	192445.4	90	196703.9	180	199562.7	450	199296.1

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00027	Instrument:	FID4
Calibration Date:	09/07/2021	Column (1):	RTX-1

Compound	Level 07		Level 08		Level 09		Level 10		Level 11		Level 12	
		RF		RF		RF		RF		RF		RF
Motor Oil Range Organics (C24-C38)	100	141072.4	250	134029.6	500	128843.9	1000	129766.7	2500	127391.3	5000	127540.4

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00027	Instrument:	FID4
Calibration Date:	09/07/2021	Column (1):	RTX-1

Compound	Level 13		Level 14		Level 15		Level 16		Level 17		Level 18	

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00027	Instrument:	FID4
Calibration Date:	09/07/2021	Column (1):	RTX-1

Compound	Level 19		Level 20		Level 21		Level 22		Level 23		Level 24	
		RF		RF		RF		RF		RF		RF
Diesel Range Organics (C12-C24)												

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00027	Instrument:	FID4
Calibration Date:	09/07/2021	Column (1):	RTX-1

Compound	Level 25		Level 26		Level 27		Level 28		Level 29		Level 30	
		RF		RF		RF		RF		RF		RF
Diesel Range Organics (C12-C24)												

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00027	Instrument:	FID4
Calibration Date:	09/07/2021	Column (1):	RTX-1

Compound	Level 31		Level 32		Level 33		Level 34		Level 35		Level 36	
		RF		RF		RF		RF		RF		RF
Diesel Range Organics (C12-C24)												

INITIAL CALIBRATION DATA

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00027	Instrument:	FID4
Calibration Date:	09/07/2021	Column (1):	RTX-1

COMPOUND	Mean RF	RF RSD	Linear COD	Quad COD	Limit Type & Limit	Q
Diesel Range Organics (C12-C24)	158608.3	3.7			RSD (20)	
Diesel Range Organics (C12-C24)	158608.3	3.7			RSD (20)	
Motor Oil Range Organics (C24-C38)	131440.7	4.0			RSD (20)	
o-Terphenyl	190151.8	6.5			RSD (20)	

SECOND-SOURCE CALIBRATION VERIFICATION

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: ED00037
Laboratory ID: SJD0189-SCV1
Sequence: SJD0189
Sequence Name: DIESEL SCV
Standard ID: I004025

ANALYTE	EXPECTED (mg/L)	FOUND (mg/L)	% DRIFT	QC LIMIT
Diesel Range Organics (C12-C24)	500.00	492	-1.7	30.00

* Indicates values outside of QC limits

SECOND-SOURCE CALIBRATION VERIFICATION

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: ED00037
Laboratory ID: SJD0189-SCV2
Sequence: SJD0189
Sequence Name: MOIL SCV
Standard ID: I004757

ANALYTE	EXPECTED (mg/L)	FOUND (mg/L)	% DRIFT	QC LIMIT
Motor Oil Range Organics (C24-C38)	1000.0	918	-8.2	30.00

* Indicates values outside of QC limits

SECOND-SOURCE CALIBRATION VERIFICATION

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EI00027
Laboratory ID: SJI0118-SCV1
Sequence: SJI0118
Sequence Name: DIESEL SCV
Standard ID: J009677

ANALYTE	EXPECTED (mg/L)	FOUND (mg/L)	% DRIFT	QC LIMIT
Diesel Range Organics (C12-C24)	500.00	509	1.9	30.00

* Indicates values outside of QC limits

INITIAL CALIBRATION CHECK

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	FID4	Calibration:	EI00027
Lab File ID:	421I1407.D	Calibration Date:	09/07/2021
Sequence:	SJI0201	Injection Date:	09/14/21
Lab Sample ID:	SJI0201-ICV1	Injection Time:	12:39
Sequence Name:	DIESEL ICV		

		CONC. (mg/L)		RESPONSE FACTOR			% DRIFT/DIFF	
COMPOUND	TYPE	STD	ICV	ICAL	ICV	MIN	ICV	LIMIT
Diesel Range Organics (C12-C24)	A	500.00	544	158608.3000	172445.0000		8.7	+/-15
o-Terphenyl	A	90.000	102	190151.8000	214904.9000		13.0	+/-15

* Values outside of QC limits

* Values outside of QC limits

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INITIAL CALIBRATION CHECK

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	FID4	Calibration:	EI00027
Lab File ID:	421I1406.D	Calibration Date:	09/07/2021
Sequence:	SJI0201	Injection Date:	09/14/21
Lab Sample ID:	SJI0201-ICV2	Injection Time:	12:04
Sequence Name:	MOIL ICV		

		CONC. (mg/L)		RESPONSE FACTOR			% DRIFT/DIFF	
COMPOUND	TYPE	STD	ICV	ICAL	ICV	MIN	ICV	LIMIT
Motor Oil Range Organics (C24-C38)	A	1000.0	1110	131440.7000	145375.4000		10.6	+/-15

* Values outside of QC limits

SECOND-SOURCE
CONTINUING CALIBRATION CHECK
NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	FID4	Calibration:	EI00027
Lab File ID:	421I0718.D	Calibration Date:	09/07/2021
Sequence:	SJI0118	Injection Date:	09/07/21
Lab Sample ID:	SJI0118-SCV1	Injection Time:	22:36
Sequence Name:	DIESEL SCV		

		CONC. (mg/L)		RESPONSE FACTOR (RF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Diesel Range Organics (C12-C24)	A	500.00	509	158608.3	161595.1		1.9	+/-30

* Values outside of QC limits

CONTINUING CALIBRATION CHECK
NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	FID4	Calibration:	EI00027
Lab File ID:	421I1416.D	Calibration Date:	09/07/2021
Sequence:	SJI0201	Injection Date:	09/14/21
Lab Sample ID:	SJI0201-CCV1	Injection Time:	15:40
Sequence Name:	DIESEL CCV		

		CONC. (mg/L)		RESPONSE FACTOR (RF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Diesel Range Organics (C12-C24)	A	500.00	481	158608.3	152643.1		-3.8	+/-15
o-Terphenyl	A	90.000	89.1	190151.8	188292.6		-1.0	+/-15

* Values outside of QC limits

* Values outside of QC limits

CONTINUING CALIBRATION CHECK
NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Instrument ID:	FID4	Calibration:	EI00027
Lab File ID:	421I1417.D	Calibration Date:	09/07/2021
Sequence:	SJI0201	Injection Date:	09/14/21
Lab Sample ID:	SJI0201-CCV2	Injection Time:	16:00
Sequence Name:	MOIL CCV		

		CONC. (mg/L)		RESPONSE FACTOR (RF)			% DRIFT/DIFF	
COMPOUND	TYPE	STD	CCV	ICAL	CCV	MIN	CCV	LIMIT
Motor Oil Range Organics (C24-C38)	A	1000.0	991	131440.7	130186.7		-1.0	+/-15

* Values outside of QC limits

ANALYSIS BATCH (SEQUENCE) SUMMARY

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJD0189
Instrument: FID4
Calibration: ED00037

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Retention Time Standard	SJD0189-IBL1	421D1307.D	NA	04/13/21 12:46
Instrument Blank	SJD0189-IBL2	421D1308.D	NA	04/13/21 13:07
DIESEL 50	SJD0189-CAL1	421D1309.D	NA	04/13/21 13:29
DIESEL 100	SJD0189-CAL2	421D1310.D	NA	04/13/21 13:50
DIESEL 250	SJD0189-CAL3	421D1311.D	NA	04/13/21 14:11
DIESEL 500	SJD0189-CAL4	421D1312.D	NA	04/13/21 14:33
DIESEL 1000	SJD0189-CAL5	421D1313.D	NA	04/13/21 14:54
DIESEL 2500	SJD0189-CAL6	421D1314.D	NA	04/13/21 15:16
DIESEL SCV	SJD0189-SCV1	421D1315.D	NA	04/13/21 15:37
MOIL 100	SJD0189-CAL7	421D1316.D	NA	04/13/21 15:59
MOIL 250	SJD0189-CAL8	421D1317.D	NA	04/13/21 16:20
MOIL 500	SJD0189-CAL9	421D1318.D	NA	04/13/21 16:42
MOIL 1000	SJD0189-CALA	421D1319.D	NA	04/13/21 17:03
MOIL 2500	SJD0189-CALB	421D1320.D	NA	04/13/21 17:24
MOIL 5000	SJD0189-CALC	421D1321.D	NA	04/13/21 17:46
MOIL SCV	SJD0189-SCV2	421D1322.D	NA	04/13/21 18:07
AK103 100	SJD0189-CALD	421D1323.D	NA	04/13/21 18:28
AK103 250	SJD0189-CALE	421D1324.D	NA	04/13/21 18:50
AK103 500	SJD0189-CALF	421D1325.D	NA	04/13/21 19:11
AK103 1000	SJD0189-CALG	421D1326.D	NA	04/13/21 19:32
AK103 2500	SJD0189-CALH	421D1327.D	NA	04/13/21 19:53
AK103 5000	SJD0189-CALI	421D1328.D	NA	04/13/21 20:14

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ANALYSIS BATCH (SEQUENCE) SUMMARY

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJD0260
Instrument: FID4
Calibration: ED00037

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Retention Time Standard	SJD0260-IBL1	421D1553.D	NA	04/16/21 03:34
Instrument Blank	SJD0260-IBL2	421D1554.D	NA	04/16/21 03:55
A/S CREOSOTE 100	SJD0260-CAL1	421D1555.D	NA	04/16/21 04:16
A/S CREOSOTE 250	SJD0260-CAL2	421D1556.D	NA	04/16/21 04:37
A/S CREOSOTE 500	SJD0260-CAL3	421D1557.D	NA	04/16/21 04:57
A/S CREOSOTE 1000	SJD0260-CAL4	421D1558.D	NA	04/16/21 05:18
A/S CREOSOTE 2500	SJD0260-CAL5	421D1559.D	NA	04/16/21 05:39
A/S CREOSOTE 5000	SJD0260-CAL6	421D1560.D	NA	04/16/21 06:00
DIESEL ICV	SJD0260-ICV1	421D1561.D	NA	04/16/21 06:21
MOIL ICV	SJD0260-ICV2	421D1562.D	NA	04/16/21 06:42
A/S Creosote ICV	SJD0260-ICV3	421D1563.D	NA	04/16/21 07:03
ZZZZZ	BJC0355-BLK1	421D1564.D	Water	04/16/21 07:24
ZZZZZ	BJC0355-BS1	421D1565.D	Water	04/16/21 07:45
ZZZZZ	BJC0355-BSD1	421D1566.D	Water	04/16/21 08:06
ZZZZZ	21C0181-02RE1	421D1567.D	Water	04/16/21 08:27
ZZZZZ	21C0181-03RE1	421D1568.D	Water	04/16/21 08:48
ZZZZZ	21C0181-04RE1	421D1569.D	Water	04/16/21 09:09
ZZZZZ	21C0181-05RE1	421D1570.D	Water	04/16/21 09:30
ZZZZZ	21C0181-06RE1	421D1571.D	Water	04/16/21 09:51
ZZZZZ	21C0181-07RE1	421D1572.D	Water	04/16/21 10:12
ZZZZZ	21C0181-08RE1	421D1573.D	Water	04/16/21 10:33
ZZZZZ	21C0181-09RE1	421D1574.D	Water	04/16/21 10:54
ZZZZZ	21C0181-10RE1	421D1575.D	Water	04/16/21 11:15
ZZZZZ	21C0181-11RE2	421D1576.D	Water	04/16/21 11:36
DIESEL CCV	SJD0260-CCV1	421D1577.D	NA	04/16/21 11:57
MOIL CCV	SJD0260-CCV2	421D1578.D	NA	04/16/21 12:18
A/S CRESOTE CCV	SJD0260-CCV3	421D1579.D	NA	04/16/21 12:39
ZZZZZ	21C0181-12RE1	421D1580.D	Water	04/16/21 13:00
ZZZZZ	21C0181-13RE1	421D1581.D	Water	04/16/21 13:21

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ANALYSIS BATCH (SEQUENCE) SUMMARY

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJD0260
Instrument: FID4
Calibration: ED00037

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
ZZZZZ	21C0181-14RE1	421D1582.D	Water	04/16/21 13:42
ZZZZZ	21C0181-15RE2	421D1584.D	Water	04/16/21 14:24
ZZZZZ	21C0181-16RE1	421D1585.D	Water	04/16/21 14:45
DIESEL CCV	SJD0260-CCV4	421D1586.D	NA	04/16/21 15:06
MOIL CCV	SJD0260-CCV5	421D1587.D	NA	04/16/21 15:28
A/S CRESOTE CCV	SJD0260-CCV6	421D1588.D	NA	04/16/21 15:49

ANALYSIS BATCH (SEQUENCE) SUMMARY

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJD0282
Instrument: FID4
Calibration: ED00037

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Retention Time Standard	SJD0282-IBL1	421D2003.D	NA	04/20/21 14:16
Instrument Blank	SJD0282-IBL2	421D2004.D	NA	04/20/21 14:38
A/S LAI BUNKER C 100	SJD0282-CAL1	421D2005.D	NA	04/20/21 14:59
A/S LAI BUNKER C 250	SJD0282-CAL2	421D2006.D	NA	04/20/21 15:21
A/S LAI BUNKER C 500	SJD0282-CAL3	421D2007.D	NA	04/20/21 15:42
A/S LAI BUNKER C 1000	SJD0282-CAL4	421D2008.D	NA	04/20/21 16:04
A/S LAI BUNKER C 2500	SJD0282-CAL5	421D2009.D	NA	04/20/21 16:25
A/S LAI BUNKER C 5000	SJD0282-CAL6	421D2010.D	NA	04/20/21 16:47
DIESEL ICV	SJD0282-ICV1	421D2011.D	NA	04/20/21 17:08
MOIL ICV	SJD0282-ICV2	421D2012.D	NA	04/20/21 17:30
A/S BUNKER C	SJD0282-ICV3	421D2013.D	NA	04/20/21 17:51
ZZZZZ	BJC0848-BLK1	421D2014.D	Water	04/20/21 18:13
ZZZZZ	BJC0848-BS1	421D2015.D	Water	04/20/21 18:34
ZZZZZ	BJC0848-BSD1	421D2016.D	Water	04/20/21 18:55
ZZZZZ	21C0428-01	421D2017.D	Water	04/20/21 19:17
ZZZZZ	21C0428-02	421D2020.D	Water	04/20/21 20:21
ZZZZZ	21C0428-03	421D2021.D	Water	04/20/21 20:42
ZZZZZ	21C0428-04	421D2022.D	Water	04/20/21 21:03
ZZZZZ	21C0428-05	421D2023.D	Water	04/20/21 21:24
ZZZZZ	21C0428-06	421D2024.D	Water	04/20/21 21:45
ZZZZZ	21C0428-07	421D2025.D	Water	04/20/21 22:07
ZZZZZ	21C0428-08	421D2026.D	Water	04/20/21 22:28
ZZZZZ	21C0428-09	421D2027.D	Water	04/20/21 22:49
A/S BUNKER C	SJD0282-CCV3	421D2031.D	NA	04/21/21 00:13
ZZZZZ	21C0428-11	421D2032.D	Water	04/21/21 00:34
ZZZZZ	21C0428-12	421D2033.D	Water	04/21/21 00:55
ZZZZZ	21C0428-13	421D2034.D	Water	04/21/21 01:16
ZZZZZ	BJD0124-BLK1	421D2035.D	Water	04/21/21 01:37
ZZZZZ	BJD0124-BS1	421D2036.D	Water	04/21/21 01:58

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ANALYSIS BATCH (SEQUENCE) SUMMARY

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJD0282
Instrument: FID4
Calibration: ED00037

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
ZZZZZ	21D0041-01	421D2037.D	Water	04/21/21 02:19
ZZZZZ	21D0041-03	421D2038.D	Water	04/21/21 02:40
ZZZZZ	21D0041-05	421D2039.D	Water	04/21/21 03:01
ZZZZZ	21D0041-07	421D2040.D	Water	04/21/21 03:22
ZZZZZ	21D0041-09	421D2041.D	Water	04/21/21 03:43
ZZZZZ	21D0041-11	421D2042.D	Water	04/21/21 04:04
DIESEL CCV	SJD0282-CCV4	421D2043.D	NA	04/21/21 04:25
MOIL CCV	SJD0282-CCV5	421D2044.D	NA	04/21/21 04:46
A/S BUNKER C	SJD0282-CCV6	421D2045.D	NA	04/21/21 05:07
ZZZZZ	BJD0328-BLK1	421D2046.D	Water	04/21/21 05:28
ZZZZZ	BJD0328-BS1	421D2047.D	Water	04/21/21 05:49
ZZZZZ	BJD0328-BSD1	421D2048.D	Water	04/21/21 06:10
ZZZZZ	21D0104-01	421D2049.D	Water	04/21/21 06:31
ZZZZZ	21D0104-02	421D2050.D	Water	04/21/21 06:52
ZZZZZ	21D0104-03	421D2051.D	Water	04/21/21 07:13
ZZZZZ	21D0104-04	421D2052.D	Water	04/21/21 07:34
ZZZZZ	21D0104-05	421D2053.D	Water	04/21/21 07:55
ZZZZZ	21D0104-06	421D2054.D	Water	04/21/21 08:16
ZZZZZ	21D0104-07	421D2055.D	Water	04/21/21 08:37
ZZZZZ	21D0104-08	421D2056.D	Water	04/21/21 08:58
ZZZZZ	21D0116-01	421D2057.D	Water	04/21/21 09:19
DIESEL CCV	SJD0282-CCV7	421D2058.D	NA	04/21/21 09:40
MOIL CCV	SJD0282-CCV8	421D2059.D	NA	04/21/21 10:01
ZZZZZ	21D0116-03	421D2060.D	Water	04/21/21 10:22
ZZZZZ	21D0116-04	421D2061.D	Water	04/21/21 10:43
ZZZZZ	21D0116-05	421D2062.D	Water	04/21/21 11:04
ZZZZZ	21D0116-06	421D2063.D	Water	04/21/21 11:25
ZZZZZ	21D0116-07	421D2064.D	Water	04/21/21 11:46
ZZZZZ	21D0116-08	421D2065.D	Water	04/21/21 12:07

ANALYSIS BATCH (SEQUENCE) SUMMARY

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJD0282
Instrument: FID4
Calibration: ED00037

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
ZZZZZ	21D0116-09	421D2066.D	Water	04/21/21 12:28
ZZZZZ	21D0116-10	421D2067.D	Water	04/21/21 12:50
ZZZZZ	21D0116-11	421D2068.D	Water	04/21/21 13:11
DIESEL CCV	SJD0282-CCV9	421D2069.D	NA	04/21/21 13:32
MOIL CCV	SJD0282-CCVA	421D2070.D	NA	04/21/21 13:53
ZZZZZ	21C0428-10	421D2028.D	Water	04/21/21 23:10
DIESEL CCV	SJD0282-CCV1	421D2029.D	NA	04/21/21 23:31
MOIL CCV	SJD0282-CCV2	421D2030.D	NA	04/21/21 23:52

ANALYSIS BATCH (SEQUENCE) SUMMARY

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJH0325
Instrument: FID4
Calibration: ED00037

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Retention Time Standard	SJH0325-IBL1	421H2503A.D	NA	08/25/21 13:15
Instrument Blank	SJH0325-IBL2	421H2504A.D	NA	08/25/21 13:36
DIESEL ICV	SJH0325-ICV1	421H2514.D	NA	08/25/21 17:21
MOIL ICV	SJH0325-ICV2	421H2515.D	NA	08/25/21 17:41
JETA	SJH0325-CAL1	421H2516.D	NA	08/25/21 18:01
AK103	SJH0325-ICV4	421H2517.D	NA	08/25/21 18:22
ZZZZZ	BJH0396-BLK1	421H2518.D	Water	08/25/21 18:42
ZZZZZ	BJH0396-BS1	421H2519.D	Water	08/25/21 19:02
ZZZZZ	BJH0396-BSD1	421H2520.D	Water	08/25/21 19:22
ZZZZZ	21H0113-01	421H2521.D	Water	08/25/21 19:42
ZZZZZ	21H0113-02	421H2522.D	Water	08/25/21 20:02
ZZZZZ	21H0113-03	421H2523.D	Water	08/25/21 20:23
ZZZZZ	21H0113-04	421H2524.D	Water	08/25/21 20:43
ZZZZZ	21H0167-01	421H2525.D	Water	08/25/21 21:03
ZZZZZ	21H0179-01	421H2526.D	Water	08/25/21 21:23
DIESEL CCV	SJH0325-CCV1	421H2530.D	NA	08/25/21 22:43
MOIL CCV	SJH0325-CCV2	421H2531.D	NA	08/25/21 23:04
JET A	SJH0325-ICV3	421H2532.D	NA	08/25/21 23:24

ANALYSIS BATCH (SEQUENCE) SUMMARY

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0118
Instrument: FID4
Calibration: EI00027

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Retention Time Standard	SJI0118-IBL1	421I0710.D	NA	09/07/21 19:55
Instrument Blank	SJI0118-IBL2	421I0711.D	NA	09/07/21 20:15
Diesel 50	SJI0118-CAL1	421I0712.D	NA	09/07/21 20:35
Diesel 100	SJI0118-CAL2	421I0713.D	NA	09/07/21 20:55
Diesel 250	SJI0118-CAL3	421I0714.D	NA	09/07/21 21:15
Diesel 500	SJI0118-CAL4	421I0715.D	NA	09/07/21 21:35
Diesel 1000	SJI0118-CAL5	421I0716.D	NA	09/07/21 21:55
Diesel 2500	SJI0118-CAL6	421I0717.D	NA	09/07/21 22:15
DIESEL SCV	SJI0118-SCV1	421I0718.D	NA	09/07/21 22:36

ANALYSIS BATCH (SEQUENCE) SUMMARY

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0201
Instrument: FID4
Calibration: EI00027

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Retention Time Standard	SJI0201-IBL1	421I1403.D	NA	09/14/21 11:03
Instrument Blank	SJI0201-IBL2	421I1404.D	NA	09/14/21 11:23
MOIL ICV	SJI0201-ICV2	421I1406.D	NA	09/14/21 12:04
DIESEL ICV	SJI0201-ICV1	421I1407.D	NA	09/14/21 12:39
Blank	BJI0334-BLK1	421I1408.D	Solid	09/14/21 12:59
LCS	BJI0334-BS1	421I1409.D	Solid	09/14/21 13:19
LCS Dup	BJI0334-BSD1	421I1410.D	Solid	09/14/21 13:39
ZZZZZ	21I0135-01	421I1415.D	Solid	09/14/21 15:20
DIESEL CCV	SJI0201-CCV1	421I1416.D	NA	09/14/21 15:40
MOIL CCV	SJI0201-CCV2	421I1417.D	NA	09/14/21 16:00
HSA-62-13-14	21I0042-03	421I1418.D	Solid	09/14/21 16:20
DUP-1-083121	21I0042-04	421I1419.D	Solid	09/14/21 16:41
DUP-1-083121	BJI0334-MS1	421I1420.D	Solid	09/14/21 17:01
DUP-1-083121	BJI0334-MSD1	421I1421.D	Solid	09/14/21 17:21

SURROGATE RECOVERY AND RT SUMMARY

NWTPH-Dx

Laboratory:	Analytical Resources, Inc.	SDG/WO:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Sequence:	SJI0201	Instrument:	FID4
Calibration:	EI00027	Calibration Date:	09/07/2021

Surrogate Compound	Spike Level mg/L	% Recovery	Recovery Limits	RT	Calibration Mean RT	RT Diff	RT Diff Limit	Q
SJI0201-IBL1 (Water)				Lab File ID: 421I1403.D			Analyzed: 09/14/21 11:03	
o-Terphenyl	100.00	127	50 - 150	5.98	6.001667	-0.0217	N/A	
SJI0201-IBL2 (Water)				Lab File ID: 421I1404.D			Analyzed: 09/14/21 11:23	
o-Terphenyl	100.00	111	50 - 150	5.98	6.001667	-0.0217	N/A	
SJI0201-ICV1 (Water)				Lab File ID: 421I1407.D			Analyzed: 09/14/21 12:39	
o-Terphenyl	90.000	113	85 - 115	5.98	6.001667	-0.0217	N/A	
BJI0334-BLK1 (Solid)				Lab File ID: 421I1408.D			Analyzed: 09/14/21 12:59	
o-Terphenyl	11.250	111	50 - 150	5.98	6.001667	-0.0217	N/A	
BJI0334-BS1 (Solid)				Lab File ID: 421I1409.D			Analyzed: 09/14/21 13:19	
o-Terphenyl	11.250	137	50 - 150	5.99	6.001667	-0.0117	N/A	
BJI0334-BSD1 (Solid)				Lab File ID: 421I1410.D			Analyzed: 09/14/21 13:39	
o-Terphenyl	11.250	114	50 - 150	5.99	6.001667	-0.0117	N/A	
SJI0201-CCV1 (Water)				Lab File ID: 421I1416.D			Analyzed: 09/14/21 15:40	
o-Terphenyl	90.000	99.0	85 - 115	5.98	6.001667	-0.0217	N/A	
21I0042-03 (Solid)				Lab File ID: 421I1418.D			Analyzed: 09/14/21 16:20	
o-Terphenyl	14.939		50 - 150	0	6.001667	-6.0017	N/A	D1
21I0042-04 (Solid)				Lab File ID: 421I1419.D			Analyzed: 09/14/21 16:41	
o-Terphenyl	14.333		50 - 150	0	6.001667	-6.0017	N/A	D1
BJI0334-MS1 (Solid)				Lab File ID: 421I1420.D			Analyzed: 09/14/21 17:01	
o-Terphenyl	14.333		50 - 150	0	6.001667	-6.0017	N/A	D1
BJI0334-MSD1 (Solid)				Lab File ID: 421I1421.D			Analyzed: 09/14/21 17:21	
o-Terphenyl	14.333		50 - 150	0	6.001667	-6.0017	N/A	D1

HOLDING TIME SUMMARY

Analysis: NWTPH-Dx

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
HSA-62-13-14 21I0042-03	08/31/21 11:00	09/02/21 10:52	09/13/21 10:05	12	14	09/14/21 16:20	1	40	
DUP-1-083121 21I0042-04	08/31/21 11:30	09/02/21 10:52	09/13/21 10:05	12	14	09/14/21 16:41	1	40	
Matrix Spike BJI0334-MS1	08/31/21 11:30	09/02/21 10:52	09/13/21 10:05	12	14	09/14/21 17:01	1	40	
Matrix Spike Dup BJI0334-MSD1	08/31/21 11:30	09/02/21 10:52	09/13/21 10:05	12	14	09/14/21 17:21	1	40	

* Indicates hold time exceedance.

METHOD DETECTION AND REPORTING LIMITS

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Solid
Instrument: FID4

Analyte	MDL	RL	Units
Diesel Range Organics (C12-C24)	2.34	5.00	mg/kg
Motor Oil Range Organics (C24-C38)	2.99	10.0	mg/kg

METHOD DETECTION AND REPORTING LIMITS

NWTPH-Dx

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Water
Instrument: FID4

Analyte	MDL	RL	Units
Diesel Range Organics (C12-C24)	0.033	0.100	mg/L
Motor Oil Range Organics (C24-C38)	0.056	0.200	mg/L

I-6884 - Chevron Motor Oil SAE30
I-6885 - Valvoline Motor Oil SAE30
I-6886 - Valvoline Motor oil SAE 5W-30
I-6887 - Valvoline Motor Oil SAE 40
I-6888 - Mobil 1 Synthetic Motor Oil 10W30

5/13/11

5/13/11

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STORE PHONE # 425 021-0080
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ST LOUIS MO 63179-0090

BILL TO 999990

SHIP TO

INVOICE NUMBER 2508-240059
INVOICE TYPE CHG. CARD SALE
INVOICE DATE 5/13/11

CASH SALE
CHEVRON INJECTOR CLEANER
SAVE INSTANTLY
BUY 1 GET 1 FREE 00000

COUNTER NO.	SPECIAL INSTRUCTIONS	SHIP VIA	CUSTOMER ORDER NO.	TIME OF ORDER	FILLED BY	CHECKED BY
5				00:00:50		

TAX	R C	QTY.	LINE	ITEM NUMBER	UNIT MEAS.	CD.	DESCRIPTION	LIST PRICE	NET PRICE	DISC %	CORE PRICE	EXTENDED PRICE
T	*	1		CAS EDGE10 30	EA		10tMotorOil	14.77	5.99			5.99
T	*	1		CAS EDGE10 30	EA		10tMotorOil	14.77	5.99			5.99
T	*	1		MOB 1-10-30	EA		10tSynthcOil	13.99	8.19			8.19
T	*	1		VAL 5-30	EA		10tMotorOil	7.95	4.69			4.69
T	*	1		VAL HD30	EA		10tMotorOil	7.95	4.69			4.69
T	*	1		VAL HD40	EA		10tMotorOil	7.95	4.69			4.69
T	*	1		CHV HD30	EA		MOTOR OIL	6.25	3.69			3.69
	*	=		MFG. DEFECT WARRANTY								

CREDIT CARD-MASTER CARD 1264 EXPIRATION DATE-XX/XX AUTHORIZATION-966947

TOTALS	7	CUSTOMER COPY	"We appreciate your business"	PAGE 1	73.44	37.93	SUB-TOTAL	37.93
							MISC.	
					CASH TEND.		TAX/FEES	
					CHANGE		TOTAL	

CUSTOMER SIGNATURE _____

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BILL TO 999990

SHIP TO

INVOICE NUMBER 2508-240059
INVOICE TYPE CHG. CARD SALE
INVOICE DATE 5/13/11

CASH SALE
CHEVRON INJECTOR CLEANER
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BUY 1 GET 1 FREE 00000

COUNTER NO.	SPECIAL INSTRUCTIONS	SHIP VIA	CUSTOMER ORDER NO.	TIME OF ORDER	FILLED BY	CHECKED BY
5				00:00:50		

TAX	R C	QTY.	LINE	ITEM NUMBER	UNIT MEAS.	CD.	DESCRIPTION	LIST PRICE	NET PRICE	DISC %	CORE PRICE	EXTENDED PRICE

I-6884 - Chevron Motor Oil SAE30
I-6885 - Valvoline Motor Oil SAE30
I-6886 - Valvoline Motor Oil SAE 5W-30
I-6887 - Valvoline Motor Oil SAE 40
I-6888 - Mobil 1 Synthetic Motor Oil 10W30

5/13/11

5/13/11

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BILL TO 999990

SHIP TO

INVOICE NUMBER 2508-240059
INVOICE TYPE CHG. CARD SALE
INVOICE DATE 5/13/11

CASH SALE
CHEVRON INJECTOR CLEANER
SAVE INSTANTLY
BUY 1 GET 1 FREE 00000

COUNTER NO.	SPECIAL INSTRUCTIONS	SHIP VIA	CUSTOMER ORDER NO.	TIME OF ORDER	FILLED BY	CHECKED BY
5				00:00:50		

TAX	R C	QTY.	LINE	ITEM NUMBER	UNIT MEAS.	CD.	DESCRIPTION	LIST PRICE	NET PRICE	DISC %	CORE PRICE	EXTENDED PRICE
T	*	1		CAS EDGE10 30	EA		10tMotorOil	14.77	5.99			5.99
T	*	1		CAS EDGE10 30	EA		10tMotorOil	14.77	5.99			5.99
T	*	1		MOB 1-10-30	EA		10tSynthcOil	13.99	8.19			8.19
T	*	1		VAL 5-30	EA		10tMotorOil	7.95	4.69			4.69
T	*	1		VAL HD30	EA		10tMotorOil	7.95	4.69			4.69
T	*	1		VAL HD40	EA		10tMotorOil	7.95	4.69			4.69
T	*	1		CHV HD30	EA		MOTOR OIL	6.25	3.69			3.69
	*	=		MFG. DEFECT WARRANTY								

CREDIT CARD-MASTER CARD 1264 EXPIRATION DATE-XX/XX AUTHORIZATION-966947

TOTALS	7	CUSTOMER COPY	"We appreciate your business"	PAGE 1	73.44	37.93	SUB-TOTAL	37.93
							MISC.	
					CASH TEND.		TAX/FEES	
					CHANGE		TOTAL	

CUSTOMER SIGNATURE _____

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BILL TO 999990

SHIP TO

INVOICE NUMBER 2508-240059
INVOICE TYPE CHG. CARD SALE
INVOICE DATE 5/13/11

CASH SALE
CHEVRON INJECTOR CLEANER
SAVE INSTANTLY
BUY 1 GET 1 FREE 00000

COUNTER NO.	SPECIAL INSTRUCTIONS	SHIP VIA	CUSTOMER ORDER NO.	TIME OF ORDER	FILLED BY	CHECKED BY
5				00:00:50		

TAX	R C	QTY.	LINE	ITEM NUMBER	UNIT MEAS.	CD.	DESCRIPTION	LIST PRICE	NET PRICE	DISC %	CORE PRICE	EXTENDED PRICE

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Email USA: techserv@sial.com
Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Triacontane – 98%

Product Number:	**263842**
Batch Number:	**MKBL2826V**
Brand:	ALDRICH
CAS Number:	638-68-6
MDL Number:	MFCD00009410
Formula:	C30H62
Formula Weight:	422.81 g/mol
Quality Release Date:	20 JUN 2012

$CH_3(CH_2)_{28}CH_3$

C003092
TPHD Triacontane NEAT
Solvent / Lot: NEAT
Prep: 8/19/2014 by VS
Exp: 2/15/2030
Location: GC

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Flakes or Crystalline Flakes	Conforms to Requirements	Flakes
Melting Point	65.0 - 69.0 °C	65.7 °C
Infrared spectrum	Conforms to Structure	Conforms
Purity (GC)	≥ 97.5 %	98.1 %

Jamie Gleason, Manager
Quality Control
Milwaukee, Wisconsin US

Alfa Aesar

Certificate of analysis

E003343
TPHD O-Terphenyl Neat
Expires 12/31/2079
Prepared By Jonathon Walter 8/10/2016

Product No.:	A19680
Product:	o-Terphenyl, 98%
Lot No.:	10114703

Appearance	White, crystalline powder
Melting point	55.0-55.9ºC
Assay (GC)	99.9+ %

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Outside USA: eurtechserv@sial.com

Certificate of Analysis

Product Name:
Triacontane - 98%

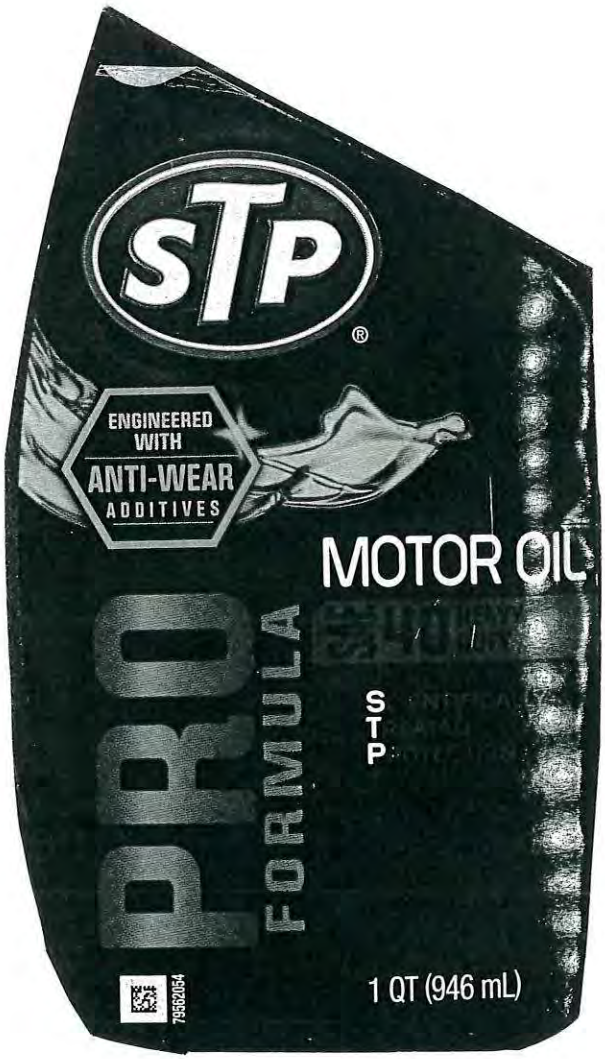
$CH_3(CH_2)_{28}CH_3$

Product Number:	**263842**
Batch Number:	**MKCD2349**
Brand:	ALDRICH
CAS Number:	638-68-6
MDL Number:	MFCD00009410
Formula:	C30H62
Formula Weight:	422.81 g/mol
Quality Release Date:	01 JUN 2017

F8659
Recd-
09/21/17 gc

Test	Specification	Result
Appearance (Color)	White	White
Appearance (Form) Flakes or Crystalline Flakes	Conforms to Requirements	Flakes
Melting Point	65.0 - 69.0 °C	65.4 °C
Infrared Spectrum	Conforms to Structure	Conforms
Purity (GC)	≥ 97.5 %	98.2 %

Michael Grady, Manager
Quality Control
Milwaukee, WI US



front

back

G 034796

5264

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested:
ARI Client Company: Landau Assoc Inc	Phone: 509 327-9737
Client Contact: Ryan Reich	
Client Project Name: Avista Central Steam Plant (CSP)	
Client Project #: 0236040	Samplers: Ryan Reich

Page: 2 of 2	
Date: 3-27-19	Ice Present? Yes
No. of Coolers: 2	Cooler Temps: 2.7°C 2.4°C

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested: NWTPH-Dx w/ Bleanup	Notes/Comments
MW28-032719	3-27-19	15:45	W	2	X	
MW 25-032819	3-28-19	9:05	W	2	X	
MW7-032819	3-28-19	9:55	W	2	X	
EW3-102418	10-24-18	13:00	Product Liquid	2		Site Blanket Standard

#003225

Comments/Special Instructions
* w/ acid silica gel cleanup

	Relinquished by:	Received by:	Relinquished by:	Received by:
(Signature)	Ryan			
Printed Name:	Ryan Reich	Jacob Haltz		
Company:	Landau Assoc	ARI		
Date & Time:	3-28-19 16:30	03/29/19 0950		

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Appendix 20.1

ALTERNATE CERTIFICATE OF ANALYSIS

The manufacturer of the below chemical was unable to provide a Certificate of Analysis at the time of request by ARI.

Date Requested from Manufacturer: 7.16.19 - not requested.

Chemical: Pentacosane-N

Manufacturer: Chem Service

Product #: NA

Lot #: 184-125A

Purity: 99%

Analyst: VTS

H006758
n-Pentacosane-Neat
Solvent / Lot: NA
Prep: 7/15/2019 by VS
Exp: 1/12/2030
Location: GC

125 Market Street
New Haven, CT 06513
USA

AccuStandard®

Tel (203)786-5290
Fax (203)786-5287
www.AccuStandard.com

CERTIFICATE OF ANALYSIS

Catalog No: DRH-004S-R1-5X
Description: Calibration/Window Defining Hydrocarbon Standard
Lot: 219041075
Solvent: Chloroform
Hazards: *Refer to SDS for complete safety information*

Signal Word: Warning

Date Certified: Apr 8, 2019
Expiration: Apr 8, 2029
Sample Size: 1 mL
Components: 17
Storage Condition: Ambient (>5 °C)/Sonicate

Certified Reference Material

ANAB ACCREDITED REFERENCE MATERIAL PRODUCER AR-1463
ANAB ACCREDITED TESTING LABORATORY AT-1339
ilac-MRA

Component	CAS #	Purity % (GC/MS)	Prepared Concentration[2] (µg/mL)	Certified Analyte Concentration[1] (µg/mL)
n-Octane	111-65-9	100.0	1017	1017
Decane	124-18-5	100.0	1014	1014
Dodecane	112-40-3	98.1	1013	994
n-Tetradecane	629-59-4	99.9	1008	1007
Hexadecane	544-76-3	98.9	1004	993
n-Octadecane	593-45-3	99.1	1013	1004
Eicosane	112-95-8	99.8	1008	1006
Docosane	629-97-0	99.1	1002	993
n-Tetracosane	646-31-1	100.0	1000	1000
Hexacosane	630-01-3	99.5	1008	1003
n-Octacosane	630-02-4	99.0	1017	1007
n-Triacontane	638-68-6	100.0	1017	1017
Dotriacontane	544-85-4	98.0	1014	994
Tetratriacontane	14167-59-0	99.0	1012	1002
Hexatriacontane	630-06-8	98.0	1003	983
n-Octatriacontane	7194-85-6	98.5	1009	994
Tetracontane	4181-95-7	99.0	1009	999

H007050
Recd JK
07/24/19

A product with a suffix (-1A, -2B, etc. or -01, -02, etc.) on its lot number has had its expiration date extended and is identical to the same lot number without the suffix.

[2] All weights are traceable through NIST, Test No. 684/289871-17

[1] Certified Analyte Concentration = Purity x Prepared Concentration.

The Uncertainty associated with the certified concentration reported on this certificate is ±2.4%. This value is the combined expanded uncertainty and represents an estimated standard deviation equal to the positive square root of the total variation of the uncertainty of components. A normal distribution is assumed and a coverage factor of K=2 is chosen using approximately a 95% confidence level.

Labels and certificates follow U.S. Conventions in reporting numerical values: A comma (,) is used to separate units of one-thousand or greater. A period (.) is used as a decimal place marker.

Certified By: Larry Decker, Organic QC Manager

For use in routine laboratory analysis.

AccuStandard is accredited to ISO 17034, ISO/IEC 17025 and certified to ISO 9001:2015

QR-ORG/INO-001
Rev. 5/18

Appendix 13.1

ALTERNATE CERTIFICATE OF ANALYSIS

An effort has been made to locate the Certificate of Analysis for the below chemical and the manufacturer of the chemical was unable to provide a certificate at the time of request by ARI. This form is serving as a substitute for documentation purposes.

Date Requested from Manufacturer: 09/20/19 purchased at gas station

Chemical: Diesel #2 NEAT

Manufacturer: 76 gas station

Product #: N/A

Lot #: N/A

Purity: NEAT

Analyst: JL

1+009117

Aug/20/19

13310 Interurban Ave S
Tukwila Wa 98168

STANLEY H & REBECCA
00061106449
13310 INTERURBAN A
TUKWILA , WA
09/20/2019 415774136
11:10:20 AM

3605
MASTERCRD

INVOICE 110939
AUTH 00-024386
REF370230920191109

PUMP# 8
DIESEL 2 0.056G
PRICE/GAL $3.599

FUEL TOTAL $ 0.20

CREDIT $ 0.20

COMPLETION
SWIPE Exp.Date:**/**
Batch: 37 Seq Num: 23
Term ID: 8
Workstation ID: 00
Your opinion
counts! Enter to
Win 1 of 60 $25
gas gift cards!!!
Provide feedback
www.gasvisit.com
Learn how to earn
50 cents/gallon in
fuel statement
credits. Go to
drivesavvy.com or
see details at the
pump. Restrictions
apply. Offer
expires 9/30/19.
18

COMPLETRE A SURVEY
WWW.GASVISIT.COM
REGISTER TO WIN!!

H009117
M
09/20/19

RESTEK®
110 Benner Circle
Bellefonte, PA 16823-8812
Tel: (800)356-1688
Fax: (814)353-1309

www.restek.com

CERTIFIED REFERENCE MATERIAL

Certificate of Analysis

ACCREDITED
ISO 17034 Accredited
Reference Material Producer
Certificate #3222.01

ACCREDITED
ISO/IEC 17025 Accredited
Testing Laboratory
Certificate #3222.02

FOR LABORATORY USE ONLY-READ SDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

I003995
DIESEL#2 2ND SOURCE stock
Solvent / Lot: mecl2
Prep: 5/7/2020 by JR
Exp: 3/3/2027
Location:

Catalog No. : !"
Lot No.: #$!%&%$%
Description : '()*)+,-.)+,/",01234254,6738)219)5)4:
'()*)+,-.)+,/",01234254,6738)219)5)4:,%;$$$,<=>?@;,A)19B+)3), C9+D5(4);,!?@>2?E.+
Container Size : ",?@
Pkg Amt: G,!,?@
Expiration Date : A25H9, !;,"$"&
Storage: "%FC,3D?(32+

C E R T I F I E D V A L U E S

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)		
1	Diesel Fuel #2 - Single Source	5,000.0 µg/mL	+/- 29.3428	µg/mL	Gravimetric
	CAS # 68334-30-5.C (Lot 032404SZ)		+/- 148.9194	µg/mL	Unstressed
	Purity ----%		+/- 158.8208	µg/mL	Stressed

Solvent: Methylene chloride
CAS # 75-09-2
Purity 99%

Column:
!"#$#!%&""#$#!%&'("
)*$+'#,-. *%/0!&& 1

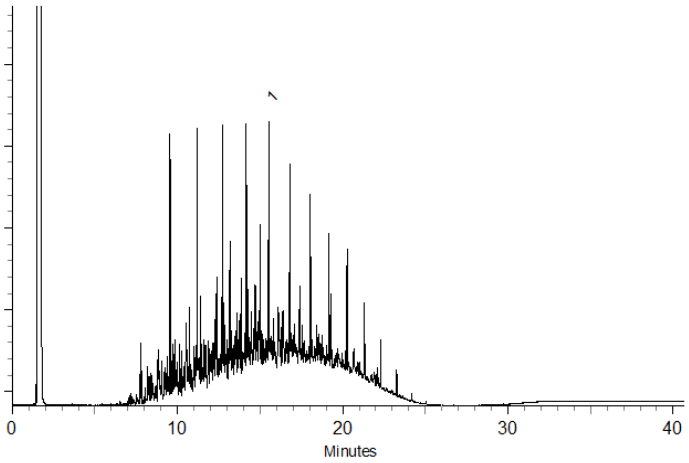
Carrier Gas:
23456789+-69:*. 9*#;58::< 58#0!#:=%

Temp. Program:
>!?@#,26A4#&#"=9%#1#?@
B#0!?@C"=9%#,26A4#0!#"=9%1

Inj. Temp:
&'!?@

Det. Temp:
!?@

Det. Type:
DEF



I9(*,H95D?21D=52?,5)E5)*)31*,2,=)3)52+,*)1,DJ,1)*1(3=,HD34(1(D3*,H9D*)3,JD5,E5D4.H1,
2HH)E123H)K,,-D5,DE1(?2+,5)*.+1*,(3,BD.5,+2L;,HD34(1(D3*,*9D.+4,L),24M.*1)4,JD5,BD.5,
*E)H(J(H,(3*15.?)31;,?)19D4;,234,2EE+(H21(D3K

Dalton Stover - Operations Technician I

Date Mixed: 06-Feb-2020 **Balance:** B345965662

Justine Albertson - Operations Tech-ARM QC

Date Passed: 07-Feb-2020

Manufactured under Restek's ISO 9001:2015
Registered Quality System
Certificate #FM 80397

General Certified Reference Material Notes

Expiration Notes:

- TUE(521(D3,421),V2+(4,JD5,.3DE)3)4,2?E.+,*1D5)4,(3,HD?E+(23H),8(19,19),5)HD??)34)4,HD34(1(D3*K
- 73H)512(31B;,HD3H)31521(D3;,234,)UE(521(D3,DJ,19),COA,25),L2*)4,D3,19),.3DE)3)4,E5D4.H1,L)(3=,*1D5)4,2HHD54(3=,1D,19),5)HD??)34)4,HD34(1(D3,JD.34,(3,19),*1D52=),J()+4K

Purity Notes:

- W.5(1B,234>D5,H9)?(H2+,(4)31(1B,25),4)1)5?(3)4,LB,D3),D5,?D5),DJ,19),JD++D8(3=,1)H93(X.)*Y,ZC>-[';,\W@C;,ZC><TC';,ZC>A0;,@C>A0;,O[;,234>D5,?)+1(3=,ED(31K
- CD?ED.34*,8(19,2,+(*1)4,E.5(1B,DJ,+)**,1923,]]^,92V),L))3,8)(=91,HD55)H1)4,1D,HD?E)3*21),JD5,(?E.5(1()*,234>D5,*2,+1*K,,HD55)H1(D3,J2H1D5,(*,.*)4,1D,H2+H.+21),19),2?D.31,DJ,HD?ED.34,3)H)**25B,1D,2H9()V),19),4)*(5)4,HD3H)31521(D3,DJ,19),E25)31,HD?ED.34,(3,*D+.1(D3K,,
- W.5(1B,DJ,(*D?)5(H,HD?ED.34*,(*,5)ED51)4,2*,19),*.?,DJ,19),(*D?)5*K,,
- W.5(1B,V2+.)*,25),5D.34)4,1D,19),3)25)*1,89D+),3.?L)5K

Certified Uncertainty Value Notes:

- I9),.3H)512(31()*,25),4)1)5?(3)4,(3,2HHD5423H),8(19,[0_,!&$ S,234,Z.(4), %K,I9),H)51(J()4,HD?L(3)4,*15)**)4,.3H)512(31B,V2+.),6,(3H+.4)*,=52V(?)15(H,.3H)512(31B;,9D?D=)3)(1B,L)18))3`2?E.+,.3H)512(31B;,*1D52=),*12L(+(1B.3H)512(31B,234,*9(EE(3=,*12L(+(1B,.3H)512(31B,234,8)5),HD?L(3)4,.*(3=,19),JD++D8(3=,JD5?.+2Y

$$U_{combined\ stressed} = k\sqrt{U^2_{gravimetric} + U^2_{homogeneity} + U^2_{storage\ stability} + U^2_{shipping\ stability}}$$

k (*,2,HDV)52=),J2H1D5,DJ,";,89(H9,=(V)*,2,+)V)+,DJ,HD3J(4)3H),DJ,2EE5DU(?21)+B,]%^K

- [1,(*,(?ED51231,1D,3D1),1921,19),*9(EE(3=,*12L(+(1B,.3H)512(31B,82*,DL12(3)4,.34)5,1)?E)521.5),)U15)?)*,JD5,*E)H(J(H,1(?),,(31)5V2+*a,19)5)JD5);,19),H)51(J()4,HD?L(3)4,*15)**)4,.3H)512(31B,V2+.),*9D.+4,D3+B,L),2EE+()4,1D,19),E5D4.H1,(J,(1,82*,*1D5)4,21,3D3`*1234254,1)?E)521.5),HD34(1(D3*,.E,1D,234,(3H+.4(3=,&,42B*,21,,3D3`*1234254,1)?E)521.5),HD34(1(D3*K
- #EE+B,19),H)51(J()4,HD?L(3)4,.3*15)**)4,.3H)512(31B,V2+.),(J,19),E5D4.H1,82*,5)H)(V)4,.34)5,*1234254,*9(EE(3=,HD34(1(D3*K,,,#EE+B,19),H)51(J()4,HD?L(3)4,*15)**)4,.3H)512(31B,V2+.),(J,19),E5D4.H1,82*,5)H)(V)4,.34)5,3D3`*1234254,HD34(1(D3*,2*,*E)H(J()4,L)+D8K,

Label Conditions	Standard Conditions	Non-Standard Conditions
"%FC,ND?(32+,(3DD?,I)?E)521.5) :	c,R$FC,	Q,R$FC,.E,1D,&,42B*
!$FC,D5,HD+4)5,6O)J5(=)521):	c,S$FC,	Q,S$FC,.E,1D,&,42B*
$FC,D5,HD+4)5,6-5))P)5:	c,"%FC,	Q,"%FC,,.E,1D,&,42B*

- 0)E2521),63D1,HD?L(3)4:,.3H)512(31B,V2+.)*,JD5,=52V(?)15(H,.3H)512(31B,25),2+*D,4(*E+2B)4,D3,19),H)51(J(H21);,(J,3))4)4;,,*)E2521),9D?D=)3)(1B,L)18))3`2?E.+,.3H)512(31B;,*1D52=),*12L(+(1B,.3H)512(31B,234,*9(EE(3=,*12L(+(1B,.3H)512(31B,V2+.)*,25),2V2(+2L+),LB,HD312H1(3=,O)*1)b,JD5,93(H2+,0)5V(H),21,888K5)*1)bKHD?>CD312H1K7*
- I9),E2Hb2=)4,2?D.31,(*,19),?(3(?.?,*2?E+),*(P),JD5,89(H9,.3H)512(31B,(*,V2+(4K,,I9),2?E.+)*,25),DV)5`J(++)4,1D,)3*.5),1921,19),?(3(?.?,E2Hb2=)4,2?D.31,H23,L),*. JJ(H()31+B,1523*J)5K6)4

Manufacturing Notes:

- CD3H)31521(D3,(*,L2*)4,.ED3,=52V(?)15(H,E5)E2521(D3,.*(3=,)(19)5,2,L2+23H),89D*),H2+(L521(D3,92*,L))3,V)5(J()4,42(+B,.*(3=,N[0 I ,152H)2L+),8)(=91,*,234>D5,4(+.1(D3*,8(19,C+2,*=+2**825)K

Handling Notes:

- 012L(+(1B,DJ,19),.3DE)3)4,E5D4.H1;,89)3,*1D5)4,(3,HD?E+(23H),8(19,19),5)HD??)34)4,HD34(1(D3*;,(*,=.25231))4,195D.=9,19),)UE(521(D3,4(*E+2B)4,D3,19),E5D4.H1,+2L)+,234,H)51(J(H21)K,CD312H1,O)*1)b,JD5,244(1(D32+,DE)3)4,E5D4.H1,*12L(+(1B,(3JD5?21(D3;,8(19,19),b3D8+)4=)>.34)5*1234(3=,1921,DE)3,E5D4.H1,*12L(+(1B,(*,*.LM)H1,1D,19),*E)H(J(H,9234+(3=,234,)3V(5D3?)312+,HD34(1(D3*,1D,89(H9,19),E5D4.H1,(*,)UED*)4K,-D5,BD.5,HD3V)3()3H),O)*1)b,*.EE+()*,4)2H1(V21)4,V(2+*,8(19,?D*1,*1234254*,E2Hb)4,(3,"? @2?E.+)* K,@25=)5,VD+.?),4)2H1(V21)4,V(2+*,25),2V2(+2L+),195D.=9,O)*1)b,2*,2,H.*1D?,D54)5)4,(1)?K,#44(1(D32++B;,O)*1)b,*)++*,'A'C0,JD5,19),E.5ED*),DJ,=+2**825),4)2H1(V21(D3,2*,H212+D=,3.?L)5, !dR!;,89(H9,(3H+.4)*,HD?E+)1),(3*15.H1(D3*K
- [J,23B,.34(**D+V)4,?21)5(2+,(*,V(*(L+),(3*(4),19),2?E.+;,*D3(H21),19),.3DE)3)4,2?E.+,.31(+,19),?21)5(2+,(*,HD?E+)1)+B,4(**D+V)4K

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Dioxin Extractions QC Benchsheet

Reagent and Standard QC

Chemical Receiving Inventory #	Reageant/ Standard	Brand	Lot #	Date Received/ Made	Intial Amount	Solvent Exchange	FEV	GC/ HRMS Pass Y/N
	Toluene	Omni Solv	I4405216	6/15/24	100mL	Nonane	10µL	
	DCM	Omni Solv			100mL	Nonane	10µL	
	Hexane	Omni Solv			100mL	Nonane	10µL	
	MeOH	B&J			100mL	Nonane	10µL	
	Nonane	Acros Organics			100µL	N/A	10µL	
	Purified Sand	Sakrete			2 scoop	Nonane	10µL	
	Glasswool	Corning Life Sciences			1" in column	Nonane	10µL	
	0% Silica	Fisher			2 scoop	Nonane	10µL	
	Acid Silica	Fisher			2 scoop	Nonane	10µL	
	Basic Silica	Fisher			2 scoop	Nonane	10µL	
	Florisil	Fluka			1 scoop	Nonane	10µL	
	Rec Standard	Wellington Labs			1mL	Nonane	10µL	
	Clean-up Standard	Wellington Labs			1mL	Nonane	10µL	
	OPR Standard	Wellington Labs			20µL	Nonane	10µL	
	QLS Standard	Wellington Labs			20µL	Nonane	10µL	

Prep Analyst/Date: 6/24/24	**Inst. Run Date:**

Dataset: Untitled
Last Altered: Monday, June 29, 2020 10:03:07 Pacific Daylight Time
Printed: Monday, June 29, 2020 10:04:40 Pacific Daylight Time

Method: T:\Autospec\Methods\Dioxin200625.mdb 26 Jun 2020 07:56:21
Calibration: T:\Autospec\Curves\200530ICIH.cdb 01 Jun 2020 10:55:54

ID: TOL I5216, Name: 20062529, Date: 26-Jun-2020, Time: 13:22:47, Conditions: AUTOSPEC01, User: pk

Compound	RT	RRT	Ion1Area	Ion2Area	RRF	Ratio	Pred R	Noise 1	Noise 2	Height 1	Height 2	S/N 1	SNFlag	EMPC	Int.1	Int.2	pg
2378-TCDF					0.795		0.770	502	912								
12378-PeCDF					0.797		1.550	617	1077								
23478-PeCDF	30.165	1.001	1.227e2	1.579e2	0.962	0.777	1.550	617	1077	2.10e3	3.93e3	3.4	YES	YES	bb	db	0.021
123478-HxCDF					0.973		1.240	730	521								
234678-HxCDF					0.984		1.240	730	521								
123678-HxCDF					0.916		1.240	730	521								
123789-HxCDF					0.922		1.240	730	521								
1234678-HpCDF					1.096		1.050	407	561								
1234789-HpCDF					1.055		1.050	407	561								
OCDF					1.325		0.890	699	892								
2378-TCDD					1.140		0.770	598	496								
12378-PeCDD					1.091		1.550	796	359								
123478-HxCDD					0.922		1.240	426	461								
123678-HxCDD					0.949		1.240	426	461								
123789-HxCDD					0.847		1.240	426	461								
1234678-HpCDD	39.214	1.000	1.780e2	1.648e2	1.124	1.080	1.050	623	450	5.26e3	4.42e3	8.4	YES	NO	db	bd	0.056
OCDD	43.632	1.001	7.460e2	8.959e2	1.237	0.833	0.890	548	755	1.46e4	1.18e4	26.6	YES	NO	db	bb	0.395
13C-2378-TCDF	24.683	1.007	8.253e5	1.052e6	2.214	0.784	0.770	2142	1231	1.27e7	1.60e7	5920.7	YES	NO	bb	bb	104.193
13C-12378-PeCDF	28.785	1.175	9.077e5	5.652e5	1.903	1.606	1.550	3236	2267	1.39e7	8.73e6	4292.3	YES	NO	bb	bb	95.101
13C-23478-PeCDF	30.132	1.230	8.542e5	5.386e5	1.845	1.586	1.550	3236	2267	1.36e7	8.60e6	4196.7	YES	NO	bb	bb	92.784
13C-123478-HxCDF	33.782	0.953	3.067e5	6.177e5	1.198	0.496	0.510	985	2180	4.77e6	9.43e6	4845.3	YES	NO	bd	bd	100.338
13C-123678-HxCDF	33.927	0.957	3.240e5	6.472e5	1.488	0.501	0.510	985	2180	4.94e6	9.69e6	5021.3	YES	NO	db	db	84.878
13C-234678-HxCDF	34.828	0.982	2.825e5	5.661e5	1.195	0.499	0.510	985	2180	4.58e6	9.04e6	4654.9	YES	NO	bb	bb	92.321
13C-123789-HxCDF	35.875	1.012	2.245e5	4.600e5	1.014	0.488	0.510	985	2180	3.58e6	7.24e6	3633.6	YES	NO	bb	bb	87.800
13C-1234678-HpCDF	37.756	1.065	2.347e5	5.376e5	1.197	0.437	0.440	1921	1828	3.90e6	8.90e6	2030.5	YES	NO	bb	bb	83.898
13C-1234789-HpCDF	39.893	1.125	1.546e5	3.545e5	0.893	0.436	0.440	1921	1828	2.31e6	5.25e6	1200.4	YES	NO	bb	bb	74.159
13C-1234-TCDD	24.501	0.000	3.592e5	4.546e5	1.000	0.790	0.770	1294	805	5.73e6	7.24e6	4430.9	YES	NO	bb	bb	100.000
13C-2378-TCDD	25.302	1.033	4.262e5	5.508e5	1.193	0.774	0.770	1294	805	6.55e6	8.49e6	5063.6	YES	NO	bb	bb	100.651
13C-12378-PeCDD	30.388	1.240	5.085e5	2.920e5	0.962	1.741	1.550	1585	769	8.14e6	4.57e6	5135.1	YES	NO	bb	bb	102.293
13C-123478-HxCDD	34.951	0.986	4.607e5	3.535e5	1.059	1.303	1.240	1709	1194	7.44e6	5.71e6	4354.5	YES	NO	bd	bd	99.975
13C-123678-HxCDD	35.062	0.989	4.656e5	3.558e5	1.278	1.309	1.240	1709	1194	7.41e6	5.66e6	4332.5	YES	NO	db	db	83.562
13C-1234678-HpCDD	39.203	1.105	2.827e5	2.610e5	0.843	1.083	1.050	1161	1015	4.45e6	4.04e6	3833.9	YES	NO	bb	bb	83.842
13C-OCDD	43.605	1.230	3.233e5	3.491e5	0.616	0.926	0.890	1678	2408	4.02e6	4.31e6	2392.6	YES	NO	bb	bb	141.987

ID: TOL I5216, Name: 20062529, Date: 26-Jun-2020, Time: 13:22:47, Conditions: AUTOSPEC01, User: pk

Compound	RT	RRT	Ion1Area	Ion2Area	RRF	Ratio	Pred R	Noise 1	Noise 2	Height 1	Height 2	S/N 1	SNFlag	EMPC	Int.1	Int.2	pg
13C-123789-HxCDD	35.463	0.000	4.323e5	3.368e5	1.000	1.283	1.240	1709	1194	6.94e6	5.37e6	4058.0	YES	NO	bb	bb	100.000
37CL-2378-TCDD	25.227	1.030	1.071e2		1.258			1328		2.42e3		1.8	NO		db		0.010
1368-TCDF					1.007		0.770	502	912								
1289-TCDF					0.754		0.770	502	912								
13468-PECDF					1.099		1.550	293	640								
12389-PECDF	31.178	1.083	1.504e2	7.409e1	0.841	2.030	1.550	617	1077	2.46e3	2.87e3	4.0	NO	YES	bb	bb	0.018
123468-HXCDF					1.142		1.240	730	521								
1368-TCDD					1.214		0.770	598	496								
1289-TCDD					1.061		0.770	598	496								
12479-PECDD					2.040		1.550	796	359								
12389-PECDD					1.257		1.550	796	359								
124679-HXCDD					1.164		1.240	426	461								
1234679-HPCDD	38.245	0.976	8.609e1	1.019e2	1.378	0.845	1.050	623	450	1.89e3	2.90e3	3.0	YES	YES	bb	bb	0.025
Total-tetrafurans			0.000e0		0.852			502		0.00e0							
Total-penta1			0.000e0					293		0.00e0							
Total-pentafurans			0.000e0		0.867			617		0.00e0							
Total-hexafurans			0.000e0		0.987			730		0.00e0							
Total-heptafurans			0.000e0		1.076			407		0.00e0							
Total-Furans			0.000e0		0.978			502		0.00e0							
Total-tetradioxins			0.000e0		1.138			598		0.00e0							
Total-pentadioxins			0.000e0		1.463			796		0.00e0							
Total-hexadioxins			0.000e0		0.971			426		0.00e0							
Total-heptadioxins			1.780e2		1.251			623		5.26e3							0.056
Total-Dioxins			9.240e2		1.187			598		1.99e4							0.451
Total-TEQ			9.240e2					598		1.99e4							0.451
FUNCTION1 PFK			1.728e5					220633		4.73e6							
FUNCTION2 PFK			0.000e0					159655		0.00e0							
FUNCTION3 PFK			0.000e0					198585		0.00e0							
FUNCTION4 PFK			2.228e5					179610		7.02e6							
FUNCTION5 PFK			2.507e4					138501		1.09e6							
FUNCTION1 HXCDPE			0.000e0					189		0.00e0							
FUNCTION1 HPCDPE			4.279e2					738		9.46e3							0.000
FUNCTION2 HPCDPE			1.573e2					792		4.18e3							0.000
FUNCTION3 OCDPE			8.296e1					216		3.72e3							0.000
FUNCTION4 NCDPE			0.000e0					279		0.00e0							
FUNCTION5 DCDPE			0.000e0					233		0.00e0							

ThermoFisher SCIENTIFIC

Certificate of Analysis

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

ThermoFisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0090918

This is to certify that units of the lot number below were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. ThermoFisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing.ThermoFisher does not maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	T291	Quality Test / Release Date	08/15/2018
Lot Number	184485		
Description	TOLUENE - OPTIMA		
Country of Origin	United States	Suggested Retest Date	Aug/2023
Chemical Origin	Organic - non animal		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		
Chemical Comment			

N/A			
Result Name	Units	Specifications	Test Value
APPEARANCE		REPORT	Clear colorless liquid free of suspended matter
ASSAY	%	>= 99.8	99.9
BENZENE	%	<= 0.05	<0.05
COLOR	APHA	<= 10	<5
EVAPORATION RESIDUE	ppm	<= 1	<0.1
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
OPTICAL ABS AT 285 NM	ABSORBANCE UNITS	<= 1	0.69
WATER (H2O)	%	<= 0.02	0.02
OPTICAL ABS AT 325 NM	ABSORBANCE UNITS	<= 0.02	0.01
OPTICAL ABS AT 350 NM	ABSORBANCE UNITS	<= 0.005	0.001
PESTICIDE RESIDUE ANALYSIS	NG/L	<= 10	<1
REFRACTIVE INDEX @ 25 DEG C		Inclusive Between 1.4930 - 1.4950	1.4940
SUBSTANCES DARKENED BY H2SO4	PASS/FAIL	= PASS TEST	PASS TEST
SULFUR COMPOUNDS	%	<= 0.003	<0.0003
OPTICAL ABS AT 300 NM	ABSORBANCE UNITS	<= 0.1	0.07

Teresa Bailey-Wyche

Quality Assurance Specialist - Certificate of Analysis Bridgewater

Note: The data listed is valid for all package sizes of this lot of this product, expressed as an extension of this catalog number listed above.
If there are any questions with this certificate, please call at (800) 227-6701.
*Based on suggested storage condition.

RESTEK®
110 Benner Circle
Bellefonte, PA 16823-8812
Tel: (800)356-1688
Fax: (814)353-1309

www.restek.com

CERTIFIED REFERENCE MATERIAL

Certificate of Analysis

ACCREDITED
ISO 17034 Accredited
Reference Material Producer
Certificate #3222.01

ACCREDITED
ISO/IEC 17025 Accredited
Testing Laboratory
Certificate #3222.02

FOR LABORATORY USE ONLY-READ SDS PRIOR TO USE.

This Reference Material is intended for Laboratory Use Only as a standard for the qualitative and/or quantitative determination of the analyte(s) listed.

J006454
DIESEL#2 2ND SOURCE stock
Solvent / Lot: mecl2
Prep: 6/18/2021 by JR
Exp: 4/30/2028
Location:

Catalog No. : !"
Lot No.: #$!%$&'$
Description : ()*+*,-./*,-0"-12345365-7849*32:*6*5;

()*+*,-./*,-0"-12345365-7849*32:*6*5;-<=$$$->?@AB=-C*2:D,*4*-E:,F6)5*=-!AB@3AG/,

Container Size : "-AB
Pkg Amt: I-!-AB
Expiration Date : #G6),- $=-"$"J
Storage: "<HE-4FA)43,
Ship: #AK)*42

C E R T I F I E D V A L U E S

Elution Order	Compound	Grav. Conc. (weight/volume)	Expanded Uncertainty (95% C.L.; K=2)	
1	Diesel Fuel #2 - Single Source	5,008.0 µg/mL	+/- 29.3897 µg/mL	Gravimetric
	CAS # 68334-30-5.C (Lot 032404SZ)		+/- 149.1577 µg/mL	Unstressed
	Purity ----%		+/- 159.0749 µg/mL	Stressed

Solvent: Methylene chloride
CAS # 75-09-2
Purity 99%

Column:
!"#$#!%&""#$#!%&'("
)*$+'#,-. *%/0!&& 1

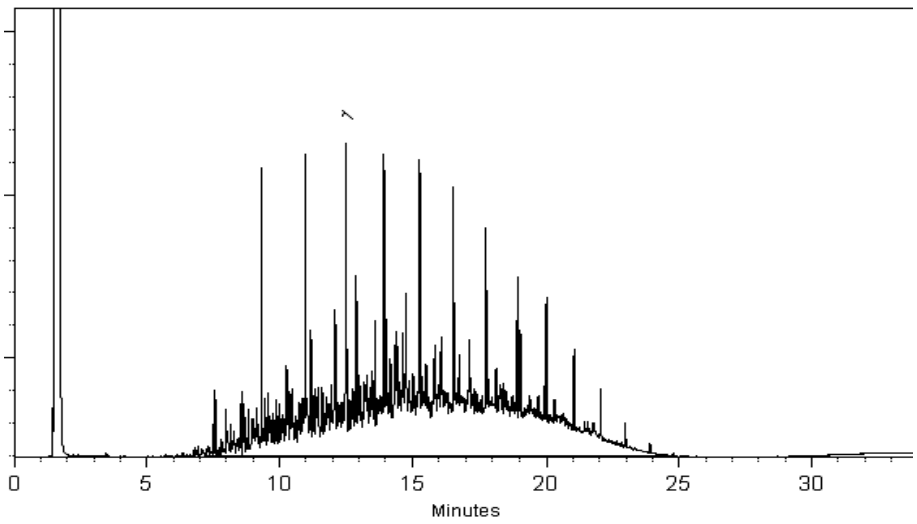
Carrier Gas:
23456789+-69:*. 9*#;8::< 58#0!#:=%

Temp. Program:
>!?@#,26A4#&#"=9%#1#?@
B#0!?@C"=9%#,26A4#0!#"=9%1

Inj. Temp:
&'!?@

Det. Temp:
!?@

Det. Type:
DEF



Q:)+-R:6FA32F?63A-6*G6*+*42+-3-?*4*63,-+*2-FP-2*+2)4?-RF45)2)F4+-R:F+*4-PF6-G6F5/R2-3RR*G234R*N--.F6-FG2)A3,-6*+/,2+-)4-DF/6-,3K=-RF45)2)F4+-+:F/,5-K*-35S/+2*5-PF6-DF/6-+G*R)P)R-)4+26/A*42=-A*2:F5=-345-3GG,)R32)F4N

Erik Strommer - Operations Tech I

Date Mixed: 25-Mar-2021 **Balance:** 1128353505

Marlina Cowan - Operations Tech I

Date Passed: 30-Mar-2021

Manufactured under Restek's ISO 9001:2015
Registered Quality System
Certificate #FM 80397

$!L#/?L"$"$-6*MN -"-FP-

General Certified Reference Material Notes

Expiration Notes:

- XYG)632)F4-532*-M3,)5-PF6-/4FG*4*5-3AG/,-+2F6*5-)4-RFAG,)34R*-9)2:-2:*-6*RFAA*45*5-RF45)2)F4+N
- 84R*623)42D=-RF4R*42632)F4=-345-*YG)632)F4-FP-2:*-EUC-36*-K3+*5-F4-2:*-/4FG*4*5-G6F5/R2-K*)4?-+2F6*5-3RRF65)4?-2F-2:*-6*RFAA*45*5-RF45)2)F4-PF/45-)4-2:*-+2F63?*-P)*,5N

Purity Notes:

- O/6)2D-345@F6-R:*A)R3,-)5*42)2D-36*-5*2*6A)4*5-KD-F4*-F6-AF6*-FP-2:*-PF,,F9)4?-2*R:4)Z/*+[-\E@.](=-^OBE=-\E@>XE(=-\E@C1=-BE@C1=-U]=-345@F6-A*,2)4?-GF)42N
- EFAGF/45+-9)2:-3-,)+2*5-G/6)2D-FP-,*++-2:34-__`-:3M*-K**4-9*)?:2-RF66*R2*5-2F-RFAG*4+32*-PF6-)AG/6)2)*+-345@F6-+3,2+N--RF66*R2)F4-P3R2F6-)+-/+*5-2F-R3,R/,32*-2:*-3AF/42-FP-RFAGF/45-4*R*++36D-2F-3R:)*M*-2:*-5*+)6*5-RF4R*42632)F4-FP-2:*-G36*42-RFAGF/45-)4-+F,/2)F4N--
- O/6)2D-FP-)+FA*6)R-RFAGF/45+-)+-6*GF62*5-3+-2:*-+/A-FP-2:*-)+FA*6+N--
- O/6)2D-M3,/*+-36*-6F/45*5-2F-2:*-4*36*+2-9:F,*-4/AK*6N

Certified Uncertainty Value Notes:

- Q:*-/4R*623)42)*+-36*-5*2*6A)4*5-)4-3RRF6534R*-9)2:-]1a-!%$ '-345-\/)5*- <N-Q:*-R*62)P)*5-RFAK)4*5-+26*++*5-/4R*623)42D-M3,/*-7-)4R,/5*+-?63M)A*26)R-/4R*623)42D=-:FAF?*4*)2D-K*29**4L3AG/,-/4R*623)42D=-+2F63?*-+23K),)2D/4R*623)42D-345-+:)GG)4?-+23K),)2D-/4R*623)42D-345-9*6*-RFAK)4*5-/+)4?-2:*-PF,,F9)4?-PF6A/,3[

$$U_{combined\ stressed} = k\sqrt{U^2_{gravimetric} + U^2_{homogeneity} + U^2_{storage\ stability} + U^2_{shipping\ stability}}$$

k)+-3-RFM*63?*-P3R2F6-FP-"=-9:)R:-?)M*+-3-,*M*,-FP-RF4P)5*4R*-FP-3GG6FY)A32*,D-_<`N

-]2-)+-)AGF62342-2F-4F2*-2:32-2:*-+:)GG)4?-+23K),)2D-/4R*623)42D-93+-FK23)4*5-/45*6-2*AG*632/6*-*Y26*A*+-PF6-+G*R)P)R-2)A*--)42*6M3,+b-2:*6*PF6*=-2:*-R*62)P)*5-RFAK)4*5-+26*++*5-/4R*623)42D-M3,/*-+:F/,5-F4,D-K*-3GG,)*5-2F-2:*-G6F5/R2-)P-)2-93+-+2F6*5-32-4F4L+2345365-2*AG*632/6*-RF45)2)F4+-/G-2F-345-)4R,/5)4?-F6-423R2+U*+2*Q*R:4)R3,-1*6M)R*-32-999N6*+2*cNRFA@EF423R2+U8-/+*-6*RFAA*4532)F4+-)P-DF/6-+:)GA*42-93+-)4L2634+)2-PF6-AF6*-2:34-%-53D+-32--4F4L+2345365-2*AG*632/6*-RF45)2)F4+N
- #GG,D-2:*-R*62)P)*5-RFAK)4*5-/4+26*++*5-/4R*623)42D-M3,/*-)P-2:*-G6F5/R2-93+-6*R*)M*5-/45*6-+2345365-+:)GG)4?-RF45)2)F4+N---#GG,D-2:*-R*62)P)*5-RFAK)4*5-+26*++*5-/4R*623)42D-M3,/*-)P-2:*-G6F5/R2-93+-6*R*)M*5-/45*6-4F4L+2345365-RF45)2)F4+-3+-+G*R)P)*5-K*,F9N-

Label Conditions	Standard Conditions	Non-Standard Conditions
"<HE-TFA)43,--7UFFA-Q*AG*632/6*;	d-&$HE-	W-&$HE-/G-2F-%-53D+
!$HE-F6-RF,5*6-7U*P6)?*632*;	d-'$HE-	W-'$HE-/G-2F-%-53D+
$HE-F6-RF,5*6-7.6**V*6; L"$HE-F6-RF,5*6-7(**G-.6**V*6;	d-"<HE-	W-"<HE--/G-2F-%-53D+

- 1*G3632*-74F2-RFAK)4*5;-/4R*623)42D-M3,/*+-PF6-?63M)A*26)R-/4R*623)42D-36*-3,+F-5)+G,3D*5-F4-2:*-R*62)P)R32*=-)P-4**5*5=--+*G3632*-:FAF?*4*)2D-K*29**4L3AG/,-/4R*623)42D=-+2F63?*-+23K),)2D-/4R*623)42D-345-+:)GG)4?-+23K),)2D-/4R*623)42D-M3,/*+-36*-3M3),3K,*-KD-RF423R2)4?-U*+2*c-PF6-4)R3,-1*6M)R*-32-999N6*+2*cNRFA@EF423R2+U8L8+
- Q:*-G3Rc3?*5-3AF/42-)+-2:*-A)4)A/A-+3AG,*-+)V*-PF6-9:)R:-/4R*623)42D-)+-M3,)5N--Q:*-3AG/,*+-36*-FM*6LP),,*5-2F-*4+/6*-2:32-2:*-A)4)A/A-G3Rc3?*5-3AF/42-R34-K*-+/P)R)*42,D-2634+P*66*5

Manufacturing Notes:

- EF4R*42632)F4-)+-K3+*5-/GF4-?63M)A*26)R-G6*G3632)F4-/+)4?-*)2:*6-3-K3,34R*-9:F+*-R3,)K632)F4-:3+-K**4-M*6)P)*5-53),D-/+)4?-T]1 Q-263R*3K,*-9*)?:2+-345@6-5),/2)F4+-9)2:-E,3+#-?,3++936*N

Handling Notes:

- 123K),)2D-FP-2:*-/4FG*4*5-G6F5/R2=-9:*4-+2F6*5-)4-RFAG,)34R*-9)2:-2:*-6*RFAA*45*5-RF45)2)F4+=-)+-?/36342**5-2:6F/?:-2:*-*YG)632)F4-5)+G,3D*5-F4-2:*-G6F5/R2-,3K*,-345-R*62)P)R32*N-EF423R2-U*+2*c-PF6-355)2)F43,-FG*4*5-G6F5/R2-+23K),)2D-)4PF6A32)F4=-9)2:-2:*-c4F9,*5?*@/45*6+2345)4?-2:32-FG*4-G6F5/R2-+23K),)2D-)+-+/KS*R2-2F-2:*-+G*R)P)R-:345,)4?-345-*4M)6F4A*423,-RF45)2)F4+-2F-9:)R:-2:*-G6F5/R2-)+-*YGF+*5N-.F6-DF/6-RF4M*4)*4R*-U*+2*c-+/GG,)*+-5*3R2)M32*5-M)3,+-9)2:-AF+2-+2345365+-G3Rc*5-)A-B-3AG/,*+ N-B36?*6-MF,/A*-5*3R2)M32*5-M)3,+-36*-3M3),3K,*-2:6F/?:-U*+2*c-3+-3-R/+2FA-F65*6*5-)2*AN-#55)2)F43,,D=-U*+2*c-+*,,+-(C(E1-PF6-2:*-G/6GF+*-FP-?,3++936*-5*3R2)M32)F4-3+-R323,F?-4/AK*6- !J&!=-9:)R:-)4R,/5*+-RFAG,*2*-)4+26/R2)F4+N

Version	00
Molecular weight	422.82
Quality Test / Release Date	01/10/2012
Molecular Formula	C30 H62
CAS No	638-68-6
Linear Formula	CH3(CH2)28CH3
Flash Point (°C)	238

Certificate of Analysis

This is to certify that units of the above mentioned lot number were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Acros Organics expressly disclaims all warranties,expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Unless otherwise stated, these products are not intended for dialysis, parenteral, or injectable use without further processing. The following are the actual analytical results obtained:

Catalog Number	27805	**Quality Test / Release Date**	01/10/2012
Lot Number	A0314709		
Description	Triacontane,98%		
Country of Origin	SWEDEN		
Declaration of Origin			

BSE/TSE comment 1	

Chemical Comment	

Result name	Units	Specifications	Test Value
Appearance		WHITE SHINY FLAKES	WHITE SHINY FLAKES
Infrared spectrometry		AUTHENTIC	AUTHENTIC
Melting point		65°C to 67°C	67°C
Separat. techn. GC		>=97.5 %	99.4 %

L. Van Den Broek, QA Manager Issued: 07-26-2013

Acros Organics
ENA23, zone1, nr 1350, Janssen Pharmaceuticalaan 3a, B-2440 Geel, Belgium
Tel +32 14/57.52.11 - Fax +32 14/59.34.34 Internet: http://www.acros.com
1 Regent Lane, Fair Lawn, NJ 07410, USA Fax 201-796-1329

J007974
TPHD Triacontane NEAT
Solvent / Lot: NEAT
Prep: 8/3/2021 by CTO
Exp: 1/30/2079
Location: GC

Form I
INORGANIC ANALYSIS DATA SHEET
SM 2540 G-97

HSA-59-9-10.5

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-01 B	SDG:	21I0042
Sampled:	08/30/21 11:55	Prepared:	09/08/21 11:18	File ID:	
% Solids:	38.24	Preparation:	No Prep Wet Chem	Analyzed:	09/08/21 11:21
Batch:	BJI0226	Sequence:		Initial/Final:	5 g Wet / 5 g
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	38.24	1	0.04	0.04	

Form I
INORGANIC ANALYSIS DATA SHEET
SM 2540 G-97

HSA-60-9-10.5

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-02 B	SDG:	21I0042
Sampled:	08/30/21 14:20	Prepared:	09/08/21 11:18	File ID:	
% Solids:	27.05	Preparation:	No Prep Wet Chem	Analyzed:	09/08/21 11:21
Batch:	BJI0226	Sequence:		Initial/Final:	5 g Wet / 5 g
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	27.05	1	0.04	0.04	

Form I
INORGANIC ANALYSIS DATA SHEET
SM 2540 G-97

HSA-62-13-14

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-03 B	SDG:	21I0042
Sampled:	08/31/21 11:00	Prepared:	09/08/21 11:18	File ID:	
% Solids:	73.67	Preparation:	No Prep Wet Chem	Analyzed:	09/08/21 11:21
Batch:	BJI0226	Sequence:		Initial/Final:	5 g Wet / 5 g
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	73.67	1	0.04	0.04	

Form I
INORGANIC ANALYSIS DATA SHEET
SM 2540 G-97

DUP-1-083121

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-04 B	SDG:	21I0042
Sampled:	08/31/21 11:30	Prepared:	09/08/21 11:18	File ID:	
% Solids:	69.07	Preparation:	No Prep Wet Chem	Analyzed:	09/08/21 11:21
Batch:	BJI0226	Sequence:		Initial/Final:	5 g Wet / 5 g
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	69.07	1	0.04	0.04	

PREPARATION BATCH SUMMARY

SM 2540 G-97

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Batch: BJI0226
Batch Matrix: Solid
Preparation: No Prep Wet Chem

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
HSA-59-9-10.5	21I0042-01		09/08/21 11:18	
HSA-60-9-10.5	21I0042-02		09/08/21 11:18	
HSA-62-13-14	21I0042-03		09/08/21 11:18	
DUP-1-083121	21I0042-04		09/08/21 11:18	
Blank	BJI0226-BLK1		09/08/21 11:18	
HSA-59-9-10.5	BJI0226-DUP2		09/08/21 11:18	

NOTE: Do not enter data in blue shaded cells as they are calculated fields. Green shaded cells MAY be altered if a rewigh is called for.

TOTAL SOLIDS (TS) BENCHSHEET for Solid samples

Method: Total Solids, Metals Correction

dry at 104°C (12-24 hr)

Batch:	BJI0441
Date:	9/15/2021 16:06
Analyst:	MA

Instrumentation

Drying Oven:	Ø7	
Analytical Balance:	11	

Batch drying time

record times as mm/dd/yy hh:mm

date/time in oven:	9/15/21	1650
date/time out:	9/16/21	1145
elapsed hrs =	0.0	

Temp in: 104 °C

Temp out: 105 °C

TS (%) calculated as:
Final dry wt (g) = (Dry Wt - Tare Wt)
TS = (Final Dry Wt)/ (grams Sample-Tare)

Sample ID	Tare Weight (g)	Tare + Sample Weight (g)	Tare + Sample Dry Weight @ 104°C (g) 1	2	3	dry Wt (g)	TS (%)	Notes
21I0005-01	1.013	10.858	9.733					
21I0042-01	1.007	10.138	4.074					
21I0042-02	1.001	10.596	3.947					
21I0126-01	1.011	10.458	9.853					
21I0135-01	1.001	10.829	10.650					
21I0147-01	0.997	10.231	7.802					
21I0147-02	1.008	10.491	7.882					
21I0147-03	1.009	10.643	7.182					
21I0147-04	1.012	10.330	6.845					
21I0147-05	1.009	10.867	8.455					
21I0147-06	1.014	10.441	7.985					

Form I

METHOD BLANK DATA SHEET

SM 2540 G-97

TotalAnalytes

Blank

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Batch: BJI0226
Laboratory ID: BJI0226-BLK1
Prepared: 09/08/21 11:18
Matrix: Solid
Preparation: No Prep Wet Chem
Analyzed: 09/08/21 11:21
Sequence:
Calibration:
Instrument: BAL2

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	ND	1	0.04	0.04	U

DUPLICATES

SM 2540 G-97

Laboratory: Analytical Resources, Inc.
SDG: 21I0042

Client: GeoEngineers
Project: South State Street PRDI

Matrix: Solid
Laboratory ID: BJI0226-DUP2

Batch: BJI0226
Lab Source ID: 21I0042-01

Preparation: No Prep Wet Chem
Initial/Final: 5 g / 5 g

Source Sample Name: HSA-59-9-10.5
% Solids: 38.24

ANALYTE	CONTROL LIMIT	SAMPLE CONCENTRATION (%)	C	DUPLICATE CONCENTRATION (%)	C	RPD %	Q
Total Solids	20	38.24		31.34		19.8	

*: Values outside of QC limits
L: Analyte concentration is <=5 times the reporting limit and the replicate control limit defaults to Dup = +/- RL instead of 20% RPD

HOLDING TIME SUMMARY

Analysis: SM 2540 G-97

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
HSA-59-9-10.5 21I0042-01	08/30/21 11:55	09/02/21 10:52	09/08/21 11:18	8	28	09/08/21 11:21	9	28	
HSA-60-9-10.5 21I0042-02	08/30/21 14:20	09/02/21 10:52	09/08/21 11:18	8	28	09/08/21 11:21	9	28	
HSA-62-13-14 21I0042-03	08/31/21 11:00	09/02/21 10:52	09/08/21 11:18	8	28	09/08/21 11:21	8	28	
DUP-1-083121 21I0042-04	08/31/21 11:30	09/02/21 10:52	09/08/21 11:18	7	28	09/08/21 11:21	8	28	
Duplicate BJI0226-DUP2	08/30/21 11:55	09/02/21 10:52	09/08/21 11:18	8	28	09/08/21 11:21	9	28	

* Indicates hold time exceedance.

METHOD DETECTION AND REPORTING LIMITS

SM 2540 G-97

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Solid
Instrument:

Analyte	MDL	RL	Units
Total Solids	0.04	0.04	%

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 6020B

Total Metals

HSA-59-9-10.5

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-01 A	SDG:	21I0042
Sampled:	08/30/21 11:55	Prepared:	09/21/21 12:40	File ID:	XDT_m1210922-036
% Solids:	38.24	Preparation:	SWN EPA 3050B	Analyzed:	09/22/21 17:12
Batch:	BJI0584	Sequence:	SJI0372	Initial/Final:	1.074 g Wet / 50 mL
Instrument:	ICPMS1			Calibration:	EI00074

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	MDL	MRL	Q
7439-89-6	Iron-57	15400	50	40	219	D

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 6020B

HSA-60-9-10.5

Total Metals

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-02 A	SDG:	21I0042
Sampled:	08/30/21 14:20	Prepared:	09/21/21 12:40	File ID:	XDT_m1210922-035
% Solids:	27.05	Preparation:	SWN EPA 3050B	Analyzed:	09/22/21 17:02
Batch:	BJI0584	Sequence:	SJI0372	Initial/Final:	1.03 g Wet / 50 mL
Instrument:	ICPMS1			Calibration:	EI00074

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	MDL	MRL	Q
7439-89-6	Iron-54	10300	50	163	323	D

PREPARATION BATCH SUMMARY

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Batch: BJI0584 Batch Matrix: Solid
Preparation: SWN EPA 3050B

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
HSA-59-9-10.5	21I0042-01	XDT_m1210922-036	09/21/21 12:40	
HSA-60-9-10.5	21I0042-02	XDT_m1210922-035	09/21/21 12:40	
Blank	BJI0584-BLK1	XDT_m1210922-032	09/21/21 12:40	BJI0584 SWN
LCS	BJI0584-BS1	XDT_m1210922-034	09/21/21 12:40	BJI0584 SWN
HSA-59-9-10.5	BJI0584-DUP1	XDT_m1210922-037	09/21/21 12:40	BJI0584 SWN
HSA-59-9-10.5	BJI0584-MS1	XDT_m1210922-038	09/21/21 12:40	BJI0584 SWN
HSA-59-9-10.5	BJI0584-MSD1	XDT_m1210922-061	09/21/21 12:40	BJI0584 SWN

Form I

METHOD BLANK DATA SHEET

EPA 6020B

Total Metals

Blank

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Batch: BJI0584
Laboratory ID: BJI0584-BLK1
Prepared: 09/21/21 12:40
Matrix: Solid
Preparation: SWN EPA 3050B
Analyzed: 09/22/21 16:44
Sequence: SJI0372
Calibration: EI00074
Instrument: ICPMS1

CAS NO.	Analyte	Concentration (mg/kg wet)	Dilution Factor	MDL	MRL	Q
7439-89-6	Iron-54	ND	20	18	36	U
7439-89-6	Iron-57	ND	20	7	36	U

LCS / LCS DUPLICATE RECOVERY

EPA 6020B

Total Metals

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/22/21 16:57
Batch:	BJI0584	Laboratory ID:	BJI0584-BS1
Preparation:	SWN EPA 3050B	Sequence Name:	LCS
Initial/Final:	1 g / 50 mL		

COMPOUND	SPIKE ADDED (mg/kg wet)	LCS CONCENTRATION (mg/kg wet)	Q	LCS % REC. #	QC LIMITS REC.
Iron-54	500	495		99.0	80 - 120
Iron-57	500	482		96.5	80 - 120

* Indicates values outside of QC limits

DUPLICATES

EPA 6020B

Total Metals

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Solid
Laboratory ID: BJI0584-DUP1
Batch: BJI0584
Lab Source ID: 21I0042-01
Preparation: SWN EPA 3050B
Initial/Final: 1.074 g / 50 mL
Source Sample Name: HSA-59-9-10.5
% Solids: 38.24

ANALYTE	CONTROL LIMIT	SAMPLE CONCENTRATION (mg/kg dry)	C	DUPLICATE CONCENTRATION (mg/kg dry)	C	RPD %	Q
Iron-57	20	15400	D	16100	D	4.55	

*: Values outside of QC limits
L: Analyte concentration is <=5 times the reporting limit and the replicate control limit defaults to Dup = +/- RL instead of 20% RPD

MS / MS DUPLICATE RECOVERY

EPA 6020B

Total Metals

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/22/21 17:21
Batch:	BJI0584	Laboratory ID:	BJI0584-MS1
Preparation:	SWN EPA 3050B	Sequence Name:	Matrix Spike
Initial/Final:	1.071 g / 50 mL	Source Sample:	HSA-59-9-10.5

COMPOUND	SPIKE ADDED (mg/kg dry)	SAMPLE CONCENTRATION (mg/kg dry)	Q	MS CONCENTRATION (mg/kg dry)	Q	MS % REC. #	QC LIMITS REC.
Iron-57	1220	15400	D	17800	HC, D	204 *	75 - 125

* Values outside of QC limits

MS / MS DUPLICATE RECOVERY

EPA 6020B

Total Metals

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/22/21 19:55
Batch:	BJI0584	Laboratory ID:	BJI0584-MSD1
Preparation:	SWN EPA 3050B	Sequence Name:	Matrix Spike Dup
Initial/Final:	1.077 g / 50 mL	Source Sample:	HSA-59-9-10.5

COMPOUND	SPIKE ADDED (mg/kg dry)	MSD CONCENTRATION (mg/kg dry)	Q	MSD % REC. #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Iron-57	1210	21100	HC, D	471 *	16.6	20	75 - 125

* Values outside of QC limits

INITIAL CALIBRATION DATA

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EI00074
Instrument: ICPMS1
Calibration Date: 09/22/2021 14:30

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
		RF		RF		RF		RF		RF		RF
Iron-54	0	0	36	1109.25	1000	588.306	2000	571.2405	5000	581.1298	10000	565.7382
Iron-57	0	0	36	389.6945	1000	238.88	2000	235.6045	5000	230.2204	10000	241.6603

INITIAL CALIBRATION DATA

EPA 6020B

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00074	Instrument:	ICPMS1
Calibration Date:	09/22/2021 14:30		

COMPOUND	Mean RF	RF RSD	Linear COD	Quad COD	COD Limit	Q
Iron-54	569.2774	61.7	0.9999		0.998	
Iron-57	222.6766	56.2	0.9994		0.998	

INITIAL AND CONTINUING CALIBRATION CHECK

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: ICPMS1
Calibration: EI00074
Control Limt: +/- 10.00%
Sequence: SJI0372

Lab Sample ID	Analyte	True	Found	%R		Units	Method
SJI0372-ICV1	Iron-54	5000.0	4970	99.4		ug/L	EPA 6020B
	Iron-57	5000.0	4650	93.0		ug/L	EPA 6020B
SJI0372-CCV1	Iron-54	5000.0	5140	103		ug/L	EPA 6020B
	Iron-57	5000.0	4810	96.2		ug/L	EPA 6020B
SJI0372-CCV2	Iron-54	5000.0	4990	99.9		ug/L	EPA 6020B
	Iron-57	5000.0	4670	93.4		ug/L	EPA 6020B
SJI0372-CCV3	Iron-54	5000.0	5050	101		ug/L	EPA 6020B
	Iron-57	5000.0	4720	94.5		ug/L	EPA 6020B
SJI0372-CCV4	Iron-54	5000.0	4810	96.2		ug/L	EPA 6020B
	Iron-57	5000.0	4470	89.4	*	ug/L	EPA 6020B
SJI0372-CCV5	Iron-54	5000.0	4980	99.7		ug/L	EPA 6020B
	Iron-57	5000.0	4610	92.2		ug/L	EPA 6020B
SJI0372-CCV6	Iron-54	5000.0	5040	101		ug/L	EPA 6020B
	Iron-57	5000.0	4660	93.2		ug/L	EPA 6020B
SJI0372-CCV7	Iron-54	5000.0	4850	97.1		ug/L	EPA 6020B
	Iron-57	5000.0	4500	90.0		ug/L	EPA 6020B
SJI0372-CCV8	Iron-54	5000.0	4680	93.5		ug/L	EPA 6020B
	Iron-57	5000.0	4310	86.1	*	ug/L	EPA 6020B
SJI0372-CCV9	Iron-54	5000.0	4750	95.1		ug/L	EPA 6020B
	Iron-57	5000.0	4420	88.3	*	ug/L	EPA 6020B
SJI0372-CCVA	Iron-54	5000.0	4760	95.1		ug/L	EPA 6020B
	Iron-57	5000.0	4420	88.4	*	ug/L	EPA 6020B
SJI0372-CCVB	Iron-54	5000.0	5020	100		ug/L	EPA 6020B
	Iron-57	5000.0	4610	92.2		ug/L	EPA 6020B
SJI0372-CCVC	Iron-54	5000.0	4760	95.2		ug/L	EPA 6020B
	Iron-57	5000.0	4420	88.5	*	ug/L	EPA 6020B
SJI0372-CCVD	Iron-54	5000.0	4830	96.6		ug/L	EPA 6020B
	Iron-57	5000.0	4440	88.8	*	ug/L	EPA 6020B
SJI0372-CCVE	Iron-54	5000.0	4850	96.9		ug/L	EPA 6020B
	Iron-57	5000.0	4490	89.9	*	ug/L	EPA 6020B
SJI0372-CCVF	Iron-54	5000.0	5100	102		ug/L	EPA 6020B
	Iron-57	5000.0	4680	93.6		ug/L	EPA 6020B
SJI0372-CCVG	Iron-54	5000.0	5350	107		ug/L	EPA 6020B
	Iron-57	5000.0	4930	98.6		ug/L	EPA 6020B

INITIAL AND CONTINUING CALIBRATION CHECK

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: ICPMS1
Calibration: EI00074
Control Limt: +/- 10.00%
Sequence: SJI0372

Lab Sample ID	Analyte	True	Found	%R		Units	Method
SJI0372-CCVH	Iron-54	5000.0	4840	96.9		ug/L	EPA 6020B
	Iron-57	5000.0	4460	89.1	*	ug/L	EPA 6020B
SJI0372-CCVI	Iron-54	5000.0	4960	99.3		ug/L	EPA 6020B
	Iron-57	5000.0	4470	89.3	*	ug/L	EPA 6020B

* Values outside of QC limits

INSTRUMENT BLANKS
EPA 6020B

Laboratory: Analytical Resources, Inc.
Client: GeoEngineers
Instrument ID: ICPMS1
Sequence: SJI0372

SDG: 21I0042
Project: South State Street PRDI
Calibration: EI00074
Date Analyzed: 09/22/21 15:03

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SJI0372-IBL1	Iron-54	0.791	18.2	36.0	ug/L	
SJI0372-IBL1	Iron-57	0.243	6.63	36.0	ug/L	
SJI0372-ICB1	Iron-54	0.901	18.2	36.0	ug/L	
SJI0372-ICB1	Iron-57	0.929	6.63	36.0	ug/L	
SJI0372-CCB1	Iron-54	1.36	18.2	36.0	ug/L	
SJI0372-CCB1	Iron-57	0.965	6.63	36.0	ug/L	
SJI0372-IBL2	Iron-54	-2.70	18.2	36.0	ug/L	
SJI0372-IBL2	Iron-57	-0.438	6.63	36.0	ug/L	
SJI0372-IBL3	Iron-54	-3.51	18.2	36.0	ug/L	
SJI0372-IBL3	Iron-57	-0.745	6.63	36.0	ug/L	
SJI0372-CCB2	Iron-54	-0.290	18.2	36.0	ug/L	
SJI0372-CCB2	Iron-57	0.078	6.63	36.0	ug/L	
SJI0372-CCB3	Iron-54	0.425	18.2	36.0	ug/L	
SJI0372-CCB3	Iron-57	0.646	6.63	36.0	ug/L	
SJI0372-IBL4	Iron-54	-3.41	18.2	36.0	ug/L	
SJI0372-IBL4	Iron-57	0.330	6.63	36.0	ug/L	
SJI0372-IBL5	Iron-54	-5.47	18.2	36.0	ug/L	
SJI0372-IBL5	Iron-57	17.2	6.63	36.0	ug/L	
SJI0372-CCB4	Iron-54	-0.790	18.2	36.0	ug/L	
SJI0372-CCB4	Iron-57	4.29	6.63	36.0	ug/L	
SJI0372-CCB5	Iron-54	3.01	18.2	36.0	ug/L	
SJI0372-CCB5	Iron-57	-0.285	6.63	36.0	ug/L	
SJI0372-IBL6	Iron-54	-2.47	18.2	36.0	ug/L	
SJI0372-IBL6	Iron-57	-7.35	6.63	36.0	ug/L	
SJI0372-CCB6	Iron-54	1.15	18.2	36.0	ug/L	
SJI0372-CCB6	Iron-57	-4.63	6.63	36.0	ug/L	
SJI0372-IBL7	Iron-54	-4.47	18.2	36.0	ug/L	
SJI0372-IBL7	Iron-57	13.4	6.63	36.0	ug/L	
SJI0372-IBL8	Iron-54	-3.70	18.2	36.0	ug/L	
SJI0372-IBL8	Iron-57	-7.56	6.63	36.0	ug/L	
SJI0372-CCB7	Iron-54	-0.627	18.2	36.0	ug/L	
SJI0372-CCB7	Iron-57	-5.97	6.63	36.0	ug/L	
SJI0372-IBL9	Iron-54	-6.21	18.2	36.0	ug/L	
SJI0372-IBL9	Iron-57	-8.14	6.63	36.0	ug/L	

INSTRUMENT BLANKS
EPA 6020B

Laboratory: Analytical Resources, Inc.
Client: GeoEngineers
Instrument ID: ICPMS1
Sequence: SJI0372

SDG: 21I0042
Project: South State Street PRDI
Calibration: EI00074
Date Analyzed: 09/22/21 22:48

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SJI0372-CCB8	Iron-54	-2.03	18.2	36.0	ug/L	
SJI0372-CCB8	Iron-57	-4.88	6.63	36.0	ug/L	
SJI0372-CCB9	Iron-54	0.899	18.2	36.0	ug/L	
SJI0372-CCB9	Iron-57	0.817	6.63	36.0	ug/L	
SJI0372-IBLA	Iron-54	-1.59	18.2	36.0	ug/L	
SJI0372-IBLA	Iron-57	-0.122	6.63	36.0	ug/L	
SJI0372-CCBA	Iron-54	1.07	18.2	36.0	ug/L	
SJI0372-CCBA	Iron-57	0.104	6.63	36.0	ug/L	
SJI0372-IBLB	Iron-54	-2.03	18.2	36.0	ug/L	
SJI0372-IBLB	Iron-57	-2.06	6.63	36.0	ug/L	
SJI0372-CCBB	Iron-54	0.610	18.2	36.0	ug/L	
SJI0372-CCBB	Iron-57	-1.14	6.63	36.0	ug/L	
SJI0372-IBLC	Iron-54	-3.46	18.2	36.0	ug/L	
SJI0372-IBLC	Iron-57	-3.69	6.63	36.0	ug/L	
SJI0372-CCBC	Iron-54	0.717	18.2	36.0	ug/L	
SJI0372-CCBC	Iron-57	-1.30	6.63	36.0	ug/L	
SJI0372-IBLD	Iron-54	-1.90	18.2	36.0	ug/L	
SJI0372-IBLD	Iron-57	-2.63	6.63	36.0	ug/L	
SJI0372-CCBD	Iron-54	1.39	18.2	36.0	ug/L	
SJI0372-CCBD	Iron-57	-1.08	6.63	36.0	ug/L	
SJI0372-CCBE	Iron-54	0.160	18.2	36.0	ug/L	
SJI0372-CCBE	Iron-57	1.24	6.63	36.0	ug/L	
SJI0372-IBLE	Iron-54	-2.47	18.2	36.0	ug/L	
SJI0372-IBLE	Iron-57	-0.935	6.63	36.0	ug/L	
SJI0372-CCBF	Iron-54	1.85	18.2	36.0	ug/L	
SJI0372-CCBF	Iron-57	1.71	6.63	36.0	ug/L	
SJI0372-IBLF	Iron-54	-2.34	18.2	36.0	ug/L	
SJI0372-IBLF	Iron-57	2.72	6.63	36.0	ug/L	
SJI0372-CCBG	Iron-54	1.97	18.2	36.0	ug/L	
SJI0372-CCBG	Iron-57	5.68	6.63	36.0	ug/L	
SJI0372-IBLG	Iron-54	-3.41	18.2	36.0	ug/L	
SJI0372-IBLG	Iron-57	0.989	6.63	36.0	ug/L	
SJI0372-CCBH	Iron-54	0.481	18.2	36.0	ug/L	
SJI0372-CCBH	Iron-57	4.41	6.63	36.0	ug/L	

INSTRUMENT BLANKS
EPA 6020B

Laboratory: Analytical Resources, Inc.
Client: GeoEngineers
Instrument ID: ICPMS1
Sequence: SJI0372

SDG: 21I0042
Project: South State Street PRDI
Calibration: EI00074
Date Analyzed: 09/23/21 05:55

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SJI0372-IBLH	Iron-54	-2.75	18.2	36.0	ug/L	
SJI0372-IBLH	Iron-57	0.815	6.63	36.0	ug/L	
SJI0372-IBLI	Iron-54	-2.72	18.2	36.0	ug/L	
SJI0372-IBLI	Iron-57	2.29	6.63	36.0	ug/L	
SJI0372-CCBI	Iron-54	0.677	18.2	36.0	ug/L	
SJI0372-CCBI	Iron-57	2.70	6.63	36.0	ug/L	

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0372
Instrument: ICPMS1
Calibration: EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
CAL 0	SJI0372-CAL1	XDT_m1210922-009	NA	09/22/21 14:30
CAL 1 - LOW CHECK	SJI0372-CAL2	XDT_m1210922-010	NA	09/22/21 14:35
CAL 2	SJI0372-CAL3	XDT_m1210922-011	NA	09/22/21 14:39
CAL 3	SJI0372-CAL4	XDT_m1210922-012	NA	09/22/21 14:44
CAL 4	SJI0372-CAL5	XDT_m1210922-013	NA	09/22/21 14:49
CAL 5	SJI0372-CAL6	XDT_m1210922-014	NA	09/22/21 14:56
RINSE	SJI0372-IBL1	XDT_m1210922-015	NA	09/22/21 15:03
Initial Cal Check	SJI0372-ICV1	XDT_m1210922-017	NA	09/22/21 15:09
Initial Cal Blank	SJI0372-ICB1	XDT_m1210922-018	NA	09/22/21 15:16
Calibration Check	SJI0372-CCV1	XDT_m1210922-019	NA	09/22/21 15:21
Calibration Blank	SJI0372-CCB1	XDT_m1210922-020	NA	09/22/21 15:28
Instrument RL Check	SJI0372-CRL1	XDT_m1210922-021	NA	09/22/21 15:37
Interference Check A	SJI0372-IFA1	XDT_m1210922-022	NA	09/22/21 15:46
Interference Check B	SJI0372-IFB1	XDT_m1210922-023	NA	09/22/21 15:50
LR200	SJI0372-HCV1	XDT_m1210922-024	NA	09/22/21 15:55
LR300	SJI0372-HCV2	XDT_m1210922-025	NA	09/22/21 15:59
Instrument Blank	SJI0372-IBL2	XDT_m1210922-026	NA	09/22/21 16:07
Instrument Blank	SJI0372-IBL3	XDT_m1210922-027	NA	09/22/21 16:13
Calibration Check	SJI0372-CCV2	XDT_m1210922-028	NA	09/22/21 16:21
Calibration Blank	SJI0372-CCB2	XDT_m1210922-029	NA	09/22/21 16:29
ZZZZZ	BJI0541-BLK2	XDT_m1210922-030	Water	09/22/21 16:35
ZZZZZ	BJI0541-BS2	XDT_m1210922-031	Water	09/22/21 16:40
Blank	BJI0584-BLK1	XDT_m1210922-032	Solid	09/22/21 16:44
LCS	BJI0584-BS1	XDT_m1210922-034	Solid	09/22/21 16:57
HSA-60-9-10.5	21I0042-02	XDT_m1210922-035	Solid	09/22/21 17:02
HSA-59-9-10.5	21I0042-01	XDT_m1210922-036	Solid	09/22/21 17:12
HSA-59-9-10.5	BJI0584-DUP1	XDT_m1210922-037	Solid	09/22/21 17:16
HSA-59-9-10.5	BJI0584-DUP1	XDT_m1210922-037	Solid	09/22/21 17:16
HSA-59-9-10.5	BJI0584-MS1	XDT_m1210922-038	Solid	09/22/21 17:21

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0372
Instrument: ICPMS1
Calibration: EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
HSA-59-9-10.5	BJI0584-MS1	XDT_m1210922-038	Solid	09/22/21 17:21
Calibration Check	SJI0372-CCV3	XDT_m1210922-040	NA	09/22/21 17:35
Calibration Blank	SJI0372-CCB3	XDT_m1210922-041	NA	09/22/21 17:43
Instrument Blank	SJI0372-IBL4	XDT_m1210922-047	NA	09/22/21 18:22
Instrument Blank	SJI0372-IBL5	XDT_m1210922-051	NA	09/22/21 18:46
Calibration Check	SJI0372-CCV4	XDT_m1210922-052	NA	09/22/21 18:54
Calibration Blank	SJI0372-CCB4	XDT_m1210922-053	NA	09/22/21 19:04
Calibration Check	SJI0372-CCV5	XDT_m1210922-055	NA	09/22/21 19:14
Calibration Blank	SJI0372-CCB5	XDT_m1210922-056	NA	09/22/21 19:22
HSA-59-9-10.5	BJI0584-MSD1	XDT_m1210922-061	Solid	09/22/21 19:55
HSA-59-9-10.5	BJI0584-MSD1	XDT_m1210922-061	Solid	09/22/21 19:55
ZZZZZ	21I0060-01	XDT_m1210922-062	Water	09/22/21 20:01
ZZZZZ	21I0060-01	XDT_m1210922-062	Water	09/22/21 20:01
Instrument Blank	SJI0372-IBL6	XDT_m1210922-066	NA	09/22/21 20:23
Calibration Check	SJI0372-CCV6	XDT_m1210922-067	NA	09/22/21 20:29
Calibration Blank	SJI0372-CCB6	XDT_m1210922-068	NA	09/22/21 20:36
Instrument Blank	SJI0372-IBL7	XDT_m1210922-073	NA	09/22/21 21:05
ZZZZZ	21I0074-08	XDT_m1210922-074	Water	09/22/21 21:10
Instrument Blank	SJI0372-IBL8	XDT_m1210922-078	NA	09/22/21 21:33
Calibration Check	SJI0372-CCV7	XDT_m1210922-079	NA	09/22/21 21:38
Calibration Blank	SJI0372-CCB7	XDT_m1210922-080	NA	09/22/21 21:45
ZZZZZ	21I0074-04	XDT_m1210922-082	Water	09/22/21 21:54
ZZZZZ	21I0074-04	XDT_m1210922-082	Water	09/22/21 21:54
ZZZZZ	21I0074-04	XDT_m1210922-082	Water	09/22/21 21:54
ZZZZZ	21I0074-06	XDT_m1210922-083	Water	09/22/21 21:59
ZZZZZ	21I0074-06	XDT_m1210922-083	Water	09/22/21 21:59
ZZZZZ	21I0074-06	XDT_m1210922-083	Water	09/22/21 21:59
ZZZZZ	21I0074-10	XDT_m1210922-084	Water	09/22/21 22:03
ZZZZZ	21I0074-12	XDT_m1210922-085	Water	09/22/21 22:08

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0372
Instrument: ICPMS1
Calibration: EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
ZZZZZ	21I0074-14	XDT_m1210922-086	Water	09/22/21 22:13
ZZZZZ	21I0074-14	XDT_m1210922-086	Water	09/22/21 22:13
ZZZZZ	21I0074-14	XDT_m1210922-086	Water	09/22/21 22:13
ZZZZZ	21I0074-16	XDT_m1210922-087	Water	09/22/21 22:17
ZZZZZ	21I0074-16	XDT_m1210922-087	Water	09/22/21 22:17
ZZZZZ	21I0074-16	XDT_m1210922-087	Water	09/22/21 22:17
ZZZZZ	21I0074-18	XDT_m1210922-088	Water	09/22/21 22:22
ZZZZZ	21I0074-20	XDT_m1210922-089	Water	09/22/21 22:28
ZZZZZ	21I0074-20	XDT_m1210922-089	Water	09/22/21 22:28
ZZZZZ	21I0074-20	XDT_m1210922-089	Water	09/22/21 22:28
Instrument Blank	SJI0372-IBL9	XDT_m1210922-090	NA	09/22/21 22:36
Calibration Check	SJI0372-CCV8	XDT_m1210922-091	NA	09/22/21 22:41
Calibration Blank	SJI0372-CCB8	XDT_m1210922-092	NA	09/22/21 22:48
Calibration Check	SJI0372-CCV9	XDT_m1210922-094	NA	09/22/21 22:57
Calibration Blank	SJI0372-CCB9	XDT_m1210922-095	NA	09/22/21 23:05
ZZZZZ	21I0074-22	XDT_m1210922-098	Water	09/22/21 23:19
ZZZZZ	21I0074-22	XDT_m1210922-098	Water	09/22/21 23:19
ZZZZZ	21I0074-22	XDT_m1210922-098	Water	09/22/21 23:19
ZZZZZ	21I0074-24	XDT_m1210922-099	Water	09/22/21 23:23
ZZZZZ	21I0074-24	XDT_m1210922-099	Water	09/22/21 23:23
ZZZZZ	21I0074-24	XDT_m1210922-099	Water	09/22/21 23:23
ZZZZZ	21I0074-26	XDT_m1210922-100	Water	09/22/21 23:27
ZZZZZ	21I0074-26	XDT_m1210922-100	Water	09/22/21 23:27
ZZZZZ	21I0074-30	XDT_m1210922-101	Water	09/22/21 23:31
ZZZZZ	21I0074-30	XDT_m1210922-101	Water	09/22/21 23:31
ZZZZZ	21I0074-30	XDT_m1210922-101	Water	09/22/21 23:31
Instrument Blank	SJI0372-IBLA	XDT_m1210922-105	NA	09/22/21 23:51
Calibration Check	SJI0372-CCVA	XDT_m1210922-106	NA	09/22/21 23:55
Calibration Blank	SJI0372-CCBA	XDT_m1210922-107	NA	09/23/21 00:02

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0372
Instrument: ICPMS1
Calibration: EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
ZZZZZ	21I0074-28	XDT_m1210922-108	Water	09/23/21 00:06
ZZZZZ	21I0074-28	XDT_m1210922-108	Water	09/23/21 00:06
ZZZZZ	21I0060-04	XDT_m1210922-109	Water	09/23/21 00:10
ZZZZZ	21I0060-04	XDT_m1210922-109	Water	09/23/21 00:10
ZZZZZ	21I0060-06	XDT_m1210922-110	Water	09/23/21 00:13
ZZZZZ	21I0060-06	XDT_m1210922-110	Water	09/23/21 00:13
ZZZZZ	21I0060-08	XDT_m1210922-111	Water	09/23/21 00:17
ZZZZZ	21I0060-08	XDT_m1210922-111	Water	09/23/21 00:17
ZZZZZ	21I0060-10	XDT_m1210922-112	Water	09/23/21 00:21
ZZZZZ	21I0060-02	XDT_m1210922-113	Water	09/23/21 00:25
ZZZZZ	21I0060-02	XDT_m1210922-113	Water	09/23/21 00:25
ZZZZZ	21I0060-02	XDT_m1210922-113	Water	09/23/21 00:25
Instrument Blank	SJI0372-IBLB	XDT_m1210922-117	NA	09/23/21 00:45
Calibration Check	SJI0372-CCVB	XDT_m1210922-118	NA	09/23/21 00:50
Calibration Blank	SJI0372-CCBB	XDT_m1210922-119	NA	09/23/21 00:56
ZZZZZ	21I0060-12	XDT_m1210922-120	Water	09/23/21 01:00
ZZZZZ	21I0060-12	XDT_m1210922-120	Water	09/23/21 01:00
ZZZZZ	21I0060-14	XDT_m1210922-121	Water	09/23/21 01:04
ZZZZZ	21I0060-14	XDT_m1210922-121	Water	09/23/21 01:04
ZZZZZ	21I0060-16	XDT_m1210922-122	Water	09/23/21 01:08
ZZZZZ	21I0060-18	XDT_m1210922-123	Water	09/23/21 01:11
ZZZZZ	21I0060-20	XDT_m1210922-124	Water	09/23/21 01:15
ZZZZZ	21I0060-20	XDT_m1210922-124	Water	09/23/21 01:15
ZZZZZ	21I0060-03	XDT_m1210922-125	Water	09/23/21 01:19
ZZZZZ	21I0060-03	XDT_m1210922-125	Water	09/23/21 01:19
ZZZZZ	21I0060-05	XDT_m1210922-126	Water	09/23/21 01:23
ZZZZZ	21I0060-05	XDT_m1210922-126	Water	09/23/21 01:23
ZZZZZ	21I0060-09	XDT_m1210922-128	Water	09/23/21 01:32
Instrument Blank	SJI0372-IBLC	XDT_m1210922-129	NA	09/23/21 01:40

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0372
Instrument: ICPMS1
Calibration: EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Calibration Check	SJI0372-CCVC	XDT_m1210922-130	NA	09/23/21 01:44
Calibration Blank	SJI0372-CCBC	XDT_m1210922-131	NA	09/23/21 01:50
ZZZZZ	21I0060-11	XDT_m1210922-132	Water	09/23/21 01:54
ZZZZZ	21I0060-11	XDT_m1210922-132	Water	09/23/21 01:54
ZZZZZ	21I0060-11	XDT_m1210922-132	Water	09/23/21 01:54
ZZZZZ	21I0060-13	XDT_m1210922-133	Water	09/23/21 01:58
ZZZZZ	21I0060-13	XDT_m1210922-133	Water	09/23/21 01:58
ZZZZZ	21I0060-13	XDT_m1210922-133	Water	09/23/21 01:58
ZZZZZ	21I0060-15	XDT_m1210922-134	Water	09/23/21 02:02
ZZZZZ	21I0060-15	XDT_m1210922-134	Water	09/23/21 02:02
ZZZZZ	21I0060-17	XDT_m1210922-135	Water	09/23/21 02:06
ZZZZZ	21I0060-17	XDT_m1210922-135	Water	09/23/21 02:06
ZZZZZ	21I0060-19	XDT_m1210922-136	Water	09/23/21 02:09
ZZZZZ	21I0060-19	XDT_m1210922-136	Water	09/23/21 02:09
ZZZZZ	21I0060-19	XDT_m1210922-136	Water	09/23/21 02:09
ZZZZZ	21I0079-08	XDT_m1210922-137	Water	09/23/21 02:13
ZZZZZ	21I0079-08	XDT_m1210922-137	Water	09/23/21 02:13
ZZZZZ	21I0079-08	XDT_m1210922-137	Water	09/23/21 02:13
ZZZZZ	21I0079-08	XDT_m1210922-137	Water	09/23/21 02:13
ZZZZZ	21I0079-08	XDT_m1210922-137	Water	09/23/21 02:13
Instrument Blank	SJI0372-IBLD	XDT_m1210922-141	NA	09/23/21 02:34
Calibration Check	SJI0372-CCVD	XDT_m1210922-142	NA	09/23/21 02:38
Calibration Blank	SJI0372-CCBD	XDT_m1210922-143	NA	09/23/21 02:44
Calibration Check	SJI0372-CCVE	XDT_m1210922-145	NA	09/23/21 02:52
Calibration Blank	SJI0372-CCBE	XDT_m1210922-146	NA	09/23/21 02:59
ZZZZZ	21I0079-02	XDT_m1210922-148	Water	09/23/21 03:06
ZZZZZ	21I0079-04	XDT_m1210922-149	Water	09/23/21 03:10
ZZZZZ	21I0096-08	XDT_m1210922-150	Water	09/23/21 03:14
ZZZZZ	21I0096-10	XDT_m1210922-151	Water	09/23/21 03:18

Analytical Resources, Incorporated
Analytical Chemists and Consultants

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0372
Instrument: ICPMS1
Calibration: EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
ZZZZZ	21I0096-12	XDT_m1210922-152	Water	09/23/21 03:22
ZZZZZ	21I0096-14	XDT_m1210922-153	Water	09/23/21 03:25
ZZZZZ	21I0096-02	XDT_m1210922-154	Water	09/23/21 03:30
ZZZZZ	21I0096-04	XDT_m1210922-155	Water	09/23/21 03:35
Instrument Blank	SJI0372-IBLE	XDT_m1210922-156	NA	09/23/21 03:42
Calibration Check	SJI0372-CCVF	XDT_m1210922-157	NA	09/23/21 03:46
Calibration Blank	SJI0372-CCBF	XDT_m1210922-158	NA	09/23/21 03:53
ZZZZZ	21I0096-06	XDT_m1210922-161	Water	09/23/21 04:04
ZZZZZ	21I0079-10	XDT_m1210922-162	Water	09/23/21 04:08
ZZZZZ	21I0079-12	XDT_m1210922-163	Water	09/23/21 04:12
ZZZZZ	21I0102-01	XDT_m1210922-165	Water	09/23/21 04:20
ZZZZZ	21I0102-01	XDT_m1210922-165	Water	09/23/21 04:20
ZZZZZ	21I0102-01	XDT_m1210922-165	Water	09/23/21 04:20
ZZZZZ	21I0102-01	XDT_m1210922-165	Water	09/23/21 04:20
ZZZZZ	21I0102-01	XDT_m1210922-165	Water	09/23/21 04:20
ZZZZZ	21I0102-01	XDT_m1210922-165	Water	09/23/21 04:20
ZZZZZ	21I0102-01	XDT_m1210922-165	Water	09/23/21 04:20
Instrument Blank	SJI0372-IBLF	XDT_m1210922-168	NA	09/23/21 04:37
Calibration Check	SJI0372-CCVG	XDT_m1210922-169	NA	09/23/21 04:41
Calibration Blank	SJI0372-CCBG	XDT_m1210922-170	NA	09/23/21 04:47
Instrument Blank	SJI0372-IBLG	XDT_m1210922-179	NA	09/23/21 05:28
Calibration Check	SJI0372-CCVH	XDT_m1210922-180	NA	09/23/21 05:32
Calibration Blank	SJI0372-CCBH	XDT_m1210922-181	NA	09/23/21 05:38
ZZZZZ	21I0092-02	XDT_m1210922-182	Water	09/23/21 05:42
ZZZZZ	21I0092-02	XDT_m1210922-182	Water	09/23/21 05:42
ZZZZZ	21I0092-02	XDT_m1210922-182	Water	09/23/21 05:42
ZZZZZ	21I0092-02	XDT_m1210922-182	Water	09/23/21 05:42
ZZZZZ	21I0092-02	XDT_m1210922-182	Water	09/23/21 05:42
ZZZZZ	21I0092-02	XDT_m1210922-182	Water	09/23/21 05:42

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0372
Instrument: ICPMS1
Calibration: EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
ZZZZZ	21I0092-04	XDT_m1210922-183	Water	09/23/21 05:47
ZZZZZ	21I0092-04	XDT_m1210922-183	Water	09/23/21 05:47
ZZZZZ	21I0092-04	XDT_m1210922-183	Water	09/23/21 05:47
ZZZZZ	21I0092-04	XDT_m1210922-183	Water	09/23/21 05:47
Instrument Blank	SJI0372-IBLH	XDT_m1210922-184	NA	09/23/21 05:55
ZZZZZ	21I0092-01	XDT_m1210922-185	Water	09/23/21 05:59
ZZZZZ	21I0092-01	XDT_m1210922-185	Water	09/23/21 05:59
ZZZZZ	21I0092-01	XDT_m1210922-185	Water	09/23/21 05:59
ZZZZZ	21I0092-01	XDT_m1210922-185	Water	09/23/21 05:59
ZZZZZ	21I0092-01	XDT_m1210922-185	Water	09/23/21 05:59
ZZZZZ	21I0092-03	XDT_m1210922-186	Water	09/23/21 06:04
ZZZZZ	21I0092-03	XDT_m1210922-186	Water	09/23/21 06:04
ZZZZZ	21I0092-03	XDT_m1210922-186	Water	09/23/21 06:04
Instrument Blank	SJI0372-IBLI	XDT_m1210922-187	NA	09/23/21 06:11
Calibration Check	SJI0372-CCVI	XDT_m1210922-188	NA	09/23/21 06:16
Calibration Blank	SJI0372-CCBI	XDT_m1210922-189	NA	09/23/21 06:22

ICP INTERFERENCE CHECK SAMPLE

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: ICPMS1
Calibration: EI00074
Sequence: SJI0372
Standard ID: J009989

Lab Sample ID	Analyte	True	Found	%R	Units
SJI0372-IFA1	Iron-54	20000	18129.76	90.6	ug/L
	Iron-57	20000	18272.60	91.4	ug/L

* Indicates %R outside of QC limits
NOTE: True value and %R are populated only for analytes found in the interference check standards, and will be seen only if those analytes were requested.

ICP INTERFERENCE CHECK SAMPLE

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: ICPMS1
Calibration: EI00074
Sequence: SJI0372
Standard ID: J009989

Lab Sample ID	Analyte	True	Found	%R	Units
SJI0372-IFB1	Iron-54	20000	17598.35	88.0	ug/L
	Iron-57	20000	17570.66	87.9	ug/L

* Indicates %R outside of QC limits
NOTE: True value and %R are populated only for analytes found in the interference check standards, and will be seen only if those analytes were requested.

DETECTION LEVEL STANDARD
EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: ICPMS1
Calibration: EI00074
Sequence: SJI0372
Lab Sample ID: SJI0372-CRL1

Analyte	True	Found	%R	Units	QC Limts
Iron-54	36.000	37.6	104	ug/L	50 - 150
Iron-57	36.000	35.2	97.7	ug/L	50 - 150

* Values outside of QC limits

HIGH-CONCENTRATION CALIBRATION VERIFICATION

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EI00074
Laboratory ID: SJI0372-HCV1
Sequence: SJI0372
Standard ID: J009626

ANALYTE	EXPECTED (ug/L)	FOUND (ug/L)	% DRIFT	QC LIMIT
Iron-54	20000	18400	-7.8	10.00
Iron-57	20000	18300	-8.3	10.00

* Values outside of QC limits

Analytical Resources, Incorporated
Analytical Chemists and Consultants

HIGH-CONCENTRATION CALIBRATION VERIFICATION

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EI00074
Laboratory ID: SJI0372-HCV2
Sequence: SJI0372
Standard ID: J009063

ANALYTE	EXPECTED (ug/L)	FOUND (ug/L)	% DRIFT	QC LIMIT
Iron-54	30000	28500	-5.2	10.00
Iron-57	30000	28600	-4.5	10.00

* Values outside of QC limits

HOLDING TIME SUMMARY

Analysis: EPA 6020B

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
HSA-59-9-10.5 21I0042-01	08/30/21 11:55	09/02/21 10:52	09/21/21 12:40	22	180	09/22/21 17:12	23	180	
HSA-60-9-10.5 21I0042-02	08/30/21 14:20	09/02/21 10:52	09/21/21 12:40	21	180	09/22/21 17:02	23	180	
Duplicate BJI0584-DUP1	08/30/21 11:55	09/02/21 10:52	09/21/21 12:40	22	180	09/22/21 17:16	23	180	
Matrix Spike BJI0584-MS1	08/30/21 11:55	09/02/21 10:52	09/21/21 12:40	22	180	09/22/21 17:21	23	180	
Matrix Spike Dup BJI0584-MSD1	08/30/21 11:55	09/02/21 10:52	09/21/21 12:40	22	180	09/22/21 19:55	23	180	

* Indicates hold time exceedance.

METHOD DETECTION AND REPORTING LIMITS

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Solid
Instrument: ICPMS1

Analyte	MDL	RL	Units
Iron-54	18	36	mg/kg
Iron-57	7	36	mg/kg

METHOD DETECTION AND REPORTING LIMITS

EPA 6020B

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Water
Instrument: ICPMS1

Analyte	MDL	RL	Units
Iron-54	18.2	36.0	ug/L
Iron-57	6.63	36.0	ug/L

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGAG10
Lot Number:	P2-AG679501
Matrix:	7% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Silver
Starting Material:	Ag Shot
Starting Material Lot#:	2217
Starting Material Purity:	99.9993%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9996 ± 30 µg/mL

Density: 1.053 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10015 ± 56 µg/mL**
ICP Assay NIST SRM 3151 Lot Number: 160729

Assay Method #2 **9992 ± 25 µg/mL**
Volhard NIST SRM 999c Lot Number: 999c

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

s	Ag	<		M	Eu	<	0.000253	O	Na		0.005562	M	Se	<	0.018179	M	Zn		0.005799
O	Al		0.006295	O	Fe		0.002932	M	Nb	<	0.000253	M	Si		0.022484	M	Zr	<	0.005559
M	As	<	0.002403	M	Ga	<	0.000253	M	Nd	<	0.000253	M	Sm	<	0.000253				
M	Au		0.001634	M	Gd	<	0.000253	O	Ni	<	0.005472	M	Sn		0.001927				
O	B	<	0.009978	M	Ge	<	0.000754	M	Os	<	0.000254	O	Sr		0.000086				
M	Ba	<	0.000785	M	Hf	<	0.000253	M	P	<	0.053784	M	Ta	<	0.000253				
M	Be	<	0.002407	M	Hg	<	0.001332	M	Pb		0.003281	M	Tb	<	0.000253				
M	Bi		0.001671	M	Ho	<	0.000253	M	Pd	<	0.001382	M	Te	<	0.003715				
O	Ca		0.007115	M	In	<	0.003483	M	Pr	<	0.000253	M	Th	<	0.000253				
M	Cd	<	0.000253	M	Ir	<	0.000254	M	Pt	<	0.000253	M	Ti	<	0.002706				
M	Ce	<	0.000573	O	K		0.004010	M	Rb	<	0.000253	M	Tl	<	0.000253				
M	Co	<	0.000253	M	La	<	0.000253	M	Re	<	0.000253	M	Tm	<	0.000253				
O	Cr	<	0.005043	O	Li	<	0.000214	M	Rh	<	0.000253	M	U	<	0.000253				
M	Cs	<	0.002769	M	Lu	<	0.000253	M	Ru	<	0.000254	M	V	<	0.000822				
O	Cu		0.004614	O	Mg		0.001034	M	S	<	0.560935	M	W	<	0.002146				
M	Dy	<	0.000253	M	Mn	<	0.000253	M	Sb	<	0.006899	M	Y	<	0.000253				
M	Er	<	0.000253	M	Mo	<	0.000479	M	Sc	<	0.000733	M	Yb	<	0.000253				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 107.87 +1 6 $Ag(H_2O)_6^+$
Chemical Compatibility -Stable in HNO_3, and HF. Avoid basic media. Ag forms more insoluble salts than any other metal. It also is subject to photochemical reduction to the metal in HCl media although 10 µg/mL solutions in 10% HCl [$AgCl_{x1-x}$] are commonly used in the analytical laboratory. The most common solubility problems exist with arsenate, arsenite , bromide, chloride, iodide, carbonate , chromate, cyanide, iodate, oxalate, oxide, sulfate, sulfide, tartrate, and thiocyanate in aqueous media. The addition of nitric acid renders many of these salts soluble.
Stability - 2-100 ppb levels stable for 75+ days when mixed with equivalent levels of all other elements including the precious metals (where chloride is present) when in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.
Ag Containing Samples (Preparation and Solution) -Metal (Soluble in HNO_3); Oxides (Soluble in HNO_3); Ores (Digestion with conc. HNO_3).
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 107 amu	1 ppt	N/A	91Zr16O
ICP-OES 243.779 nm	0.12/0.01 µg/mL	1	Mn, Th, Ni, Rh
ICP-OES 328.068 nm	0.007/0.0007 µg/mL	1	Ce, Rh, V
ICP-OES 338.289 nm	0.013/0.001 µg/mL	1	Ce, Cr, Th

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

June 07, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- June 07, 2023

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Supervisor, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGAS10
Lot Number:	R2-AS691113
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Arsenic
Starting Material:	As Pieces
Starting Material Lot#:	2208
Starting Material Purity:	99.9980%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9981 ± 55 µg/mL

Density: 1.028 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9981 ± 55 µg/mL**
ICP Assay NIST SRM 3103a Lot Number: 100818

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The follow ing equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.001578	M	Eu	<	0.000526	O	Na		0.036136	M	Se	<	0.014204	O	Zn	<	0.003390
O	Al		0.006694	M	Fe		0.002633	O	Nb	<	0.011526	O	Si		0.139479	M	Zr	<	0.003156
s	As	<		M	Ga	<	0.000526	M	Nd	<	0.000526	M	Sm	<	0.000526				
M	Au	<	0.000526	M	Gd	<	0.000526	O	Ni	<	0.005537	M	Sn	<	0.001052				
M	B		0.017011	M	Ge	<	0.000526	M	Os	<	0.000526	M	Sr	<	0.000526				
M	Ba	<	0.000526	M	Hf	<	0.000526	O	P	<	0.056500	M	Ta	<	0.000526				
O	Be	<	0.001130	M	Hg	<	0.002104	M	Pb	<	0.000526	M	Tb	<	0.000526				
M	Bi	<	0.002104	M	Ho	<	0.000526	M	Pd	<	0.000526	M	Te	<	0.003682				
O	Ca		0.005657	M	In	<	0.000526	M	Pr	<	0.002630	M	Th	<	0.000526				
M	Cd	<	0.000526	M	Ir	<	0.000526	M	Pt	<	0.000526	O	Ti	<	0.001017				
M	Ce	<	0.000526	O	K		0.003865	M	Rb	<	0.002104	M	Tl	<	0.000526				
M	Co	<	0.003156	M	La	<	0.000526	M	Re	<	0.000526	M	Tm	<	0.000526				
M	Cr		0.000877	M	Li	<	0.000526	M	Rh	<	0.000526	M	U	<	0.000526				
M	Cs	<	0.002104	M	Lu	<	0.000526	M	Ru	<	0.000526	M	V	<	0.001578				
M	Cu	<	0.003156	O	Mg		0.000235	O	S	<	0.056500	M	W	<	0.000526				
M	Dy	<	0.000526	M	Mn	<	0.001052	M	Sb	<	0.000526	M	Y	<	0.000526				
M	Er	<	0.000526	M	Mo	<	0.000526	M	Sc	<	0.002104	M	Yb	<	0.000526				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 74.92 ; mix of +3 and +5 ; 6 ; H_3AsO_4 and $HAsO_2$

Chemical Compatibility - Arsenic has no cationic chemistry. It is soluble in HCl, HNO_3,H_3PO_4, H_2SO_4 and HF aqueous matrices water and NH_4OH . It is stable with most inorganic anions (forms arsenate when boiled with chromate) but many cationic metals form the insoluble arsenates under pH neutral conditions. When fluorinated and / or under acidic conditions arsenate formation is typically not a problem at moderate to low concentrations.

Stability - 2-100 ppb levels stable for months alone or mixed with other elements at equivalent levels in 1% HNO_3 / LDPE container.

As Containing Samples (Preparation and Solution) - Metal (soluble in 1:1 H_2O / HNO_3); Oxides (the oxide exists in crystalline and amorphous forms where the amorphic form is more water soluble. The oxides typically dissolve in dilute acidic solutions when boiled); Minerals (one gram of powered sample is fused in a Ni crucible with 10 grams of a 1:1 mix of K_2CO_3 and KNO_3 and the melt extracted with hot water); Organic Matrices (0.2 to 0.5 grams of sample are fused with 15 grams of a 1:1 Na_2CO_3 / Na_2O_2 mix in a Ni crucible. The fuseate is extracted with water and acidified with HNO_3).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 75 amu	20 ppt	N/A	40Ar35Cl, 59Co16O, 36Ar38Ar1H,8Ar37Cl,Ar39K, 150Nd2+,150Sm2+
ICP-OES 189.042 nm	0.05/0.005 µg/mL	1	Cr
ICP-OES 193.696 nm	0.1/0.01 µg/mL	1	V, Ge
ICP-OES 228.812 nm	0.1/0.01 µg/mL	1	Cd, Pt, Ir, Co

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

March 25, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **March 25, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

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info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCD10
Lot Number:	P2-CD675954
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Cadmium
Starting Material:	Cd Shot
Starting Material Lot#:	1954
Starting Material Purity:	99.9998%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10014 ± 30 µg/mL

Density: 1.029 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10021 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #2 **10038 ± 43 µg/mL**
ICP Assay NIST SRM 3108 Lot Number: 130116

Assay Method #3 **9996 ± 30 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag		0.000834	O	Eu	<	0.002146	O	Na		0.003359	M	Se	<	0.003997	O	Zn		0.000251
O	Al		0.002435	O	Fe	<	0.001180	M	Nb	<	0.000399	O	Si		0.009519	M	Zr	<	0.000399
M	As	<	0.003997	M	Ga	<	0.000399	M	Nd	<	0.000399	M	Sm	<	0.000799				
M	Au	<	0.002809	M	Gd	<	0.000399	M	Ni	<	0.002398	M	Sn	<	0.000799				
M	B	<	0.005197	M	Ge	<	0.004397	M	Os	<	0.000401	O	Sr	<	0.000107				
M	Ba	<	0.000399	M	Hf	<	0.000399	O	P	<	0.023606	M	Ta	<	0.000399				
O	Be	<	0.000107	O	Hg	<	0.010730	M	Pb	<	0.001599	M	Tb	<	0.000399				
M	Bi	<	0.000399	M	Ho	<	0.000399	M	Pd	<	0.000799	M	Te	<	0.005596				
O	Ca		0.001399	O	In	<	0.015558	M	Pr	<	0.000399	M	Th	<	0.000399				
s	Cd	<		M	Ir	<	0.000401	M	Pt	<	0.000399	O	Ti	<	0.000536				
M	Ce	<	0.000399	O	K		0.004479	M	Rb	<	0.000399	M	Tl		0.000625				
M	Co	<	0.000399	M	La	<	0.000399	M	Re	<	0.000399	M	Tm	<	0.000399				
M	Cr	<	0.001199	O	Li	<	0.000214	M	Rh	<	0.000399	M	U	<	0.000399				
M	Cs	<	0.000399	M	Lu	<	0.000399	M	Ru	<	0.000401	M	V	<	0.001599				
O	Cu	<	0.003219	O	Mg		0.000083	O	S	<	0.021460	M	W	<	0.000799				
M	Dy	<	0.000399	O	Mn	<	0.000429	M	Sb	<	0.001599	M	Y	<	0.000399				
M	Er	<	0.000399	M	Mo	<	0.000399	O	Sc	<	0.000429	M	Yb	<	0.000399				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 112.41 +2 4 Cd2(OH) (aq)3+ and Cd(OH)(aq)
Chemical Compatibility -Stable in HCl, HNO3, H2SO4 , and HF. Avoid basic media forming insoluble carbonate and hydroxide.
Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5 % HNO3 / LDPE container.
Cd Containing Samples (Preparation and Solution) -Metal (soluble in HNO3); Oxides (soluble in HCl or HNO3); Ores (dissolve in HCl /HNO3 then take to fumes with H2SO4. The silica and lead sulfate are filtered off after the addition of water); Organic based (dry ash at 450°C and dissolve ash in HCl), (sulfuric / peroxide acid digestion).
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 111 amu	11 ppt	n/a	95Mo16O
ICP-OES 214.438 nm	0.003 / 0.0003 µg/mL	1	Pt, Ir
ICP-OES 226.502 nm	0.003 / 0.0003 µg/mL	1	Ir
ICP-OES 228.802 nm	0.003 / 0.0003 µg/mL	1	Co, Ir, As, Pt

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

March 07, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **March 07, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Supervisor, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCO10
Lot Number:	N2-CO671028
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Cobalt
Starting Material:	COBALT
Starting Material Lot#:	1749
Starting Material Purity:	99.9978%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9988 ± 34 µg/mL

Density: 1.057 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9973 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #2 **10024 ± 50 µg/mL**
ICP Assay NIST SRM traceable to 3113 Lot Number: M2-CO661665

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

O	Ag		0.022956	M	Eu	<	0.000422	O	Na		0.008125	M	Se	<	0.009290	M	Zn		0.007197
O	Al		0.013621	O	Fe		0.048700	M	Nb	<	0.000422	O	Si		0.017539	M	Zr	<	0.014357
i	As	<		M	Ga	<	0.000844	M	Nd	<	0.017735	M	Sm	<	0.001689				
M	Au	<	0.000583	M	Gd		0.003247	O	Ni	<	0.043642	M	Sn	<	0.005067				
M	B	<	0.013512	M	Ge	<	0.004645	M	Os	<	0.000583	O	Sr		0.000841				
O	Ba		0.071210	M	Hf	<	0.000422	n	P	<		M	Ta	<	0.000422				
O	Be	<	0.001771	M	Hg	<	0.002334	M	Pb		0.010094	M	Tb	<	0.001689				
M	Bi		0.000614	M	Ho	<	0.000422	M	Pd	<	0.000422	M	Te	<	0.008445				
O	Ca		0.025034	M	In	<	0.003378	M	Pr	<	0.006756	M	Th	<	0.000422				
M	Cd	<	0.000844	M	Ir	<	0.000583	M	Pt	<	0.000422	M	Ti	<	0.002533				
M	Ce		0.002721	O	K		0.005785	M	Rb	<	0.001689	M	Tl	<	0.000422				
s	Co	<		M	La		0.000877	M	Re		0.016853	M	Tm	<	0.000422				
M	Cr	<	0.020269	O	Li		0.000262	M	Rh	<	0.000422	M	U	<	0.000422				
M	Cs		0.000877	M	Lu	<	0.000422	M	Ru	<	0.000583	M	V	<	0.001689				
M	Cu		0.007197	O	Mg		0.003444	n	S	<		M	W	<	0.000844				
M	Dy	<	0.000422	O	Mn	<	0.006072	M	Sb	<	0.005911	M	Y		0.001228				
M	Er	<	0.000422	M	Mo	<	0.005911	M	Sc	<	0.001689	M	Yb	<	0.003378				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 58.93 +2 6 $Co(H_2O)_6^{2+}$
Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4 ,HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.
Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.
Co Containing Samples (Preparation and Solution) - Metal (soluble in HNO_3); Oxides (Soluble in HCl); Ores (dissolve in HCl / HNO_3).
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 59 amu	2 ppt	n/a	42Ca16O1H , 40Ar18O1H , 36Ar23Na, 43Ca16O, 24Mg35Cl
ICP-OES 228.616 nm	0.01/0.001 µg/mL	1	
ICP-OES 237.862 nm	0.01/0.002 µg/mL	1	W, Re, Al, Ta
ICP-OES 238.892 nm	0.01/0.002 µg/mL	1	Fe, W, Ta

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

January 15, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **January 15, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Supervisor, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCR(3)10
Lot Number:	P2-CR684202
Matrix:	10% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Chromium
Starting Material:	Cr METAL
Starting Material Lot#:	2077
Starting Material Purity:	99.9942%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10056 ± 49 µg/mL

Density: 1.084 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10061 ± 71 µg/mL**
ICP Assay NIST SRM 3112a Lot Number: 170630

Assay Method #2 **10052 ± 64 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.000540	M	Eu	<	0.003200	O	Na		0.130027	M	Se	<	0.012000	O	Zn	<	0.002700
O	Al		0.016626	O	Fe		0.202502	M	Nb	<	0.022000	n	Si	<		M	Zr	<	0.020000
M	As		0.003836	O	Ga	<	0.031000	M	Nd	<	0.000540	M	Sm	<	0.035000				
M	Au	<	0.000540	M	Gd	<	0.000540	O	Ni		0.009165	M	Sn		0.004049				
M	B	<	0.049000	M	Ge	<	0.005400	M	Os	<	0.088000	O	Sr	<	0.000250				
O	Ba	<	0.002000	M	Hf	<	0.000540	i	P	<		M	Ta	<	0.000540				
O	Be	<	0.000250	M	Hg	<	0.001600	M	Pb		0.002557	M	Tb	<	0.000540				
M	Bi		0.008952	M	Ho	<	0.000540	M	Pd	<	0.001100	M	Te	<	0.004800				
O	Ca		0.074605	M	In	<	0.001100	M	Pr	<	0.000540	M	Th	<	0.000540				
M	Cd	<	0.000540	M	Ir	<	0.000540	M	Pt	<	0.000540	O	Ti		0.013428				
M	Ce	<	0.000540	O	K		0.034105	i	Rb	<		M	Tl	<	0.001100				
O	Co	<	0.002900	M	La	<	0.001100	M	Re	<	0.002700	O	Tm	<	0.001800				
s	Cr	<		O	Li	<	0.000130	M	Rh	<	0.032000	M	U	<	0.001100				
M	Cs	<	0.019000	M	Lu	<	0.000540	M	Ru	<	0.094000	O	V		0.159869				
O	Cu		0.010018	O	Mg		0.001449	i	S	<		M	W	<	0.028000				
M	Dy	<	0.000540	O	Mn	<	0.014000	M	Sb	<	0.008600	M	Y	<	0.001100				
M	Er	<	0.016000	O	Mo	<	0.013000	O	Sc	<	0.001400	M	Yb	<	0.000540				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 52.00 +3 6 $Cr(H_2O)_6^{3+}$

Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4, HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Cr3 Containing Samples (Preparation and Solution) -Metal (soluble in HCl); Oxides/Ores (Chrome ore/oxides are very difficult to dissolve. The following procedures [A-D] are commonly used: A. Fusion with $KHSO_4$ and extraction with hot KCl. The residue fused with Na_2CO_3 and $KClO_3$, 3:1. B. Fusion with $NaKSO_4$ and NaF 2:1, C. Fusion with magnesia or lime and sodium or potassium carbonates, 4:1. D. Fusion with Na_2O_2 or NaOH and KNO_3 or NaOH and Na_2O_2. Nickel, iron, copper, or silver crucibles should be used for D. Platinum may be used for A, B, C); Organic Matrices (ash at 4500C followed by one of the fusion methods above or sulfuric/hydrogen peroxide acid digestions may be applicable to non oxide containing samples).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 52 amu	40 ppt	N/A	36S16O, 36Ar16O - The 50Cr, 53Cr, 54Cr lines suffer from many more potential interferences from sulfur, chlorine and argon compounds of oxygen, nitrogen and carbon.
ICP-OES 205.552 nm	0.006/0.0008 µg/mL	1	Os
ICP-OES 276.654 nm	0.01/0.001 µg/mL	1	Cu, Ta, V
ICP-OES 284.325 nm	0.008/0.0007 µg/mL	1	

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

November 02, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **November 02, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCU10
Lot Number:	P2-CU682108
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Copper
Starting Material:	Cu Metal
Starting Material Lot#:	2095
Starting Material Purity:	99.9996%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10013 ± 30 µg/mL

Density: 1.032 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9977 ± 50 µg/mL**
ICP Assay NIST SRM 3114 Lot Number: 121207

Assay Method #2 **10024 ± 26 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **10007 ± 46 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.007542	M	Eu	<	0.000942	O	Na		0.001434	M	Se	<	0.016971	M	Zn	<	0.005657
O	Al	<	0.000609	O	Fe		0.008700	M	Nb	<	0.000942	O	Si		0.003052	M	Zr	<	0.000942
M	As	<	0.010371	M	Ga	<	0.000942	M	Nd	<	0.000942	M	Sm	<	0.000942				
M	Au	<	0.001885	M	Gd	<	0.000942	M	Ni		0.003781	M	Sn	<	0.005657				
O	B		0.003663	M	Ge	<	0.005657	M	Os	<	0.000942	M	Sr	<	0.000942				
M	Ba		0.004253	M	Hf	<	0.000942	O	P	<	0.031668	M	Ta	<	0.000942				
M	Be	<	0.000942	O	Hg	<	0.007064	M	Pb		0.005789	M	Tb	<	0.000942				
M	Bi	<	0.000942	M	Ho	<	0.000942	M	Pd	<	0.000942	M	Te	<	0.004714				
O	Ca		0.002304	M	In	<	0.000942	M	Pr	<	0.000942	M	Th	<	0.000942				
M	Cd	<	0.000942	M	Ir	<	0.000942	M	Pt	<	0.000942	O	Ti	<	0.002801				
M	Ce	<	0.000942	O	K		0.000763	M	Rb	<	0.000942	M	Tl	<	0.000942				
M	Co		0.001890	M	La	<	0.000942	M	Re	<	0.000942	M	Tm	<	0.000942				
M	Cr	<	0.005657	O	Li	<	0.000243	i	Rh	<		M	U	<	0.000942				
M	Cs	<	0.000942	M	Lu	<	0.000942	M	Ru	<	0.039588	M	V	<	0.003771				
s	Cu	<		O	Mg		0.000320	O	S		0.007174	M	W	<	0.005657				
M	Dy	<	0.000942	O	Mn		0.000793	M	Sb	<	0.001885	M	Y	<	0.000942				
M	Er	<	0.000942	M	Mo	<	0.005657	M	Sc	<	0.000942	M	Yb	<	0.000942				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 63.55 +2 6 $Cu(H_2O)_6^{2+}$

Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4, HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Cu Containing Samples (Preparation and Solution) -Metal (soluble in HNO_3); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO_3).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 63 amu	10 ppt	n/a	40Ar23Na 47Ti16O, 14N12C37Cl, 16O12C35Cl, 23Na40Ca
ICP-OES 219.958 nm	0.01/.002 µg/mL	1	Th, Ta, Nb, U, Hf
ICP-OES 224.700 nm	0.01/.001 µg/mL	1	Pb, Ir, Ni, W
ICP-OES 324.754 nm	0.06/.001 µg/mL		Nb, U, Th, Mo, Hf

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

August 24, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **August 24, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGMN10
Lot Number:	P2-MN687536
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Manganese
Starting Material:	Mn Metal
Starting Material Lot#:	2275
Starting Material Purity:	99.9909%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10046 ± 30 µg/mL

Density: 1.035 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10045 ± 25 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #2 **10083 ± 68 µg/mL**
ICP Assay NIST SRM 3132 Lot Number: 050429

Assay Method #3 **10031 ± 47 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.001500	M	Eu	<	0.000730	O	Na		0.176713	M	Se	<	0.006600	M	Zn		0.009960
O	Al		0.004337	M	Fe	<	0.650000	M	Nb	<	0.000730	O	Si		0.097995	M	Zr	<	0.000730
M	As	<	0.008000	M	Ga		0.004337	M	Nd	<	0.001500	M	Sm	<	0.000730				
M	Au	<	0.000730	M	Gd	<	0.000730	M	Ni		0.024097	M	Sn	<	0.002200				
M	B		0.069078	M	Ge	<	0.004400	M	Os	<	0.000730	O	Sr		0.000931				
M	Ba	<	0.001500	M	Hf	<	0.000730	i	P	<		M	Ta	<	0.000730				
M	Be	<	0.000730	M	Hg	<	0.002200	M	Pb		0.007389	M	Tb	<	0.000730				
M	Bi	<	0.003000	M	Ho	<	0.000730	M	Pd	<	0.000730	M	Te	<	0.019000				
O	Ca		0.062652	M	In	<	0.003000	M	Pr	<	0.000730	M	Th	<	0.000730				
M	Cd	<	0.001500	M	Ir	<	0.000730	M	Pt	<	0.000730	O	Ti	<	0.006500				
M	Ce	<	0.007300	O	K		0.006425	M	Rb	<	0.006600	M	Tl	<	0.000730				
O	Co		0.014779	M	La	<	0.003000	M	Re	<	0.000730	M	Tm	<	0.000730				
O	Cr		0.273102	O	Li		0.000417	M	Rh	<	0.003000	M	U	<	0.001500				
M	Cs	<	0.000730	M	Lu	<	0.000730	M	Ru	<	0.004400	M	V	<	0.000730				
O	Cu		0.007711	O	Mg		0.321297	i	S	<		M	W	<	0.004400				
M	Dy	<	0.001500	s	Mn	<		M	Sb	<	0.021000	O	Y		0.001365				
M	Er	<	0.001500	M	Mo		0.010281	O	Sc	<	0.004100	M	Yb	<	0.000730				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 54.94 +2 6 $Mn(H_2O)_6^{2+}$

Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4 ,HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5 % HNO_3/LDPE container.

Mn Containing Samples (Preparation and Solution) -Metal (Soluble in dilute acids); Oxides (Soluble in dilute acids); Ores (Dissolve with HCl. If silica is present add HF and then fume off silica by adding H_2SO_4 and heat to SO_3 fumes - dense white fumes).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 55 amu	10 ppt	n/a	40Ar14N1H,39K16O,37Cl18O,40Ar15N,38Ar17O,36Ar18O1H ,38Ar16O1H,37Cl17O1H,23Na32S
ICP-OES 257.610 nm	0.0014 / 0.00002 µg/mL	1	Ce, W, Re
ICP-OES 259.373 nm	0.0016 / 0.00002 µg/mL	1	U, Ta, Mo, Fe, Nb
ICP-OES 260.569 nm	0.0021 / 0.00002 µg/mL	1	Co

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

January 05, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **January 05, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGNI10
Lot Number:	P2-NI686384
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Nickel
Starting Material:	Ni Metal
Starting Material Lot#:	2277 and 2282
Starting Material Purity:	99.9992%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9979 ± 30 µg/mL

Density: 1.038 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9971 ± 54 µg/mL**
ICP Assay NIST SRM 3136 Lot Number: 120619

Assay Method #2 **9970 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **9993 ± 33 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag		0.002606	M	Eu	<	0.001100	O	Na		0.004965	O	Se	<	0.067000	M	Zn		0.006578
M	Al	<	0.013000	O	Fe		0.018618	M	Nb	<	0.001100	O	Si		0.010923	M	Zr	<	0.001100
O	As	<	0.067000	M	Ga	<	0.001100	M	Nd	<	0.001100	M	Sm	<	0.001100				
M	Au	<	0.002100	M	Gd	<	0.001100	s	Ni	<		M	Sn	<	0.016000				
M	B	<	0.017000	M	Ge	<	0.004200	M	Os		0.002110	O	Sr	<	0.000940				
M	Ba	<	0.001100	M	Hf	<	0.001100	i	P	<		M	Ta	<	0.001100				
O	Be	<	0.000410	M	Hg		0.014895	M	Pb		0.006578	M	Tb	<	0.001100				
M	Bi	<	0.004200	M	Ho	<	0.001100	M	Pd	<	0.001100	M	Te	<	0.015000				
O	Ca		0.003351	M	In	<	0.001100	M	Pr	<	0.001100	M	Th	<	0.001100				
M	Cd		0.001365	M	Ir		0.004716	M	Pt	<	0.001100	M	Ti	<	0.004200				
M	Ce	<	0.001100	O	K		0.004716	M	Rb	<	0.001100	M	Tl	<	0.001100				
O	Co		0.017377	M	La	<	0.001100	M	Re		0.001737	M	Tm	<	0.001100				
O	Cr	<	0.006700	O	Li	<	0.000140	M	Rh	<	0.006300	M	U	<	0.001100				
M	Cs	<	0.007300	M	Lu	<	0.001100	M	Ru	<	0.019000	M	V	<	0.002100				
M	Cu		0.004096	O	Mg		0.000372	i	S	<		M	W	<	0.006300				
M	Dy	<	0.001100	O	Mn	<	0.001900	M	Sb		0.005833	O	Y	<	0.000540				
M	Er	<	0.001100	M	Mo	<	0.008400	M	Sc	<	0.002100	M	Yb	<	0.001100				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 58.69 +2 6 Ni(H2O)62+
Chemical Compatibility -Stable in HCl, HNO3, H2SO4 ,HF, H3PO4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.
Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO3 / LDPE container.
Ni Containing Samples (Preparation and Solution) -Metal (Soluble in HNO3); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO3).
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 60 amu	100 ppt	n/a	43Ca16O1H , 44Ca16O, 23Na37Cl
ICP-OES 221.647 nm	0.01 / 0.0009 µg/mL	1	Si
ICP-OES 231.604 nm	0.02 / 0.002 µg/mL	1	Sb, Ta, Co
ICP-OES 232.003 nm	0.02 / 0.006 µg/mL	1	Cr, Re, Os, Nb, Ag, Pt, Fe

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

December 02, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **December 02, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

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300 Technology Drive
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

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Testing Laboratory
Certificate 883.01

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Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGZN10
Lot Number:	P2-ZN686137
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Zinc
Starting Material:	Zn Shot
Starting Material Lot#:	2201
Starting Material Purity:	99.9993%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10040 ± 30 µg/mL

Density: 1.033 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10009 ± 54 µg/mL**
ICP Assay NIST SRM 3168a Lot Number: 120629

Assay Method #2 **10049 ± 33 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **10041 ± 28 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.003057	M	Eu	<	0.000509	O	Na		0.001874	M	Se	<	0.023441	s	Zn	<
O	Al	<	0.005720	O	Fe		0.006348	M	Nb	<	0.000509	O	Si	<	0.057200	M	Zr	< 0.000509
M	As	<	0.003057	M	Ga	<	0.007134	M	Nd	<	0.000509	M	Sm	<	0.000509			
M	Au	<	0.000510	M	Gd	<	0.000509	M	Ni	<	0.000509	M	Sn	<	0.000509			
O	B	<	0.017160	M	Ge	<	0.003057	M	Os	<	0.000510	M	Sr	<	0.000509			
M	Ba	<	0.000509	M	Hf	<	0.000509	O	P	<	0.057200	M	Ta	<	0.000509			
M	Be	<	0.000509	M	Hg	<	0.001021	O	Pb		0.023870	M	Tb	<	0.000509			
M	Bi	<	0.005095	M	Ho	<	0.000509	M	Pd	<	0.002038	M	Te	<	0.023441			
O	Ca		0.033793	M	In	<	0.000509	M	Pr	<	0.000509	M	Th	<	0.000509			
O	Cd		0.003924	M	Ir	<	0.000510	M	Pt	<	0.000509	M	Ti	<	0.000509			
M	Ce	<	0.000509	O	K		0.001499	M	Rb	<	0.002038	M	Tl	<	0.009172			
M	Co	<	0.000509	M	La	<	0.000509	M	Re	<	0.000509	M	Tm	<	0.000509			
O	Cr		0.001549	O	Li	<	0.000457	M	Rh	<	0.000509	M	U	<	0.000509			
M	Cs	<	0.000509	M	Lu	<	0.000509	M	Ru	<	0.006129	M	V	<	0.000509			
O	Cu	<	0.010296	O	Mg		0.000349	O	S	<	0.034320	M	W	<	0.001019			
M	Dy	<	0.000509	M	Mn	<	0.000509	M	Sb	<	0.001019	M	Y	<	0.000509			
M	Er	<	0.000509	M	Mo	<	0.000509	M	Sc	<	0.000509	M	Yb	<	0.000509			

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 65.39 +2 4 Zn(OH)(aq)1+
Chemical Compatibility -Stable in HCl, HNO3, H2SO4 ,HF, H3PO4. Avoid basic media forming insoluble carbonate and hydroxide. Stable with most metals and inorganic anions in acidic media.
Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO3 / LDPE container.
Zn Containing Samples (Preparation and Solution) -Metal (soluble in HNO3); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO3); Organic based (dry ash at 4500C and dissolve ash in HCl) (sulfuric/peroxide acid digestion)
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 66 amu	7 ppt	N/A	50Ti16O,50Cr16O, 50V16O, 34S16O2, 32S16O18O, 32S17O2, 33S16O17O, 32S34S, 33S2
ICP-OES 202.548 nm	0.004/0.0002 µg/mL	1	Nb, Cu, Co, Hf
ICP-OES 206.200 nm	0.006/0.0006 µg/mL	1	Sb, Ta, Bi, Os
ICP-OES 213.856 nm	0.002/0.0004 µg/mL	1	Ni, Cu, V

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

December 05, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **December 05, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

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ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGU1
Lot Number:	P2-U683975
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	1 000 µg/mL ea: Uranium
Starting Material:	Uranyl Nitrate
Starting Material Lot#:	1948
Starting Material Purity:	99.9985%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 1001 ± 5 µg/mL

Density: 1.010 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **1001 ± 5 µg/mL**
ICP Assay NIST SRM 3164 Lot Number: 080521

Assay Method #2 **1002 ± 6 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Certified Abundance:

IV's Certified Abundance

Isotope	Atom %
Uranium 238U	99.8 ± 0.1
Uranium 235U	0.24 ± 0.05

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.000103	M	Eu	<	0.000103	M	Na		0.020618	M	Se	<	0.001246	M	Zn	<	0.003533
M	Al	<	0.003740	M	Fe		0.001029	M	Nb	<	0.000207	M	Si	<	0.035027	M	Zr	<	0.000103
M	As	<	0.001143	M	Ga	<	0.001350	M	Nd	<	0.000623	M	Sm	<	0.000311				
M	Au	<	0.000207	M	Gd	<	0.000311	M	Ni	<	0.008313	M	Sn	<	0.007273				
M	B	<	0.005819	M	Ge	<	0.001974	M	Os	<	0.000103	M	Sr	<	0.001039				
M	Ba	<	0.002286	M	Hf	<	0.000103	i	P	<		M	Ta	<	0.000103				
M	Be	<	0.001350	M	Hg	<	0.000415	M	Pb	<	0.000103	M	Tb	<	0.000103				
M	Bi	<	0.000103	M	Ho	<	0.000103	M	Pd	<	0.000207	M	Te	<	0.006234				
M	Ca	<	0.010391	M	In	<	0.000103	M	Pr	<	0.000103	M	Th		0.010535				
M	Cd	<	0.000103	M	Ir	<	0.000103	M	Pt	<	0.000103	M	Ti	<	0.000207				
M	Ce	<	0.000103	M	K	<	0.041565	M	Rb	<	0.000519	M	Tl	<	0.000103				
M	Co	<	0.000415	M	La	<	0.001662	M	Re	<	0.000103	M	Tm	<	0.000103				
M	Cr	<	0.001870	M	Li	<	0.001662	M	Rh	<	0.000103	s	U	<					
M	Cs		0.000175	M	Lu	<	0.000103	M	Ru	<	0.000519	M	V	<	0.000207				
M	Cu		0.000792	M	Mg	<	0.002493	i	S	<		M	W	<	0.000103				
M	Dy	<	0.000103	M	Mn	<	0.001454	M	Sb	<	0.000103	M	Y	<	0.000103				
M	Er	<	0.000103	M	Mo	<	0.000415	M	Sc	<	0.006234	M	Yb	<	0.000103				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 238.03 +6 8 UO_2^{2+}(uranyl)

Chemical Compatibility - Soluble in HCl and HNO_3. Avoid H_3PO_4. H_2SO_4 and HF matrices should not be a problem depending upon [U]. Although the UO_2^{2+} ion is distinctly basic, any U+4 will precipitate in basic media. UO_2^{2+}salts are generally soluble in water and UO_2^{2+} is stable with most metals and inorganic anions. The uranyl phosphate is insoluble in water. UF_4 and UF_6 are water soluble.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5% HNO_3 / LDPE container.

U Containing Samples (Preparation and Solution) -Metal (Dissolves rapidly in HCl and HNO_3); Oxide (Soluble in HNO_3); Ores (Digest for 1-2 hours with 1 gram of ore to 30 mL 1:1 HNO_3. Silica insolubles are removed by filtration after bringing the sample to fumes with conc. H_2SO_4.)

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 238 amu	2 ppt	N/A	206Pb16O2
ICP-OES 263.553 nm	0.3 / 0.01 µg/mL	1	Ce, Ir, Th, Rh, W, Zr, Ta, Ti, V, Hf, Fe, Re, Ru
ICP-OES 367.007 nm	0.3 / 0.02 µg/mL	1	Th, Ce
ICP-OES 385.958 nm	0.3 / 0.01 µg/mL	1	Th, Fe

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

September 28, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **September 28, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Multi Analyte Custom Grade Solution
Catalog Number:	AR-6020ICS-0A10
Lot Number:	R2-MEB692465
Matrix:	1.4% (v/v) HNO3
Value / Analyte(s):	1 000 µg/mL ea: Chloride,
	200 µg/mL ea: Carbon,
	100 µg/mL ea: Calcium, Aluminum, Iron, Potassium, Magnesium, Sodium, Phosphorus, Sulfur,
	2 µg/mL ea: Titanium, Molybdenum

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Aluminum, Al	100.0 ± 0.3 µg/mL	Calcium, Ca	100.0 ± 0.5 µg/mL
Carbon, C	200.1 ± 0.5 µg/mL	Chloride, Cl	1 000 ± 5 µg/mL
Iron, Fe	100.0 ± 0.5 µg/mL	Magnesium, Mg	100.0 ± 0.5 µg/mL
Molybdenum, Mo	2.001 ± 0.012 µg/mL	Phosphorus, P	100.1 ± 0.6 µg/mL
Potassium, K	100.0 ± 0.5 µg/mL	Sodium, Na	100.0 ± 0.5 µg/mL
Sulfur, S	100.0 ± 0.5 µg/mL	Titanium, Ti	2.001 ± 0.017 µg/mL

Density: 1.007 g/mL (measured at 20 ± 4 ºC)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Al	ICP Assay	3101a	140903
Al	EDTA	928	928
C	Acidimetric	84L	84L
Ca	ICP Assay	3109a	130213
Ca	EDTA	928	928
Fe	ICP Assay	3126a	140812
Fe	EDTA	928	928
K	ICP Assay	3141a	140813
K	Gravimetric		See Sec. 4.2
Mg	ICP Assay	3131a	140110
Mg	EDTA	928	928
Mo	ICP Assay	3134	130418
Na	ICP Assay	3152a	120715
Na	Gravimetric		See Sec. 4.2
P	ICP Assay	3139a	060717
P	Acidimetric	84L	84L
S	Acidimetric	84L	84L
S	ICP Assay	traceable to 3154	M2-S657208
Ti	ICP Assay	3162a	130925

The follow ing equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

$CRM/RM\ Expanded\ Uncertainty\ (\pm) = U_{CRM/RM} = k\ (u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{1/2}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\ (u_{char\ i})^2)]^{1/2}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\ (u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

$CRM/RM\ Expanded\ Uncertainty\ (\pm) = U_{CRM/RM} = k\ (u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{1/2}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

N/A

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

April 22, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **April 22, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

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ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGAG10
Lot Number:	P2-AG688237
Matrix:	7% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Silver
Starting Material:	Ag Shot
Starting Material Lot#:	2217
Starting Material Purity:	99.9993%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10004 ± 30 µg/mL

Density: 1.054 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9984 ± 32 µg/mL**
ICP Assay NIST SRM 3151 Lot Number: 160729

Assay Method #2 **10016 ± 26 µg/mL**
Volhard NIST SRM 999c Lot Number: 999c

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

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u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

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u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

s	Ag	<		M	Eu	<	0.000253	O	Na		0.005563	M	Se	<	0.018179	M	Zn		0.005800
O	Al		0.006296	O	Fe		0.002932	M	Nb	<	0.000253	M	Si		0.022487	M	Zr	<	0.005559
M	As	<	0.002403	M	Ga	<	0.000253	M	Nd	<	0.000253	M	Sm	<	0.000253				
M	Au		0.001635	M	Gd	<	0.000253	O	Ni	<	0.005472	M	Sn		0.001928				
O	B	<	0.009978	M	Ge	<	0.000754	M	Os	<	0.000254	O	Sr		0.000086				
M	Ba	<	0.000785	M	Hf	<	0.000253	M	P	<	0.053784	M	Ta	<	0.000253				
M	Be	<	0.002407	M	Hg	<	0.001332	M	Pb		0.003281	M	Tb	<	0.000253				
M	Bi		0.001671	M	Ho	<	0.000253	M	Pd	<	0.001382	M	Te	<	0.003715				
O	Ca		0.007116	M	In	<	0.003483	M	Pr	<	0.000253	M	Th	<	0.000253				
M	Cd	<	0.000253	M	Ir	<	0.000254	M	Pt	<	0.000253	M	Ti	<	0.002706				
M	Ce	<	0.000573	O	K		0.004010	M	Rb	<	0.000253	M	Tl	<	0.000253				
M	Co	<	0.000253	M	La	<	0.000253	M	Re	<	0.000253	M	Tm	<	0.000253				
O	Cr	<	0.005043	O	Li	<	0.000214	M	Rh	<	0.000253	M	U	<	0.000253				
M	Cs	<	0.002769	M	Lu	<	0.000253	M	Ru	<	0.000254	M	V	<	0.000822				
O	Cu		0.004614	O	Mg		0.001035	M	S	<	0.560935	M	W	<	0.002146				
M	Dy	<	0.000253	M	Mn	<	0.000253	M	Sb	<	0.006899	M	Y	<	0.000253				
M	Er	<	0.000253	M	Mo	<	0.000479	M	Sc	<	0.000733	M	Yb	<	0.000253				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 107.87 +1 6 $Ag(H_2O)_6^+$

Chemical Compatibility -Stable in HNO_3, and HF. Avoid basic media. Ag forms more insoluble salts than any other metal. It also is subject to photochemical reduction to the metal in HCl media although 10 µg/mL solutions in 10% HCl [$AgCl_{x1-x}$] are commonly used in the analytical laboratory. The most common solubility problems exist with arsenate, arsenite , bromide, chloride, iodide, carbonate , chromate, cyanide, iodate, oxalate, oxide, sulfate, sulfide, tartrate, and thiocyanate in aqueous media. The addition of nitric acid renders many of these salts soluble.

Stability - 2-100 ppb levels stable for 75+ days when mixed with equivalent levels of all other elements including the precious metals (where chloride is present) when in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Ag Containing Samples (Preparation and Solution) -Metal (Soluble in HNO_3); Oxides (Soluble in HNO_3); Ores (Digestion with conc. HNO_3).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 107 amu	1 ppt	N/A	91Zr16O
ICP-OES 243.779 nm	0.12/0.01 µg/mL	1	Mn, Th, Ni, Rh
ICP-OES 328.068 nm	0.007/0.0007 µg/mL	1	Ce, Rh, V
ICP-OES 338.289 nm	0.013/0.001 µg/mL	1	Ce, Cr, Th

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

January 29, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **January 29, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com
tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES !" #$$%&' !(&' () *+, - . / 01234 &5&%#67 &89!%&: &5(" ;) % (<& =) : >&(&5$&) ; 7 &;&%&5$& ? #(&%#6@)% 9$&%3#5' *+, A*B=- . / CD234 &5&%#6 7 &89!%&: &5(" ;) %<(& =) : >&(&5$&) ; E&"(!5F #5' =#6G%#(!) 5 H#G) %#() %&" 3I *5) %5#5!$ J&5(9%&" !" #6') #5 *+, K/ / - %&F!"(&%&' : #59;#$(9%&%LM+7 = &%(!$#(& N9: G&%LM+7 G/ / 01PI

2.0 PRODUCT DESCRIPTION

@)% 9$(=) ' &S	+!5F6& T5#6Q(& = 9" () : 4 %#' & +) 69(!) 5
= #(#6) F N9: G&%S	= 4 TH- /
H) (N9: G&%S	+COTH / / R10
? #(%LJS	. V LWAVPXN, 0
J#69& AT5#6Q(&L" PS	-/ / / / YFA H&#S T69: !59:
+(#%!5F ? #(&%#6S	T6LN, 0P0 ZKXC,
+(#%!5F ? #(&%#6H) ([S	@CC00/ C
+(#%!5F ? #(&%#6@9%(QS	KKIKK- 0V

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: - / / -- \ 0- YFA H

Density: - I/ R FA HL: &#"9%&' #(C/ \ 1]=P

Assay Information:

Assay Method #1 **10015 ± 44 µg/mL**
= @T" "#QN+E +7 ? 0- / - # H) (N9: G&%S- 1/ K/ 0

Assay Method #2 **10008 ± 25 µg/mL**
B^ ET N*+E +7 ? KCR H) (N9: G&%SKCR

Assay Method #3 **10014 ± 36 µg/mL**
= #6$96#&' N*+E +7 ? H) (N9: G&%S+ && + &$I 1IC

CE<& = #6$96#(&' J#69& !" # W#69& $#6$96#(&' ;%): (<& _ &!F<( ) ; # "(#%!5F : #(&%#6(<#(<#" G&&5 $&%(!&' ' !%&$(6QVWI # N#(!) 5#6*5" (!(9(&) ; +(#5' #%" #5' E&$<5) 6) FQLN*+EP+7 ? A7 ? I + && + &$ 1IC ;) %G#6#5$& (%$&#G16(Q

E<& ;) 66) !5F &89#(!) 5" #%& 9" &' !5 (<& $#6$96#!) 5) ; (<& $&%(;!&' W#69& #5' (<& 95$&%#!5(Q 7 &>) %&' 95$&%#!5(!&" %&>%&" &5(&U>#5' &' 95$&%#!5(!&" &U>%&" " &' #(#>>%U: #(&&Q(<& KDV $) 5;!' &5$& 6&%&69" !5F # $) W&%F& ;#$() %) ; ` a CI

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{1/2}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2 (u_{char\ i})^2)]^{1/2}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{1/2}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

OE<!" >%' 9$(!" (%#$&#G& () N*+E W# #5 95G%` &5 $<#!5 ) ; $) : >#%" ) 5" I E<& 95$&%#!5(!&" ;) %&#$< $&%!(!&' W#9& #%& %&>) %&' 2 #` !5F !5() #$$) 95((<& +7 ? A7 ? 95$&%#!5(Q&%)%#5' (<& : &#" 9%&: &5(2_&!F<!5F #5' W9: &' !9(!) 5 &%)%I *5 %#%& $#" &" _<&%& 5) N*+E +7 ? A7 ? #%& #W#!6#G&2 (<& (&%: !5G) 9" & " (' Ib!" " >&$!;!&' I

4.1 Thermometer Calibration

OT6(<&%:) : &(&% #%& N*+E (%#$&#G& (<%9F< (<&%:) : &(&% (<#(#%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q

4.2 Balance Calibration

OT6#5#6Q!$#6G#6#5$&" #%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q#5' >%$&' 9%&I E<& _&!F<(" 9" &' ;) %&(!5F #%& #559#6Q$) : >#%&' () : #" (&%_&!F<(" #5' #%& (%#$&#G& () N*+EI

4.3 Glassware Calibration

OT5 !5G) 9" & >%$&' 9%& !" 9" &' () $#6G%#(& #6=#" " T F6#" " _#%& 9" &' !5 (<& : #59;#$(9%5F #5' 89#6(Q $) 5(%)6) ; =7 ? A7 ? " I

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

=7 ? A7 ? " #%& (&" (&' ;) % (#$& : &(#6$!: >9%!&" GQTU#6*=@Q B+ #5' *=@O?+I E<& %&" 96(;%: (<& :) " (" &5" !(!W& : &(<) ' ;) %&#$< &&: &5(2!" %&>) %&' G&6) _I +) 9(!) 5" (&" (&' GQ*=@O?+ _&%& #5#6Q&' !5 #5 d H@T@!(&%&' =6&#5 7)) : I T5 d H@T@!(&%I" KKIKKRDV &;;!$!&5(;) %<(& %&:) W#6) ; >#%!$6&" ') _5 () / I0 Y: I

?	TF	f	/ I/ / - D/ /	?	B9	f	/ I/ / / gR/	,	N#		/ ID- / C/ /	?	+&	f	/ I/ - 1/ / /	?	I 5		/ I/ / K- R0
"	T6	f		,	e&		/ I- - 1CR1	?	NG	f	/ I/ / / gR/	,	+!		/ I/ D0/ g/	,	I %		/ I/ / 0g. 0
?	T"	f	/ I/ / gR/ /	,	4 #		/ I- K- R0D	?	N'	f	/ I/ / / gR/	?	+:	f	/ I/ / / gR/				
?	T9	f	/ I/ / / gR/	?	4 '	f	/ I/ / 1- / /	,	N!		/ I/ / - - / C	?	+5	f	/ I/ / gR/ /				
,	h	f	/ I/ C- / / /	?	4 &	f	/ I/ / - 1/ /	?	, "	f	/ I/ / R / /	,	+%		/ I/ / gD0/				
,	h#		/ I/ - CgDC	?	X;	f	/ I/ / C. / /	5	@	f		?	E#	f	/ I/ / / gR/				
,	h&	f	/ I/ / - 0/ /	?	XF	f	/ I/ / g- / /	?	@G		/ I/ / gD0/	?	EG	f	/ I/ / / gR/				
?	h!	f	/ I/ / R- / /	?	X)	f	/ I/ / / gR/	?	@	f	/ I/ / / gR/	?	E&	f	/ I/ 0/ / / /				
,	=#		/ I/ . - 1CR	?	*5	f	/ I/ / / K/ /	?	@%	f	/ I/ / / gR/	?	E<	f	/ I/ / / gR/				
?	='	f	/ I/ / - 1/ /	?	*%	f	/ I/ / / gR/	?	@	f	/ I/ / / gR/	,	E!		/ I/ / - - 1C				
?	=&	f	/ I/ / C. / /	,	i		/ I/ D0/ g/	?	7 G	f	/ I/ - 1/ / /	?	E6	f	/ I/ / / gR/				
,	=)		/ I/ / - K. K	?	H#	f	/ I/ / CK/ /	?	7 &	f	/ I/ / / gR/	?	E:	f	/ I/ / / gR/				
,	=%		/ I/ - 1CRD	,	H!		/ I/ / / - 1C	?	7 <	f	/ I/ / / gR/	?	d	f	/ I/ / - 1/ /				
?	="		/ I/ / D0/ g	?	H9	f	/ I/ / / gR/	?	7 9	f	/ I/ / / gR/	?	J	f	/ I/ / D1/ /				
,	=9		/ I/ / 01gK	,	? F		/ I/ gK0R	!	+	f		?	j	f	/ I/ - C/ / /				
?	^ Q	f	/ I/ / D1/ /	,	? 5		/ I/ / - gD0	?	+G	f	/ I/ / 1C/ /	?	k	f	/ I/ / / gR/				
?	B%	f	/ I/ / / gR/	?	?)	f	/ I/ - C/ / /	?	+$	f	/ I/ / C- / /	?	kG	f	/ I/ / / gR/				

? O= <&$` &' GQ*= @O? + , O= <&$` &' GQ*= @Q B+ ! O+ >&$(%#6*5(&%&%&5$&
5 ON) (= <&$` &' e) % " O+) 6(!) 5 +(#5' #% B6& &5(

6.0 INTENDED USE

Oe) %<(& $#6G%#(!) 5) ; #5#6Q!$#6!5" (%: &5(" #5' W#6' #(!) 5) ; #5#6Q!$#6: &(<) ' " #" #>>%>%#(&I

@#F& C) ; 1

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

O+() %& G&(_&&5 #>>%)U: #(&6Q1m O/ m =_<!6& !5 "&#6&' E=E G#FI

Oj <!6& "() %&' !5 (<& "&#6&' E=E G#F2(%#5">!%#(!) 5); (<!" =7 ? A7 ? !" 5&F6F!G6&I T;(&%) >&5!5F (<& "&#6&' E=E G#F (%#5">!%#(!) 5); (<& =7 ? A7 ? _!6) $$9%2%&" 96!5F !5 # F%#' 9#6!5$%&#" & !5 (<& #5#6Q(& $) 5$&5(%#(!) 5L" PI *(!" (<& %&">) 5"!G!6Q) ; (<& 9"&%)(#$$) 95(;) %<!" &;;&$(I j <&5 (<& G) ((6& !" _&!F<&' G) (< G&;) %& #5' #;(&%G&!5F >6#$&' !5 "() %#F&2 (<& : #"" ' !;;&%&5$&) G'&%%&' _!6G& # : &#"9%&) ; (%#5">!%#(!) 5 : #"" 6) ""I

OT;(&%) >&5!5F (<& "&#6&' E=E G#F2`&&> $#> (!F<(6Q"&#6&' _<&5 5) (!5 9"& #5' "() %& G&(_&&5 1m O1m =)(: !5!: !c& (<& &;;&$(") ; (%#5">!%#(!) 5I d"& #(C/ m\ 1m =)(: !5!: !c& W)69: &(%$' !6)(!) 5 &%)%%_<&5 9"!5F (<& %&>) %(&' ' &5"!(Q ^) 5) (>!>&((& ;%): (<& $) 5(#!5&% ^) 5) (%&(9%5 %&:) W&' #6)89) (" () $) 5(#!5&%

Oe) %) %& !5;) %:#(!) 52W!" !(**www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - CgIKR n0 g T6LXC, Rgn0

Chemical Compatibility - +) 69G6& !5 X= 62XN, 02Xe #5' XC+, 1I TW)!' 5&9(%#6: &' !#I +) 69G6& !5 "(%)5F6Q G#"!$ N#, X ;) %:!5F (<& T6L XPILXC, PC- O"&$!&"I +(#G6& _!(< :) "(: &(#6" #5' !5) %F#5!$ #5!) 5" I E<& ><) "><#(& !" !5") 69G6& !5 _#(&%#5') 56Q" 6F<(6Q") 69G6& !5 #$!' I

Stability - OO/ / >>G6&W&6 "(#G6& ;) %) 5(<" !5 - V XN, 0 AH^@B $) 5(#!5&% - O/ 2/ / >>: ") 69(!) 5" $<&: !$#66Q"(#G6& ;) %Q&#% !5 OODV XN, 0 AH^@B $) 5(#!5&%

Al Containing Samples (Preparation and Solution) - ? &(#6Lh&" (' !" ") 6W&' !5 X= 6AXN, 0 Pd#OT6C, 0 LN#C=, (;9"!) 5 !5 @(Po

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	Estimated D.L.	Order	Interferences L95' &%65&' !5' !$#(&" "&W&%&P
*=@O/+ C. #: 9	0/ >>(	NAT	- C=- DN2- 0=- 1N2 - X- C=- 1N2 - - h- g, 2 D1=%On2 D1e&On
*=@OB+ - g. I/ . R5:	/ I- A I/ / K YFA H	-	e&
*=@OB+ 0K1I1/ - 5:	/ I/ DA I/ / g YFA H	-	d2 =&
*=@OB+ 0KgI- DC 5:	/ I/ 0A I/ / g YFA H	-	?) 2 I%2 &

8.0 HAZARDOUS INFORMATION

O@6&#"& %&;&%)((<& +#;&(Q^ #(# +<&&(;) %!5;) %:#(!) 5 %&F#%!5F (<!" =7 ? A7 ? I

9.0 HOMOGENEITY

OE<!" ") 69(!) 5 _#" : !U&' #$$) %!5F () #5 !5G<) 9"& >%)$&' 9%& #5' !" F9#%#5(&&' () G& <) :) F&5&) 9"I X) :) F&5&!(Q' #(# !5' !$#(& (<#((<& &5' 9"&%"<) 96 (#`& # : !5!: 9: "#: >6& "!c&) ; / IC: H() #""9%& <) :) F&5&!(Q

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

OM+7 = &%(!;!$#(& N9: G&%M+7 O/ 01

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

O= <&: !$#6E&"(!5F OT$$%&' !(&' A TCHT = &%(!;!$#(& N9: G&%RR0I/ -

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

O7 &;&%&5$& ? #(&%#6@)% 9$&%OT$$%&' !(&' A TCHT = &%(!;!$#(& N9: G&%RR0I/ C

!" #$%!&() *! +# -.(/00 (1* ' 2!"3"$ 4(5#6* .(7 2#&-&%!8, #$.() %)(;;0</ .(=>?@*3*A2"!* B(C00DDED<EE@;0 FCF0/0 .(G%H0F;0 FCF0I: @&!"#$%!&6*! +# -9 "J @&K L &!"#$%!&6*! +# -9 "J

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

@#F& 0) ; 1

11.1 Certification Issue Date

p#59#%QC. 2C/ C-

OE<& $&%i(!$#(!) 5 !" W#6' _!(<!5 (<& : &#" 9%&: &5(95$&%#(!5(Q" >&$!;!&' >%)W &' (<& =7 ? A7 ? !" " () %&' #5' <#5' 6&' !5 #$$) %#5$& _!(< !5" (%)$(!) 5" F!W&5 !5 +&$. I- I E<!" $&%i(!$#(!) 5 !" 596&;!&' !; !5" (%)$(!) 5" !5 +&$. I- #%& 5) (;) 6) _ &') %i; (<& =7 ? A7 ? !" ' #: #F&' 2$) 5(#: !5#(&' 2) %) (<&%_!" & :) ' !;!&' I

11.2 Lot Expiration Date

OJanuary 27, 2025

OE<& ' #(& #;(&%_ <!$< (<!" =7 ? A7 ? " <) 96 5) (G& 9" &' I

OE<& 6) (&U>!%#(!) 5 ' #(& %&;6&$(" (<& >&%) ') ; (!: & (<#((<& " (#G6(Q) ; # =7 ? A7 ? $#5 G& " 9>>) %&' GQ6) 5F (&%: " (#G6(Q" (9' !&" $) 5' 9$(&') 5 >%)>&%&Q" () %&' #5' <#5' 6&' =7 ? A7 ? " I H) (&U>!%#(!) 5 !" 6: !(&' >% #%&Q.GQ (%#5" >!%#(!) 5 L6) " ") ; _#(&% ;)% (<& ") 6) (!) 5P#5' !5;%&89&5(6Q.GQ.$<&: !$#6" (#G6(Q

11.3 Period of Validity

O+ &#6&' E= E h#F , >&5 ^ #(&Sqqqqqqqqqqqqqqqqqqqqqqqqqq

OE<!" =7 ? A7 ? " <) 96 5) (G& 9" &' 6) 5F&%<(#5) 5& Q&#%L) %" !U:) 5(<" !5 (<& $#" &) ; # 0/ : HG) ((&P ;)% (<& ' #(&) ;) >&5!5F (<& #6) : !5!c&' G#F) %#;(&%<(& ' #(& F!W&5 !5 +&$I - - IC2_ <!$<&W&%$) : &" ;!%(I E<!" !" $) 5(!5F&5(9>) 5 (<& =7 ? A7 ? G&!5F " () %&' #5' <#5' 6&' !5 #$$) %#5$& _!(< (<& !5" (%)$(!) 5" F!W&5 !5 +&$I . I- I

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

? !$<#&6h)) (<
^! %&$() %2M9#6(Q=) 5(%6

Michael 2 Booth

Certifying Officer:

@#964 #!5&"
= <#!%:#5 A+&5!) %E&$<5!$#6^ !%&$() %

Paul R Gaines

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGAS10
Lot Number:	R2-AS691113
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Arsenic
Starting Material:	As Pieces
Starting Material Lot#:	2208
Starting Material Purity:	99.9980%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9981 ± 55 µg/mL

Density: 1.028 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9981 ± 55 µg/mL**
ICP Assay NIST SRM 3103a Lot Number: 100818

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The follow ing equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.001578	M	Eu	<	0.000526	O	Na		0.036136	M	Se	<	0.014204	O	Zn	<	0.003390
O	Al		0.006694	M	Fe		0.002633	O	Nb	<	0.011526	O	Si		0.139479	M	Zr	<	0.003156
s	As	<		M	Ga	<	0.000526	M	Nd	<	0.000526	M	Sm	<	0.000526				
M	Au	<	0.000526	M	Gd	<	0.000526	O	Ni	<	0.005537	M	Sn	<	0.001052				
M	B		0.017011	M	Ge	<	0.000526	M	Os	<	0.000526	M	Sr	<	0.000526				
M	Ba	<	0.000526	M	Hf	<	0.000526	O	P	<	0.056500	M	Ta	<	0.000526				
O	Be	<	0.001130	M	Hg	<	0.002104	M	Pb	<	0.000526	M	Tb	<	0.000526				
M	Bi	<	0.002104	M	Ho	<	0.000526	M	Pd	<	0.000526	M	Te	<	0.003682				
O	Ca		0.005657	M	In	<	0.000526	M	Pr	<	0.002630	M	Th	<	0.000526				
M	Cd	<	0.000526	M	Ir	<	0.000526	M	Pt	<	0.000526	O	Ti	<	0.001017				
M	Ce	<	0.000526	O	K		0.003865	M	Rb	<	0.002104	M	Tl	<	0.000526				
M	Co	<	0.003156	M	La	<	0.000526	M	Re	<	0.000526	M	Tm	<	0.000526				
M	Cr		0.000877	M	Li	<	0.000526	M	Rh	<	0.000526	M	U	<	0.000526				
M	Cs	<	0.002104	M	Lu	<	0.000526	M	Ru	<	0.000526	M	V	<	0.001578				
M	Cu	<	0.003156	O	Mg		0.000235	O	S	<	0.056500	M	W	<	0.000526				
M	Dy	<	0.000526	M	Mn	<	0.001052	M	Sb	<	0.000526	M	Y	<	0.000526				
M	Er	<	0.000526	M	Mo	<	0.000526	M	Sc	<	0.002104	M	Yb	<	0.000526				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 74.92 ; mix of +3 and +5 ; 6 ; H_3AsO_4 and $HAsO_2$

Chemical Compatibility - Arsenic has no cationic chemistry. It is soluble in HCl, HNO_3,H_3PO_4, H_2SO_4 and HF aqueous matrices water and NH_4OH . It is stable with most inorganic anions (forms arsenate when boiled with chromate) but many cationic metals form the insoluble arsenates under pH neutral conditions. When fluorinated and / or under acidic conditions arsenate formation is typically not a problem at moderate to low concentrations.

Stability - 2-100 ppb levels stable for months alone or mixed with other elements at equivalent levels in 1% HNO_3 / LDPE container.

As Containing Samples (Preparation and Solution) - Metal (soluble in 1:1 H_2O / HNO_3); Oxides (the oxide exists in crystalline and amorphous forms where the amorphic form is more water soluble. The oxides typically dissolve in dilute acidic solutions when boiled); Minerals (one gram of powered sample is fused in a Ni crucible with 10 grams of a 1:1 mix of K_2CO_3 and KNO_3 and the melt extracted with hot water); Organic Matrices (0.2 to 0.5 grams of sample are fused with 15 grams of a 1:1 Na_2CO_3 / Na_2O_2 mix in a Ni crucible. The fuseate is extracted with water and acidified with HNO_3).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 75 amu	20 ppt	N/A	40Ar35Cl, 59Co16O, 36Ar38Ar1H,8Ar37Cl,Ar39K, 150Nd2+,150Sm2+
ICP-OES 189.042 nm	0.05/0.005 µg/mL	1	Cr
ICP-OES 193.696 nm	0.1/0.01 µg/mL	1	V, Ge
ICP-OES 228.812 nm	0.1/0.01 µg/mL	1	Cd, Pt, Ir, Co

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

March 25, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **March 25, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGBA10
Lot Number:	P2-BA682107
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Barium
Starting Material:	Ba(NO3)2
Starting Material Lot#:	Mixed Lots
Starting Material Purity:	99.9995%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10072 ± 32 µg/mL

Density: 1.024 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10054 ± 80 µg/mL**
ICP Assay NIST SRM 3104a Lot Number: 140909

Assay Method #2 **10075 ± 30 µg/mL**
Gravimetric NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.001538	O	Eu	<	0.028728	O	Na		0.006767	M	Se	<	0.007964	O	Zn		0.004335
M	Al		0.005194	M	Fe		0.016554	M	Nb	<	0.000200	O	Si	<	0.020780	M	Zr	<	0.000271
M	As	<	0.000519	M	Ga	<	0.000200	M	Nd	<	0.000200	M	Sm	<	0.082480				
M	Au	<	0.003452	M	Gd	<	0.000200	M	Ni	<	0.001290	M	Sn	<	0.000200				
M	B	<	0.002519	M	Ge	<	0.000430	M	Os	<	0.000752	O	Sr		0.027070				
s	Ba	<		M	Hf	<	0.002746	O	P	<	0.044677	M	Ta	<	0.001008				
M	Be	<	0.000430	M	Hg	<	0.001063	M	Pb	<	0.002257	M	Tb	<	0.000200				
M	Bi	<	0.002971	M	Ho	<	0.000200	M	Pd	<	0.000286	M	Te	<	0.001470				
O	Ca		0.026224	M	In	<	0.000200	M	Pr	<	0.000200	M	Th	<	0.000200				
M	Cd	<	0.000200	M	Ir	<	0.000446	M	Pt	<	0.000200	M	Ti	<	0.000324				
M	Ce	<	0.004362	O	K		0.011526	M	Rb		0.001487	M	Tl	<	0.000200				
M	Co	<	0.000200	O	La	<	0.091587	M	Re	<	0.000200	M	Tm	<	0.000954				
M	Cr	<	0.002191	O	Li	<	0.002181	M	Rh	<	0.000200	M	U	<	0.000200				
M	Cs	<	0.001640	M	Lu	<	0.002934	M	Ru	<	0.000200	M	V	<	0.000229				
M	Cu	<	0.003646	O	Mg		0.002379	O	S	<	0.073041	M	W	<	0.001627				
M	Dy	<	0.000200	M	Mn	<	0.000902	M	Sb	<	0.000514	O	Y	<	0.019637				
M	Er	<	0.000556	M	Mo	<	0.000455	M	Sc	<	0.000478	M	Yb	<	0.001991				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 137.33 +2 6 $Ba(H_2O)_6^{+2}$
Chemical Compatibility - Soluble in HCl, and HNO_3. Avoid H_2SO_4, HF and neutral to basic media. Stable with most metals and inorganic anions forming insoluble silicate, carbonate, hydroxide, oxide, fluoride, sulfate, oxalate, chromate, arsenate, iodate, molybdate, sulfite and tungstate in neutral aqueous media.
Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1 -10,000 ppm solutions chemically stable for years in 1-3.5% HNO_3 / LDPE container.
Ba Containing Samples (Preparation and Solution) -Metal(is best dissolved in diluted HNO_3); Ores(Carbonate fusion in Pt0 followed by HCl dissolution. If sulfate is present dissolve the fuseate using HCl / tartaric acid to prevent $BaSO_4$ precipitate); Organic Matrices (dry ash and dissolve in dilute HCl.)
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 138 amu	1 ppt	N/A	122Sn16O, 122Te16O
ICP-OES 230.424 nm	0.004/0.0005 µg/mL	1	Mo, Ir, Co
ICP-OES 233.527 nm	0.004/0.0003 µg/mL	1	
ICP-OES 455.403 nm	0.002/0.0001 µg/mL	1	Zr, U

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

September 13, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **September 13, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com
tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES !" #$$%&' !(&' () *+, - . / 01234 &5&%#67 &89!%&: &5(" ;) % (<& =) : >&(&5$&) ; 7 &;&%&5$& ? #(&%#6@)% 9$&%3#5' *+, A*B=- . / CD234 &5&%#6 7 &89!%&: &5(" ;) %<(& =) : >&(&5$&) ; E&" (!5F #5' =#6G%#(!) 5 H#G) %#() %&" 3I *5) %5!$ J&5(9%&" !" #6) #5 *+, K/ / - %&F!" (&%&' : #59;#$(9%&%LM+7 = &%(!$#(& N9: G&%M+7 G/ 01PI

2.0 PRODUCT DESCRIPTION

@)% 9$(=) ' &S	+!5F6& T5#6Q(& = 9" () : 4 %#' & +) 69(!) 5
= #(#6) F N9: G&%S	= 4 UB- /
H) (N9: G&%S	@QCOUBV. RRVD
? #(%MS	VX LYAYPZN , 0
J#69& AT5#6Q(&L" PS	-/ / / / [FA H&#S U&%Q6B9:
+(#%(5F ? #(&%#6S	U&%Q6B9: ' !#$&(#(&
+(#%(5F ? #(&%#6H) (\ S	CCC-
+(#%(5F ? #(&%#6@9%(QS	KKIKKKRX

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: -/ / 0V] 0D [FA H

Density: - I- 1/ FA HL: &#" 9%&' #(C/] 1 ^= P

Assay Information:

Assay Method #1 **10051 ± 42 µg/mL**
= @T" "#QN+ E + 7 ? 0- / D# H) (N9: G&%S/ K/ D- 1

Assay Method #2 **10008 ± 59 µg/mL**
= #6$96#&' N*+ E + 7 ? H) (N9: G&%S+ && + &$I 1IC

CE<& = #6$96#(&' J#69& !" # Y#69& $#6$96#(&' ;%: (<& _ &!F<( ) ; # " (#%(5F : #(&%#6(<#(<#" G&&5 $&%(!&' ' !%&$(6QY" I # N#(!) 5#6*5" (!(9(&) ; +(#5' #%" #5' E&$<5) 6) FQLN*+EP+7 ? A7 ? I + && + &$ 1IC ;) %G#6#5$& (%#$&#G96(Q

E<& ;) 66) !5F &89#(!) 5" #%& 9" &' !5 (<& $#6$96#(!) 5) ; (<& $&%(;!&' Y#69& #5' (<& 95$&%(#!5(Q 7 &>) %(&' 95$&%(#!5(!&" %&>%&" &5(&W¥#5' &' 95$&%(#!5(!&" &W¥%&" " &' #(#>>%)W #(&6Q(<& KDX $) 5;!' &5$& 6&Y&69" !5F # $) Y&%#F& ;#$() %) ; ` a C

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

OE<!" >%þ' 9$(!" (%#$&#G&& () N*+E Y!# #5 95G%þ` &5 $<#!5 ) ; $) : >#%!') 5"I E<& 95$&%#&!5(!&" ;) %&#$< $&%!(!&' Y#6%& #%& %&>) %&(' 2 #` !5F !5() #$$) 95((<& +7 ? A7 ? 95$&%#&!5(Q&%)%%#5' (<& : &#" 9%&: &5(2_ &!F<!5F #5' Y) 6%: & ' !6%(!) 5 &%)%%I *5 %#%& $#" &" _<&%& 5) N*+E +7 ? A7 ? #%& #Y#!6#G&&2 (<& (&%: !5G<) 9" & " (' Ib!" " >&$!;!&' I

4.1 Thermometer Calibration

OT6(<&%:) : &(&% #%& N*+E (%#$&#G&& (<%þ9F< (<&%:) : &(&% (<#(#%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q

4.2 Balance Calibration

OT6#5#6Q!$#6G#6#5$&" #%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q#5' >%þ$&' 9%&I E<& _ &!F<(" 9" &' ;) %&(" (!5F #%& #559#6Q$) : >#%&' () : #" (&%_ &!F<(" #5' #%& (%#$&#G&& () N*+EI

4.3 Glassware Calibration

OT5 !5G<) 9" & >%þ$&' 9%&!" 9" &' () $#6G%#(& #6= 6#" " T F6#" " _#%& 9" &' !5 (<& : #59;#$(9%5F #5' 89#6(Q $) 5(%6) ; =7 ? A7 ? " I

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

=7 ? A7 ? " #%& (&" (&' ;) % (#%& : &(#6&$!: >9%(!&" GQTV#6*=@D B+ #5' *=@D?+I E<& %&" 96(;%: (<& :) " (" &5" !(!Y& : &(<) ' ;) %&#$< &&: &5(2!" %&>) %&(' G&() _I +) 6%(!) 5" (&" (&' GQ*=@D?+ _&%& #5#6Qc&' !5 #5 dH@TGe!6&%&' =6&#5 7)) : I T5 dH@TGe!6&%!" KKIKKRDX &;;!$!&5(;) %<(& %&:) Y#6) ; >#%!$6&" ') _5 () / I0 [: I

?	TF	/ I/ 1D1- 1	?	B9	f	/ I/ / / CD1	,	N#	/ I/ - D/ / K	?	+& f	/ I/ - DCD.	,	k5	/ I/ / 1/ DK
,	T6	/ I/ / R/ DR	,	e&		/ I/ -- . 1K	?	NG	f	/ I/ / / CD1	,	+!		/ I/ V0. K0	,	k% f	/ I/ / . / V1
?	T"	f / I/ / V1. 0	?	4 #	f	/ I/ / / CD1	?	N'	f	/ I/ / / CD1	?	+:	f	/ I/ / / CD1			
?	T9	f / I/ / / C1R	?	4 '	f	/ I/ / / CD1	?	N!	f	/ I/ / C/ 01	?	+5	f	/ I/ / CD1C			
,	U	f / I/ C- VV-	?	4 &	f	/ I/ / / D/ R	?	, "	f	/ I/ / / C1R	?	+%	f	/ I/ / / CD1			
?	U#	/ I/ / - . V/	?	Z;	f	/ I/ / / CD1	,	@	f	/ IVVVD/ /	?	E#	f	/ I/ / / CD1			
"	U&	f	?	ZF	f	/ I/ / - C11	?	@G	f	/ I/ / - C. -	?	EG	f	/ I/ / / CD1			
?	U!	f / I/ / / CD1	?	Z)	f	/ I/ / / CD1	?	@	f	/ I/ / / CD1	?	E&	f	/ I/ / - . R/			
,	=#	/ I/ - DCDV	?	*5	f	/ I/ / / CD1	?	@%	f	/ I/ / / CD1	?	E<	f	/ I/ / / CD1			
?	='	f / I/ / / CD1	?	*%	f	/ I/ / / C1R	?	@(	f	/ I/ / / CD1	,	E!	f	/ I/ / CCVV			
?	=&	f / I/ / / CD1	,	h		/ I/ 0- - C.	?	7G	f	/ I/ / / D/ R	?	E6	f	/ I/ / / CD1			
?	=)	f / I/ / 1/ VR	?	H#	f	/ I/ / / CD1	?	7&	f	/ I/ / / CD1	?	E:	f	/ I/ / / CD1			
?	=%	f / I/ / - DCD	,	H!	f	/ I/ / / VVV	?	7<	f	/ I/ / / CD1	?	d	f	/ I/ / / CD1			
?	="	/ I/ / - V1C	?	H9	f	/ I/ / / CD1	?	79	f	/ I/ / / C1R	?	J	f	/ I/ / / D/ R			
?	=9	f / I/ / D/ RD	,	? F		/ I/ / - K/ .	!	+	f		?	i	f	/ I/ / 1/ VR			
?	gQ	f / I/ / / CD1	,	? 5	f	/ I/ / - 000	?	+G	f	/ I/ / / CD1	?	j	f	/ I/ / / CD1			
?	B%	f / I/ / / CD1	?	?)	f	/ I/ / / . VC	,	+$	f	/ I/ / - 000	?	j G	f	/ I/ / / CD1			

? O=<&$` &' GQ*=@D? + , O=<&$` &' GQ*=@D B+ ! O+>&$(%#6*5(&%&%&5$&
5 ON) (=<&$` &' e) % " O+) 69!) 5 +(#5' #% B6& &5(

6.0 INTENDED USE

Oe) %<(& $#6G%#(!) 5) ; #5#6Q!$#6!5" (%þ: &5(" #5' Y#6' #(!) 5) ; #5#6Q!$#6: &(<) ' " #" #>>%þ>%#(&I

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

O+() %& G&(_&&5 #>>%W! #(&6Q1I O0/ I = _<!6& !5 "&#6&' E= E G#FI

Oi <!6& "() %&' !5 (<& "&#6&' E= E G#F2(%5">!%(!) 5) ; (<!" =7 ? A7 ? !" 5&F6F!G&I T;(&%) >&5!5F (<& "&#6&' E= E G#F (%5">!%(!) 5) ; (<& =7 ? A7 ? _!6) $$9%2%&" 96!5F !5 # F%' 9#6!5$%&#" & !5 (<& #5#6Q(& $) 5$&5(%(!) 5L"PI *(!" (<& %&">) 5"!G!6Q) ; (<& 9"&%)(#$$) 95(;) %<!" &;;&$(I i <&5 (<& G) ((6& !" _&!F<&' G) (< G&;) %& #5' #;(&%G&!5F >6#$&' !5 "() %#F&2 (<&: #"" ' !;;&%&5$&) G'&%&' _!6G& # : &#"9%&) ; (%5">!%(!) 5 : #"" 6) ""I

OT;(&%) >&5!5F (<& "&#6&' E= E G#F2`&&> $#> (!F<(6Q"&#6&' _<&5 5) (!5 9"& #5' "() %& G&(_&&5 1I OC1I = ( ) : !5!: !c& (<& &;;&$(") ; (%5">!%(!) 5I d"& #(C/ I] 1I = ( ) : !5!: !c& Y) 6: &(%$' !6(!) 5 &%)%%_<&5 9"!5F (<& %&>) %&' &5"!(Q g) 5) (>!>&((& ;%: (<& $) 5(#!5&% g) 5) (%&(9%5 %&:) Y&' #6&9) (" () $) 5(#!5&%

Oe) %) %& !5;) %:#(!) 52Y!"!(**www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - KI/ - mC 1 U&LZC, PImC

Chemical Compatibility -+) 6G&& !5 Z= 62ZN, 02 ZC+, 1 #5' Ze #89&) 9" : #(%$&"I +(#G6& _!(< #66: &(#6" #5' !5) %F#5!$ #5!) 5"I

Stability - CO/ / >>G6&Y&6 "(#G6& ;) %) 5(<" !5 - X ZN, 0 AHg@B $) 5(#!5&% - O/ 2/ / >>: ") 6(!) 5" $<&: !$#6Q"(#G6& ;) %Q&#% !5 DO/ X ZN, 0 AHg@B $) 5(#!5&%

Be Containing Samples (Preparation and Solution) - ? &(# 6!" G&"(' !"") 6Y&' !5 ' !6(&' ZC+, 1 PnU&, LG) !65F 5!(%$2<Q %$<6) %$2) %' 969%$ #$!" ") % hZ+; 1 ;9"!) 5Pn %&" LZC+, 1AZe ' !F&"(!) 5) %$#%G) 5#(& ;9"!) 5 !5 @(Pn , %F#5!$? #(%$&" L"969%$A>&%W! & ' !F&"(!) 5) %5!(%$A 969%$A>&%$<6) %$ #$!" ' &$) : >) "!(!) 52) % %Q#"< #5' ' !"") 6(!) 5 #$$) %!5F () (<& U&, >%$&' 9%& #G) Y&PI

Atomic Spectroscopic Information (ICP-OES D.L.s are given as <u>radial/axial</u> view):

Technique/Line	Estimated D.L.	Order	Interferences L95' &%65&' !5' !$#(&" "&Y&%&P
*=@O+ K#: 9	1 >>(	NAT	
*=@OB+ C01IRV- 5:	/ I/ / / 0A I/ / / - V [FA H	-	e&2E#2?)
*=@OB+ 0- 0I/ 1C 5:	/ I/ / / 0A I/ / / / K [FA H	-	J2 =&2 d
*=@OB+ 0- 0I- / . 5:	/ I/ / / . A I/ / / D [FA H	-	= &2E<2E:

8.0 HAZARDOUS INFORMATION

O@6&#"& %&;&%)((<& +#;&(Q g #(# +<&&(;) %!5;) %:#(!) 5 %&F#%!5F (<!" =7 ? A7 ? I

9.0 HOMOGENEITY

OE<!" ") 6(!) 5 _#" : !W&' #$$) %!5F () #5 !5G<) 9"& >%$&' 9%& #5' !" F9#%#5(&&' () G& <) :) F&5&) 9"I Z) :) F&5&!(Q' #(# !5' !$#(& (<#((<& &5' 9"&%' <) 96 (#`& # : !5!: 9: "#: >6& "!c&) ; / IC: H() #""9%& <) :) F&5&!(Q

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

OM+7 = &%(!;!$#(& N9: G&%M+7 O/ 01

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

O= <&: !$#6E&"(!5F OT$$%&' !(&' A TCHT = &%(!;!$#(& N9: G&%RR0I/ -

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

O7 &;&%&5$& ? #(&%#6@% 9$&%OT$$%&' !(&' A TCHT = &%(!;!$#(& N9: G&%RR0I/ C

!" #$%!&() *! ; #' - .(/00 (1* ' 2!"3"$ 4(5#6* .(7 2#&-&%!8, #$.() %(;:0</ .(=>?@*3*A2"!* B(C0OD DE D<EE@;0 9FCF9/0/0 .(G%#F;0 9FCF9/0I: @&!"#$%!&6*! ; #' - 9 "J @&!KL &!"#$%!&6*! ; #' - 9 "J

11.0 CERTIFICATION, LOT EXPIRATION, PERIOD OF VALIDITY AND REVISION HISTORY

@#F& 0) ; 1

11.1 Certification Issue Date

T>%6CC2C/ - K

OE<& $&%!(!$#(!) 5 !" Y#6" _!(<!5 (<& : &#" 9%& &5(95$&%#(!5(Q" >&$!;!&' >%)Y!' &' (<& =7 ? A7 ? !" " () %&' #5' <#5' 6&' !5 #$$) %#5$& _!(< !5" (%a$(!) 5" F!Y&5 !5 +&$. I- I E<!" $&%!(!$#(!) 5 !" 5966;!&' !; !5" (%a$(!) 5" !5 +&$. I- #%& 5) (;) 66) _&') %!; (<& =7 ? A7 ? !" ' #: #F&' 2$) 5(#: !5#(&' 2) %) (<&%_!" & :) ' !;!&' I

11.2 Lot Expiration Date

OApril 22, 2023

OE<& ' #(& #;(&%_<!$< (<!" =7 ? A7 ? " <) 96 5) (G& 9" &' I

OE<& 6) (&V¥!%#(!) 5 ' #(& %&;6&$(" (<& >&%) ') ; (!: & (<#((<& " (#G66(Q) ; # =7 ? A7 ? $#5 G& " 9>>) %&' GQ6) 5F (&%: " (#G66(Q" (9' !&" $) 5' 9$(&') 5 >%)>&%6Q" () %&' #5' <#5' 6&' =7 ? A7 ? " I H) (&V¥!%#(!) 5 !" 6: !(&' >% #%6&QGQ (%#5" >!%#(!) 5 L6) "") ; _#(&% ;)% (<& ") 69(!) 5P#5' !5;%&89&5(6&QGQ$<&: !$#6" (#G66(Q

11.3 Period of Validity

O+ &#6&' E= E U#F , >&5 g #(&Soooooooooooooooooooooooooo

OE<!" =7 ? A7 ? " <) 96 5) (G& 9" &' 6) 5F&%<(#5) 5& Q&#%L) %" !W:) 5(<" !5 (<& $#" &) ; # 0/ : HG) ((6&P ;)% (<& ' #(&) ;) >&5!5F (<& #69: !5!c&' G#F) %#;(&%<(& ' #(& F!Y&5 !5 +&$I - - IC2_<!$<&Y&%$) : &" ;!%(I E<!" !" $) 5(!5F&5(9>) 5 (<& =7 ? A7 ? G&!5F " () %&' #5' <#5' 6&' !5 #$$) %#5$& _!(< (<& !5" (%a$(!) 5" F!Y&5 !5 +&$I . I- I

11.4 Revision Status

O7 &Y!" !) 5 - O7 &Y!" &') 5 E<9%' #Q2p#5 - 12C/ C- GQ9(%a) 5FI 7 &Y!" !) 5 _#" : #' & ;) %<(& ;) 66) _!5F %&#") 5S ?) ' !;!&' +&$(!) 5 . = <&: !$#6e) %: !5 +) 69(!) 5I

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

? !$<#&6U)) (<
g! %&$() %2M9#6(Q=) 5(%6

Michael 2 Booth

Certifying Officer:

@#964 #!5&"
= <#!%:#5 A+ &5!) %E&$<5!$#6g !%&$() %

Paul R Zaina

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCA10
Lot Number:	R2-CA697921
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Calcium
Starting Material:	Calcium Oxide
Starting Material Lot#:	P2-CA677788
Starting Material Purity:	99.9995%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9985 ± 30 µg/mL

Density: 1.039 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9976 ± 43 µg/mL**
ICP Assay NIST SRM 3109a Lot Number: 130213

Assay Method #2 **9965 ± 25 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **10008 ± 26 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.002500	M	Eu	<	0.001300	M	Na		0.008214	O	Se	<	0.022000	O	Zn		0.001158
O	Al	<	0.030000	O	Fe		0.002316	M	Nb	<	0.001300	O	Si	<	0.022000	M	Zr	<	0.006200
O	As	<	0.025000	M	Ga	<	0.002500	M	Nd	<	0.001300	M	Sm	<	0.001300				
M	Au	<	0.013000	M	Gd	<	0.001300	O	Ni	<	0.005300	O	Sn	<	0.013000				
O	B	<	0.006900	O	Ge	<	0.018000	M	Os	<	0.002500	M	Sr		0.115847				
M	Ba		0.000905	M	Hf	<	0.002500	O	P	<	0.027000	M	Ta	<	0.008600				
O	Be	<	0.000270	M	Hg	<	0.001300	M	Pb		0.001685	M	Tb	<	0.001300				
M	Bi	<	0.002500	M	Ho	<	0.001300	M	Pd	<	0.006200	O	Te	<	0.045000				
s	Ca	<		M	In	<	0.001300	M	Pr	<	0.001300	M	Th	<	0.001300				
O	Cd	<	0.000540	M	Ir	<	0.001300	M	Pt	<	0.001300	O	Ti	<	0.004200				
M	Ce	<	0.001300	O	K		0.015797	M	Rb	<	0.014000	M	Tl	<	0.001300				
O	Co		0.000558	M	La	<	0.001300	M	Re	<	0.001300	M	Tm	<	0.001300				
O	Cr	<	0.006000	O	Li	<	0.006900	M	Rh	<	0.002500	M	U	<	0.001300				
M	Cs	<	0.001300	M	Lu	<	0.001300	M	Ru	<	0.003800	O	V	<	0.002200				
M	Cu	<	0.002500	O	Mg		0.002843	n	S	<		M	W	<	0.012000				
M	Dy	<	0.001300	O	Mn		0.000115	M	Sb	<	0.007400	M	Y	<	0.001300				
M	Er	<	0.001300	M	Mo		0.002527	O	Sc	<	0.006100	M	Yb	<	0.001300				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 40.08 +2 6 $Ca(H_2O)_6^{+2}$

Chemical Compatibility - Soluble in HCl and HNO_3. Avoid H_2SO_4, HF, H_3PO_4 and neutral to basic media. Stable with most metals and inorganic anions forming insoluble silicate, carbonate, hydroxide, oxide, fluoride, sulfate, oxalate, chromate, arsenate, and tungstate in neutral aqueous media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-10% HNO_3 / LDPE container.

Ca Containing Samples (Preparation and Solution) -Metal (best dissolved in diluted HNO_3); Ores (Carbonate fusion in Pt0 followed by HCl dissolution); Organic Matrices (dry ash and dissolution in dilute HCl. Do not heat when dissolving to avoid precipitation of SiO_2). The oxide, hydroxide, carbonate, phosphate, and fluoride of calcium are soluble in % levels of HCl or HNO_3. The sulfates (gypsum, anhydrite, etc.), certain silicates, and complex compounds require fusion with Na_2CO_3 followed by HCl / water dissolution. Note that contamination is a very real problem when analyzing for trace levels.

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 44 amu	1200 ppt	n/a	16O212C, 28Si16O, 88Sr
ICP-OES 393.366 nm	0.0002 / 0.00004 µg/mL	1	U, Ce
ICP-OES 396.847 nm	0.0005 / 0.00006 µg/mL	1	Th
ICP-OES 422.673 nm	0.01 / 0.001 µg/mL	1	Ge

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

November 09, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **November 09, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Director, Quality Control

Certifying Officer:

Paul Gaines
Chairman / Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCD10
Lot Number:	P2-CD685077
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Cadmium
Starting Material:	Cd Shot
Starting Material Lot#:	1954
Starting Material Purity:	99.9996%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9954 ± 30 µg/mL

Density: 1.029 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9956 ± 54 µg/mL**
ICP Assay NIST SRM 3108 Lot Number: 130116

Assay Method #2 **9953 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

O	Ag	<	0.006348	M	Eu	<	0.010622	O	Na		0.004020	M	Se	<	0.008116	O	Zn	<	0.002152
O	Al		0.011566	M	Fe		0.003011	M	Nb	<	0.000405	O	Si		0.005480	M	Zr	<	0.000405
M	As	<	0.001623	M	Ga	<	0.000405	M	Nd	<	0.000405	M	Sm	<	0.000405				
M	Au	<	0.000405	M	Gd	<	0.000405	M	Ni	<	0.002840	M	Sn	<	0.001217				
M	B	<	0.004463	M	Ge	<	0.000405	M	Os	<	0.000405	M	Sr	<	0.000405				
O	Ba	<	0.000968	M	Hf	<	0.000405	O	P	<	0.045730	M	Ta	<	0.000405				
M	Be	<	0.000405	O	Hg	<	0.002152	M	Pb	<	0.002434	M	Tb	<	0.000405				
M	Bi	<	0.000405	M	Ho	<	0.000405	M	Pd	<	0.000405	M	Te	<	0.016636				
O	Ca		0.002946	O	In	<	0.021520	M	Pr	<	0.000405	M	Th	<	0.000405				
s	Cd	<		M	Ir	<	0.000405	M	Pt	<	0.000405	M	Ti	<	0.001217				
M	Ce	<	0.000405	O	K		0.008179	M	Rb	<	0.000405	M	Tl	<	0.004495				
M	Co	<	0.000405	M	La	<	0.000405	M	Re	<	0.000405	M	Tm	<	0.000405				
M	Cr		0.002907	M	Li	<	0.000405	M	Rh	<	0.000405	M	U	<	0.000405				
M	Cs	<	0.002374	M	Lu	<	0.000405	M	Ru	<	0.000405	M	V	<	0.003179				
M	Cu	<	0.002434	O	Mg		0.000137	O	S	<	0.037660	M	W	<	0.000405				
M	Dy	<	0.000405	M	Mn	<	0.001623	M	Sb	<	0.004057	M	Y	<	0.000405				
M	Er	<	0.000405	M	Mo	<	0.000811	M	Sc	<	0.001623	M	Yb	<	0.000811				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 112.41 +2 4 Cd2(OH) (aq)3+ and Cd(OH)(aq)

Chemical Compatibility -Stable in HCl, HNO3, H2SO4 , and HF. Avoid basic media forming insoluble carbonate and hydroxide.

Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5 % HNO3 / LDPE container.

Cd Containing Samples (Preparation and Solution) -Metal (soluble in HNO3); Oxides (soluble in HCl or HNO3); Ores (dissolve in HCl /HNO3 then take to fumes with H2SO4. The silica and lead sulfate are filtered off after the addition of water); Organic based (dry ash at 450°C and dissolve ash in HCl), (sulfuric / peroxide acid digestion).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 111 amu	11 ppt	n/a	95Mo16O
ICP-OES 214.438 nm	0.003 / 0.0003 µg/mL	1	Pt, Ir
ICP-OES 226.502 nm	0.003 / 0.0003 µg/mL	1	Ir
ICP-OES 228.802 nm	0.003 / 0.0003 µg/mL	1	Co, Ir, As, Pt

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

November 08, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **November 08, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCO10
Lot Number:	N2-CO671028
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Cobalt
Starting Material:	COBALT
Starting Material Lot#:	1749
Starting Material Purity:	99.9978%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9988 ± 34 µg/mL

Density: 1.057 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9973 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #2 **10024 ± 50 µg/mL**
ICP Assay NIST SRM traceable to 3113 Lot Number: M2-CO661665

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

O	Ag		0.022956	M	Eu	<	0.000422	O	Na		0.008125	M	Se	<	0.009290	M	Zn		0.007197
O	Al		0.013621	O	Fe		0.048700	M	Nb	<	0.000422	O	Si		0.017539	M	Zr	<	0.014357
i	As	<		M	Ga	<	0.000844	M	Nd	<	0.017735	M	Sm	<	0.001689				
M	Au	<	0.000583	M	Gd		0.003247	O	Ni	<	0.043642	M	Sn	<	0.005067				
M	B	<	0.013512	M	Ge	<	0.004645	M	Os	<	0.000583	O	Sr		0.000841				
O	Ba		0.071210	M	Hf	<	0.000422	n	P	<		M	Ta	<	0.000422				
O	Be	<	0.001771	M	Hg	<	0.002334	M	Pb		0.010094	M	Tb	<	0.001689				
M	Bi		0.000614	M	Ho	<	0.000422	M	Pd	<	0.000422	M	Te	<	0.008445				
O	Ca		0.025034	M	In	<	0.003378	M	Pr	<	0.006756	M	Th	<	0.000422				
M	Cd	<	0.000844	M	Ir	<	0.000583	M	Pt	<	0.000422	M	Ti	<	0.002533				
M	Ce		0.002721	O	K		0.005785	M	Rb	<	0.001689	M	Tl	<	0.000422				
s	Co	<		M	La		0.000877	M	Re		0.016853	M	Tm	<	0.000422				
M	Cr	<	0.020269	O	Li		0.000262	M	Rh	<	0.000422	M	U	<	0.000422				
M	Cs		0.000877	M	Lu	<	0.000422	M	Ru	<	0.000583	M	V	<	0.001689				
M	Cu		0.007197	O	Mg		0.003444	n	S	<		M	W	<	0.000844				
M	Dy	<	0.000422	O	Mn	<	0.006072	M	Sb	<	0.005911	M	Y		0.001228				
M	Er	<	0.000422	M	Mo	<	0.005911	M	Sc	<	0.001689	M	Yb	<	0.003378				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 58.93 +2 6 $Co(H_2O)_6^{2+}$
Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4 ,HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.
Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.
Co Containing Samples (Preparation and Solution) - Metal (soluble in HNO_3); Oxides (Soluble in HCl); Ores (dissolve in HCl / HNO_3).
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 59 amu	2 ppt	n/a	42Ca16O1H , 40Ar18O1H , 36Ar23Na, 43Ca16O, 24Mg35Cl
ICP-OES 228.616 nm	0.01/0.001 µg/mL	1	
ICP-OES 237.862 nm	0.01/0.002 µg/mL	1	W, Re, Al, Ta
ICP-OES 238.892 nm	0.01/0.002 µg/mL	1	Fe, W, Ta

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

January 15, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **January 15, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Supervisor, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCR(3)10
Lot Number:	R2-CR691013
Matrix:	10% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Chromium
Starting Material:	Cr METAL
Starting Material Lot#:	2077
Starting Material Purity:	99.9942%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10044 ± 40 µg/mL

Density: 1.082 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10057 ± 58 µg/mL**
ICP Assay NIST SRM 3112a Lot Number: 170630

Assay Method #2 **10035 ± 50 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The follow ing equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.000540	M	Eu	<	0.003200	O	Na		0.130091	M	Se	<	0.012000	O	Zn	<	0.002700
O	Al		0.016634	O	Fe		0.202602	M	Nb	<	0.022000	n	Si	<		M	Zr	<	0.020000
M	As		0.003838	O	Ga	<	0.031000	M	Nd	<	0.000540	M	Sm	<	0.035000				
M	Au	<	0.000540	M	Gd	<	0.000540	O	Ni		0.009170	M	Sn		0.004051				
M	B	<	0.049000	M	Ge	<	0.005400	M	Os	<	0.088000	O	Sr	<	0.000250				
O	Ba	<	0.002000	M	Hf	<	0.000540	i	P	<		M	Ta	<	0.000540				
O	Be	<	0.000250	M	Hg	<	0.001600	M	Pb		0.002559	M	Tb	<	0.000540				
M	Bi		0.008956	M	Ho	<	0.000540	M	Pd	<	0.001100	M	Te	<	0.004800				
O	Ca		0.074642	M	In	<	0.001100	M	Pr	<	0.000540	M	Th	<	0.000540				
M	Cd	<	0.000540	M	Ir	<	0.000540	M	Pt	<	0.000540	O	Ti		0.013435				
M	Ce	<	0.000540	O	K		0.034122	i	Rb	<		M	Tl	<	0.001100				
O	Co	<	0.002900	M	La	<	0.001100	M	Re	<	0.002700	O	Tm	<	0.001800				
s	Cr	<		O	Li	<	0.000130	M	Rh	<	0.032000	M	U	<	0.001100				
M	Cs	<	0.019000	M	Lu	<	0.000540	M	Ru	<	0.094000	O	V		0.159949				
O	Cu		0.010023	O	Mg		0.001450	i	S	<		M	W	<	0.028000				
M	Dy	<	0.000540	O	Mn	<	0.014000	M	Sb	<	0.008600	M	Y	<	0.001100				
M	Er	<	0.016000	O	Mo	<	0.013000	O	Sc	<	0.001400	M	Yb	<	0.000540				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 52.00 +3 6 $Cr(H_2O)_6^{3+}$

Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4, HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Cr3 Containing Samples (Preparation and Solution) -Metal (soluble in HCl); Oxides/Ores (Chrome ore/oxides are very difficult to dissolve. The following procedures [A-D] are commonly used: A. Fusion with $KHSO_4$ and extraction with hot KCl. The residue fused with Na_2CO_3 and $KClO_3$, 3:1. B. Fusion with $NaKSO_4$ and NaF 2:1, C. Fusion with magnesia or lime and sodium or potassium carbonates, 4:1. D. Fusion with Na_2O_2 or NaOH and KNO_3 or NaOH and Na_2O_2. Nickel, iron, copper, or silver crucibles should be used for D. Platinum may be used for A, B, C); Organic Matrices (ash at 4500C followed by one of the fusion methods above or sulfuric/hydrogen peroxide acid digestions may be applicable to non oxide containing samples).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 52 amu	40 ppt	N/A	36S16O, 36Ar16O - The 50Cr, 53Cr, 54Cr lines suffer from many more potential interferences from sulfur, chlorine and argon compounds of oxygen, nitrogen and carbon.
ICP-OES 205.552 nm	0.006/0.0008 µg/mL	1	Os
ICP-OES 276.654 nm	0.01/0.001 µg/mL	1	Cu, Ta, V
ICP-OES 284.325 nm	0.008/0.0007 µg/mL	1	

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

March 25, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **March 25, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCU10
Lot Number:	R2-CU693370
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Copper
Starting Material:	Cu Metal
Starting Material Lot#:	2095
Starting Material Purity:	99.9996%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10016 ± 30 µg/mL

Density: 1.033 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10010 ± 55 µg/mL**
ICP Assay NIST SRM 3114 Lot Number: 121207

Assay Method #2 **10017 ± 26 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **10015 ± 25 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.007542	M	Eu	<	0.000942	O	Na		0.001434	M	Se	<	0.016971	M	Zn	<	0.005657
O	Al	<	0.000609	O	Fe		0.008698	M	Nb	<	0.000942	O	Si		0.003052	M	Zr	<	0.000942
M	As	<	0.010371	M	Ga	<	0.000942	M	Nd	<	0.000942	M	Sm	<	0.000942				
M	Au	<	0.001885	M	Gd	<	0.000942	M	Ni		0.003780	M	Sn	<	0.005657				
O	B		0.003662	M	Ge	<	0.005657	M	Os	<	0.000942	M	Sr	<	0.000942				
M	Ba		0.004252	M	Hf	<	0.000942	O	P	<	0.031668	M	Ta	<	0.000942				
M	Be	<	0.000942	O	Hg	<	0.007064	M	Pb		0.005788	M	Tb	<	0.000942				
M	Bi	<	0.000942	M	Ho	<	0.000942	M	Pd	<	0.000942	M	Te	<	0.004714				
O	Ca		0.002304	M	In	<	0.000942	M	Pr	<	0.000942	M	Th	<	0.000942				
M	Cd	<	0.000942	M	Ir	<	0.000942	M	Pt	<	0.000942	O	Ti	<	0.002801				
M	Ce	<	0.000942	O	K		0.000762	M	Rb	<	0.000942	M	Tl	<	0.000942				
M	Co		0.001890	M	La	<	0.000942	M	Re	<	0.000942	M	Tm	<	0.000942				
M	Cr	<	0.005657	O	Li	<	0.000243	i	Rh	<		M	U	<	0.000942				
M	Cs	<	0.000942	M	Lu	<	0.000942	M	Ru	<	0.039588	M	V	<	0.003771				
s	Cu	<		O	Mg		0.000320	O	S		0.007172	M	W	<	0.005657				
M	Dy	<	0.000942	O	Mn		0.000793	M	Sb	<	0.001885	M	Y	<	0.000942				
M	Er	<	0.000942	M	Mo	<	0.005657	M	Sc	<	0.000942	M	Yb	<	0.000942				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 63.55 +2 6 $Cu(H_2O)_6^{2+}$

Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4, HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Cu Containing Samples (Preparation and Solution) -Metal (soluble in HNO_3); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO_3).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 63 amu	10 ppt	n/a	40Ar23Na 47Ti16O, 14N12C37Cl, 16O12C35Cl, 23Na40Ca
ICP-OES 219.958 nm	0.01/.002 µg/mL	1	Th, Ta, Nb, U, Hf
ICP-OES 224.700 nm	0.01/.001 µg/mL	1	Pb, Ir, Ni, W
ICP-OES 324.754 nm	0.06/.001 µg/mL		Nb, U, Th, Mo, Hf

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

June 05, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **June 05, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES™
Refine your results. Redefine your industry.

300 Technology Drive
Christiansburg, VA 24073 USA
inorganicventures.com

P: 800-669-6799/540-585-3030
F: 540-585-3012
info@inorganicventures.com

Certificate of Analysis

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES !" #$$%&' !(&' () *+, - . / 01234 &5&%#67 &89!%&: &5(" ;) % (<& =) : >&(&5$&) ; 7 &;&%&5$& ? #(&%#6@)% 9$&%3#5' *+, A*B=- . / CD234 &5&%#6 7 &89!%&: &5(" ;) %<(& =) : >&(&5$&) ; E&" (!5F #5' = #6G%#(!) 5 H#G) %#() %&" 3I *5) %5#5!$ J &5(9%&" !" #6') #5 *+, K/ / - %&F!" (&%&' : #59;#$(9%&%LM+7 = &%(!$#(& N9: G&%M+7 O- / 01PI

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2.0 PRODUCT DESCRIPTION

@)% 9$(=) ' &S	? 96(! T5#6Q(& = 9" () : 4 %#' & +) 69(!) 5
= #(#6) F N9: G&%S	T7*O
H) (N9: G&%S	+ CO?BU. / 1CR1
? #(%WS	DW LXAXPYN, 0
J#69& AT5#6Q(&L" PS	- / / / / ZFA. H&#S *%5

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Iron, Fe	**10 000.0 ± 40.0 µg/mL**		

Density: - I/ 00 FA. HL: &#" 9%&' #(C/ [1 \= P

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
^ &	*= @T" "#Q	0- C] #	- 1/ R- C
^ &	B_ET	KCR	KCR

E<& ;) 66) !5F &89#(!) 5" #%& 9" &' !5 (<& $#6$96#(!) 5) ; (<& $&%(;!&' X#69& #5' (<& 95$&%(#!5(Q 7 &>) %(&' 95$&%(#!5(!&" %&>%&" &5(&V>#5' &' 95$&%(#!5(!&" &V>%&" " &' #(#>>%)V!: #(&%Q(<& KDW $) 5;!' &5$& 6&&69" !5F # $) X&%F& ;#$() %) ; a b O

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

OE<!" >%)' 9$(!" (%#$&#G&() N*+E X!# #5 95G%)a&5 $<#!5) ; $) : >#%') 5" I E<& 95$&%#(!5(!&" ;) %&#$< $&%(!&' X#69& #%& %&>) %&' 2 #a!5F !5() #$$) 95((<& +7 ? A7 ? 95$&%#(!5(Q&%)%%#5' (<& : &#" 9%&: &5(2` &!F<!5F #5' X) 69: & ' !6(!) 5 &%)%%I *5 %#%& $#" &" ` <&%& 5) N*+E +7 ? A7 ? #%& #X#!6#G&2 (<& (&%: d5G<) 9" & " (' Ic!" " >&$!;!&' I

4.1 Thermometer Calibration

OT66(<&%:) : &(&% #%& N*+E (%#$$&#G6& (<%)9F< (<&%:) : &(&% (<#(#%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q

4.2 Balance Calibration

OT66#5#6Q!$#6G#6#5$&" #%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q#5' >%)$$&' 9%&I E<&` &!F<(" 9"&' ;) %&(" (!5F #%& #559#66Q$) : >#%&' () : #"(&% &!F<(" #5' #%& (%#$$&#G6& () N*+EI

4.3 Glassware Calibration

OT5 !5G<) 9"&>%)$$&' 9%& !" 9"&' () $#6G%#(& #66=6#"" T F6#""` #%& 9"&' !5 (<&: #59;#$(9%5F #5' 89#6(Q $) 5(%)6) ; =7 ? A7 ? "I

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

NAT

6.0 INTENDED USE

O^) %<(& $#6G%#(!) 5) ; #5#6Q!$#6!5"(%9: &5(" #5' X#6 #(!) 5) ; #5#6Q!$#6: &(<) '" #" #>>%)>%#(&I

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

O+() %& G&(` &&5 #>>%)V!: #(&6Q1d O0/ d =` <!6& !5 "&#6&' E=E G#FI

Oe <!6& "() %&' !5 (<& "&#6&' E=E G#F2(%#5">!%#(!) 5) ; (<!" =7 ? A7 ? !" 5&F6!G6&I T;(&%) >&5!5F (<& "&#6&' E=E G#F (%#5">!%#(!) 5) ; (<& =7 ? A7 ? `!6) $$9%2%&"96(!5F !5 # F%#' 9#6!5$%&#"& !5 (<& #5#6Q(& $) 5$&5(%#(!) 5L"PI *(!" (<& %&">) 5"!G!6(Q) ; (<& 9"&%)( #$$) 95( ;) %<!" &;;&$(I e <&5 (<& G) ((6& !" `&!F<&' G) (< G&;) %& #5' #;(&%G&!5F >6#$&' !5 "() %#F&2 <&: #"" ' !;;&%&5$&) G'&%X&' ` !6G& # : &#"9%&) ; (%#5">!%#(!) 5 : #"" 6) ""I

OT;(&%) >&5!5F (<& "&#6&' E=E G#F2a&&> $#> (!F<(6Q"&#6&' ` <&5 5) ( !5 9"& #5' "() %& G&(` &&5 1d OC1d =() : !5!: !f& (<& &;;&$(") ; (%#5">!%#(!) 5I g"& #(C/ d[1d =() : !5!: !f& X) 6): &(%!$ '!6) (!) 5 &%)%% <&5 9"!5F (<& %&>) %(&' ' &5"!(Q _) 5) (>!>&((& ;%): (<& $) 5(#!5&%% _) 5) (%&(9%5 %&:) X&' #6!89) (" () $) 5(#!5&%

O^) %) %& !5;) %:#(!) 52X!"!(**www.inorganicventures.com/TCT**

8.0 HAZARDOUS INFORMATION

O@6&#"& %&;&%)((<& +#;&(Q_#(# +<&&(;) % !5;) %:#(!) 5 %&F#%'!5F (<!" =7 ? A7 ? I

9.0 HOMOGENEITY

OE<!" ") 69(!) 5 `#" : !V&' #$$) %'!5F () #5 !5G<) 9"&>%)$$&' 9%& #5' !" F9#%#5(&&' () G& <) :) F&5&) 9"I Y) :) F&5&!(Q' #(# !5' !$#(& (<#((<& &5' 9"&%'<) 96 (#a& # : !5!: 9: "#: >6& "!f&) ; / IC: H() #""9%& <) :) F&5&!(QI

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

OM+7 = &%(!;!$#(& N9: G&%M+7 G/ 01

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

O=<&: !$#6E&"(!5F OT$$%&' !(&' A TCHT = &%(!;!$#(& N9: G&%RR0I/ -

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

O7 &;&%&5$& ? #(&%!#6@%) 9$&%OT$$%&' !(&' A TCHT = &%(!;!$#(& N9: G&%RR0I/ C

!" #$%!&() *! +# - .(/00 (1*' 2!"3"$ 4(5#&*.(7 2#&-&%!8, #$.() %(;:0</ .(=>?@*3*A2"!* B(C0D D D E<EE@;0 F CF0/0 .(G%H F;0 F CF0I: @&!"#$%!&6*! +# - 9 "J @&K L &!"#$%!&6*! +# - 9 "J

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

@#F& C) ; 0

11.1 Certification Issue Date

T>%6C/ 2C/ C-

OE<& $&%!(!$#(!) 5 !" X#6' ` !(<!5 (<& : &#" 9%&: &5( 95$&%#(!5(Q" >&$!;!&' >%)X' &' (<& =7 ? A7 ? !" " () %&' #5' <#5' 6&' !5 #$$) %#5$& ` !(< !5" (%)$(!) 5" F!X&5 !5 + &$. I- I E<!" $&%!(!$#(!) 5 !" 5966;!&' !; !5" (%)$(!) 5" !5 + &$. I- #%& 5) (;) 66 ` &') %!; (<& =7 ? A7 ? !" ' #: #F&' 2$) 5(#: !5#(&' 2) %) (<&% !" & :) ' !;!&' I

11.2 Lot Expiration Date

O**April 20, 2025**

OE<& ' #(& #;(&% <!$< (<!" =7 ? A7 ? " <) 96 5) (G& 9" &' I

OE<& 6) (&\>!%#(!) 5 ' #(& %&;6&$(" (<& >&%) ') ; (!: & (<#((<& " (#G6(Q) ; # =7 ? A7 ? $#5 G& " 9>>) %&' GQ6) 5F (&%: " (#G6(Q" (9' !&" $) 5' 9$(&') 5 >%)>&%&Q" () %&' #5' <#5' 6&' =7 ? A7 ? " I H) (&\>!%#(!) 5 !" 6: !(&' >% #%&QGQ (%#5" >!%#(!) 5 L6) " ") ; ` #(&% ;)% (<& ") 6) (!) 5P#5' !5;%&89&5(6QGQ$<&: !$#6" (#G6(Q

11.3 Period of Validity

O+ &#6&' E= E U#F , >&5 _ #(&Shhhhhhhhhhhhhhhhhhhhhhhhhhhh

OE<!" =7 ? A7 ? " <) 96 5) (G& 9" &' 6) 5F&%<(#5) 5& Q&#%L) %" !V :) 5(<" !5 (<& $#" &) ; # 0/ : HG) ((&P ;)% (<& ' #(&) ;) >&5!5F (<& #6) : !5!f &' G#F) %#;(&%<(& ' #(& F!X&5 !5 + &$I - - IC2 ` <!$<&X&%$) : &" ;!%(I E<!" !" $) 5(!5F&5( 9>) 5 (<& =7 ? A7 ? G&!5F " () %&' #5' <#5' 6&' !5 #$$) %#5$& ` !(< (<& !5" (%)$(!) 5" F!X&5 !5 + &$I . I- I

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

? !$<#&6U)) (<
_! %&$() %2M9#6(Q=) 5(%6

Michael 2 Booth

Certifying Officer:

@#964 #!5&"
= <#!%:#5 A+ &5!) %E&$<5!$#6_ !%&$() %

Paul R Gaines

300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com
tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES !" #$$%& !(&' () *+, - . / 01234 &5&%#67 &89!%&: &5(" ;) % (<& =) : >&(&5$&) ; 7 &;&%&5$& ? #(&%#6@)% 9$&%3#5' *+, A*B=- . / CD234 &5&%#6 7 &89!%&: &5(" ;) %<(& =) : >&(&5$&) ; E&" (!5F #5' =#6G%#(!) 5 H#G) %#() %&" 3I *5) %5#5!$ J &5(9%&" !" #6) #5 *+, K/ / - %&F!" (&%&' : #59;#$(9%&%LM+7 = &%(!$#(& N9: G&%LM+7 G / 01PI

2.0 PRODUCT DESCRIPTION

@)% 9$(=) ' &S	+!5F6& T5#6Q(& = 9" () : 4 %#' & +) 69(!) 5
= #(#6) F N9: G&%S	= 4 U- /
H) (N9: G&%S	+COU / / K. R
? #(%LVS	CW LXAXPYN, 0
J#69& AT5#6Q(&L" PS	- / / / / ZFA. H&#S @) (#" " !9:
+(#%L5F ? #(&%#6S	UN, 0
+(#%L5F ? #(&%#6H) ([S	C0- 0
+(#%L5F ? #(&%#6@9%(QS	KKIKK. - W

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: - / / - \ ] 0/ ZFA. H

Density: - I/ CD FA. HL: &#" 9%&' #(C/] 1 ^= P

Assay Information:

Assay Method #1 **10018 ± 54 µg/mL**
= @T" "#QN+E +7 ? 0- 1- # H) (N9: G&%&- 1/ R- 0

Assay Method #2 **10016 ± 24 µg/mL**
4 %#X!: &(%$ N*+E +7 ? H) (N9: G&%&+ && + &$I 1IC

Assay Method #3 **10014 ± 45 µg/mL**
= #6$96#&' N*+E +7 ? H) (N9: G&%&+ && + &$I 1IC

CE<& = #6$96#(&' J#69& !" # X#69& $#6$96#(&' ;%): (<& _ &!F<( ) ; # " (#%L5F : #(&%#6(<#(<#" G&&5 $&%(!&' ' !%&$(6QX" I # N#(!) 5#6*5" (!(9(&) ; +(#5' #%" #5' E&$<5) 6) FQLN*+EP+7 ? A7 ? I + && + &$ 1IC ;) %G#6#5$& (%$&#G16(Q

E<& ;) 66) !5F &89#(!) 5" #%& 9" &' !5 (<& $#6$96#!) 5) ; (<& $&%(;!&' X#69& #5' (<& 95$&%(#!5(QI 7 &>) %&' 95$&%(#!5(!&" %&>%&" &5(&V>#5' &' 95$&%(#!5(!&" &V>%&" " &' #(#>>%V!: #(&&Q(<& KDW $) 5;!' &5$& 6&&69" !5F # $) X&%F& ;#$() %) ; ` a CI

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

OE<!" >%þ' 9$(!" (%#$&#G8& () N*+E X!# #5 95G%þ` &5 $<#!5 ) ; $) : >#%!') 5"I E<& 95$&%#(!5(!&" ;) %&#$< $&%!(!&' X#6%& #%& %&>) %&(' 2 #` !5F !5() #$$) 95((<& +7 ? A7 ? 95$&%#(!5(Q&%)%%#5' (<& : &#" 9%&: &5(2_ &!F<!5F #5' X) 6%: & ' !6%(!) 5 &%)%%I *5 %#%&$#" &" _<&%& 5) N*+E +7 ? A7 ? #%& #X#!6#G8&2 (<& (&%: !5G<) 9" & " (' Ib!" " >&$!;!&' I

4.1 Thermometer Calibration

OT6(<&%:) : &(&% #%& N*+E (%#$&#G8& (<%þ9F< (<&%:) : &(&% (<#(#%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q#5' >%þ$&' 9%&I E<& _&!F<(" 9" &' ;) %&" (!5F #%& #559#6Q$) : >#%&' () : #" (&%_&!F<(" #5' #%& (%#$&#G8& () N*+EI

4.3 Glassware Calibration

OT5 !5G<) 9" & >%þ$&' 9%&!" 9" &' () $#6G%#(& #6= 6#" " T F6#" " _#%& 9" &' !5 (<& : #59;#$(9%5F #5' 89#6(Q $) 5(%6) ; =7 ? A7 ? " I

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

=7 ? A7 ? " #%& (&" (&' ;) % (#%& : &(#6%$!: >9%(!&" GQTV#6*=@D ?+ B+ #5' *=@D ?+ I E<& %&" 96(;%: (<& :) " (" &5" !(!X& : &(<) ' ;) %&#$< &8& : &5(2!" %&>) %&(' G&0 _I +) 6%(!) 5" (&" (&' GQ*=@D ?+ _&%& #5#6Qc&' !5 #5 d H@T Ge!(&%&' =6&#5 7)) : I T5 d H@T Ge!(&%'" KKIKKRDW &;;!$!&5(;) %<(& %&:) X#6) ; >#%!$(6&" ') _5 () / I0 Z: I

?	TF	f	/ I// - 1//	?	B9	f	/ I// / \ \ /	,	N#		/ IC1/ / / /	?	+&	f	/ I// . K//	,	k5		/ I// - . / / /
,	T6		/ I// - \ / /	,	e&		/ I// DR/ /	?	NG	f	/ I// / \ \ /	,	+!		/ I// - C//	,	k%	f	/ I// - \ / /
?	T"	f	/ I// D0/ /	?	4 #	f	/ I// / \ \ /	?	N'	f	/ I// / \ \ /	?	+:	f	/ I// / \ \ /				
?	T9	f	/ I// C/ / /	?	4 '	f	/ I// / \ \ /	,	N!	f	/ I// 1K/ /	?	+5	f	/ I// / \ \ /				
,	g	f	/ I// D\ / /	?	4 &	f	/ I// C/ / /	?	, "	f	/ I// 00/ /	,	+%		/ I// / / DD				
,	g#	f	/ I// / R\ /	?	Y;	f	/ I// / \ \ /	,	@	f	/ I// 0C/ /	?	E#	f	/ I// / \ \ /				
,	g&	f	/ I// / / RC	?	YF	f	/ I// C/ / /	?	@G	f	/ I// C0/ /	?	EG	f	/ I// / \ \ /				
?	g!	f	/ I// / \ \ / /	?	Y)	f	/ I// / \ \ /	?	@	f	/ I// / \ \ /	?	E&	f	/ I// - . / / /				
,	=#		/ I// 0- / / /	?	*5	f	/ I// / \ \ /	?	@%	f	/ I// / \ \ /	?	E<	f	/ I// / \ \ /				
,	='	f	/ I// / 1D/	?	*%	f	/ I// / \ \ /	?	@(	f	/ I// / \ \ /	?	E!	f	/ I// / \ \ /				
?	=&	f	/ I// / \ \ /	"	U	f		?	7G		/ I1R/ / / /	?	E6	f	/ I// / \ \ /				
,	=)	f	/ I// / . R/	?	H#	f	/ I// / \ \ /	?	7&	f	/ I// / \ \ /	?	E:	f	/ I// / \ \ /				
,	=%		/ I// / D0/	,	H!	f	/ I// / / R1	?	7<	f	/ I// / \ \ /	?	d	f	/ I// / \ \ /				
?	="	f	/ I// / \ \ /	?	H9	f	/ I// / \ \ /	?	79	f	/ I// / \ \ /	,	J	f	/ I// - - / /				
?	=9	f	/ I// / C. / /	,	? F		/ I// / \ 0//	,	+		/ I// CR/ / /	?	i	f	/ I// / \ \ /				
?	hQ	f	/ I// / / \ \ /	,	? 5		/ I// / / 1R/	?	+G	f	/ I// / \ \ /	?	j	f	/ I// / \ \ /				
?	B%	f	/ I// / \ \ /	?	?)	f	/ I// / \ \ /	,	+$	f	/ I// / / 01/	,	j G	f	/ I// / C. /				

? O=<&$`&' GQ*=@D ? + , O=<&$`&' GQ*=@D B+ ! O+>&$(%#6*5(&%&%&5$&
5 ON) (=<&$`&' e) % " O+) 69!) 5 +(#5' #% B6& &5(

6.0 INTENDED USE

Oe) %<(& $#6G%#(!) 5) ; #5#6Q!$#6!5" (%: &5(" #5' X#6' #(!) 5) ; #5#6Q!$#6: &(<) ' " #" #>>%þ>%#(&I

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

O+() %& G&(_&&5 #>>%}V!: #(&6Q1I O0/ I = _<!6& !5 "&#6&' E= E G#FI

Oi <!6& "() %&' !5 (<& "&#6&' E= E G#F2(%#5">!%#(!) 5) ; (<!" =7 ? A7 ? !" 5&F6F!G&I T;(&%) >&5!5F (<& "&#6&' E= E G#F (%#5">!%#(!) 5) ; (<& =7 ? A7 ? _!6) $$9%2%&" 96(!5F !5 # F%#' 9#6!5$%&#" & !5 (<& #5#6Q(& $) 5$&5(%#(!) 5L" PI *(!" (<& %&">) 5" !G!6!(Q) ; (<& 9"&%)(#$$) 95(;) %<!" &;;&$(I i <&5 (<& G) ((6& !" _&!F<&' G) (< G&;) %& #5' #;(&%G&!5F >6#$&' !5 "() %#F&2 (<& : #"" ' !;;&%&5$&) G'&%%&' _!6G& # : &#"9%&) ; (%#5">!%#(!) 5 : #"" 6) ""I

OT;(&%) >&5!5F (<& "&#6&' E= E G#F2`&&> $#> (!F<(6Q"&#6&' _<&5 5) (!5 9"& #5' "() %& G&(_&&5 1I OC1I = ( ) : !5!: !c& (<& &;;&$(") ; (%#5">!%#(!) 5I d"& #(C/ I] 1I = ( ) : !5!: !c& X) 6) : &(%!$ ' !6!(!) 5 &%%) %%_<&5 9"!5F (<& %&>) %&(' ' &5"!(Q h) 5) (>!>&((& ;%) : (<& $) 5(#!5&%% h) 5) (%&(9%5 %&:) X&' #6!89) (" () $) 5(#!5&%%

Oe) %) %& !5;) %:#(!) 52X!"!(**www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 0KI-/ m+ L\ P Un1#8P

Chemical Compatibility - +) 6!G6& !5 Y= 62YN, 02 YC+, 1 #5' Ye #89&) 9" : #(%!$&"I TX) !' 9"&) ; Y=6 1 ' 9&() !5") 6!G!6!(Q) ; (<& >&%$<6) %#(&I +(#G6& _!(< #66: &(#6" #5' !5) %F#5!$ #5!) 5" &V$&>(=6 1OI

Stability - OG/ / >>G 6&X&6 "(#G6& ;) %) 5(<" !5 - W YN, 0 AHh@B $) 5(#!5&%% - G/ 2/ / >>: ") 6!9(!) 5" $<&: !$#66Q"(#G6& ;) %Q&#%" !5 - OW YN, 0 AHh@B $) 5(#!5&%%

K Containing Samples (Preparation and Solution) - ? &(#6Lh!"") 6X&" X&%Q%#>!' 6Q!5 _#(&%Pn %&" L+) ' !9: $#%G) 5#(&;9"!) 5 !5 @(;) 6) _&' GQY= 6' !"") 6!9(!) 5OG6#5` 6&X&6) ; U !5 ") ' !9: $#%G) 5#(& $%!$#6Pn %F#5!$? #(%!$&" L+96;9%$A>&%}V!' &' !F&"(!) 5 P

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	Estimated D.L.	Order	Interferences L95' &%65&' !5' !$#(&" "&X&%&P
*=@@O+ 0K#: 9	-/ >>(	5A#	0RT%Y2O0N#-\ , 2 . R+&
*=@OB+ 1/ 1I. C- 5:	-I- A/ I/ DZFA H	-	d2 =&
*=@OB+ .\\ I1K/ 5:	/I1 A/ I/ / - ZFA H	-	C5') %&%#%!#(!) 5 ;%): 7IBI") 5 ") : &) >(!$#6' &"!F5"
*=@OB+ ..-ID0- 5:	-I/ A/ I/ 0 ZFA H	-	C5') %&%#%!#(!) 5 ;%): 7IBI") 5 ") : &) >(!$#6' &"!F5"

8.0 HAZARDOUS INFORMATION

O@6&#"& %&;&%)((<& +#;&(Qh#(# +<&&(;) %!5;) %:#(!) 5 %&F#%!5F (<!" =7 ? A7 ? I

9.0 HOMOGENEITY

OE<!" ") 6!9(!) 5 _#" : !V&' #$$) %!5F () #5 !5G<) 9"& >%}$&' 9%& #5' !" F9#%#5(&&' () G& <):) F&5&) 9"I Y):) F&5&!(Q' #(# !5' !$#(& (<#((<& &5' 9"&%' <) 96' (#`& # : !5!: 9: "#: >6& "!c&) ; /IC: H() #""9%& <):) F&5&!(QI

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

OM+7 = &%(!;!$#(& N9: G&%M+7 G/ 01

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

O=<&: !$#6E&"(!5F OT$$%&' !(&' A TCHT = &%(!;!$#(& N9: G&%RR0I/ -

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

O7 &;&%&5$& ? #(&%!#6@%) 9$&%OT$$%&' !(&' A TCHT = &%(!;!$#(& N9: G&%RR0I/ C

!" #$%!&() *! +#-.(/00 (1*' 2!"3"$ 4(5#6*.(7 2#-&%!8, #$.() %(;:0</ .(=>?@*3*A2"!* B(C00DDED<EE@;0 FCF0/0 .(G%#F;0 FCF0I: @&!"#$%!&6*! +#-9"J @&!KL &!"#$%!&6*! +#-9"J

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

e&G%#%Q/ \ 2C/ C-

OE<& $&%!($#(!) 5 !" X#6' _!(<!5 (<& : &#" 9%&: &5(95$&%#(!5(Q" >&$!;!&' >%)X' &' (<& =7 ? A7 ? !" "() %&' #5' <#5' 6&' !5 #$$) %#5$& _!(< !5" (%)$(!) 5" F!X&5 !5 +&$. I- I E<!" $&%!($#(!) 5 !" 596&;!&' !; !5" (%)$(!) 5" !5 +&$. I- #%& 5) (;) 66) _&') %!; (<& =7 ? A7 ? !" ' #: #F&' 2$) 5(#: !5#(&' 2) %) (<&%_!" & :) ' !;!&' I

11.2 Lot Expiration Date

O**February 06, 2025**

OE<& ' #(& #;(&%_<!$< (<!" =7 ? A7 ? "<) 96 5) (G& 9" &' I

OE<& 6) (&\>!%#(!) 5 ' #(& %&;6&$(" (<& >&%) ') ; (!: & (<#((<& "(#G16(Q) ; # =7 ? A7 ? $#5 G& "9>>) %&' GQ6) 5F (&%: "(#G16(Q" (9' !&" $) 5' 9$(&') 5 >%)>&%&Q" () %&' #5' <#5' 6&' =7 ? A7 ? "I H) (&\>!%#(!) 5 !" 6: !(&' >% #%&QGQ (%&5" >!%#(!) 5 L6) "") ; _#(&% ;)% (<& ") 6) (!) 5P#5' !5;%&89&5(6QGQ$<&: !$#6"(#G16(Q

11.3 Period of Validity

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OE<!" =7 ? A7 ? "<) 96 5) (G& 9" &' 6) 5F&%<(#5) 5& Q&#%L) %" !V:) 5(<" !5 (<& $#" &) ; # 0/ : HG) ((&P ;)% (<& ' #(&) ;) >&5!5F (<& #69: !5!c&' G#F) %#;(&%<(& ' #(& F!X&5 !5 +&$I -- IC2_<!$<&X&%$) : &" ;!%(I E<!" !" $) 5(!5F&5(9>) 5 (<& =7 ? A7 ? G&!5F "() %&' #5' <#5' 6&' !5 #$$) %#5$& _!(< (<& !5" (%)$(!) 5" F!X&5 !5 +&$I . I- I

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

? !$<#&6g)) (<
h!%&$() %2M9#6(Q=) 5(%6

Certifying Officer:

@#964 #!5&"
= <#!%:#5 A+&5!) %E&$<5!$#6h!%&$() %

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGMG10
Lot Number:	R2-MG695748
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Magnesium
Starting Material:	Magnesium Metal
Starting Material Lot#:	2168
Starting Material Purity:	99.9984%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10044 ± 30 µg/mL

Density: 1.053 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10055 ± 26 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #2 **10042 ± 57 µg/mL**
ICP Assay NIST SRM 3131a Lot Number: 140110

Assay Method #3 **10033 ± 26 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

O	Ag		0.002104	M	Eu	<	0.000910	O	Na		0.071011	O	Se	<	0.048000	O	Zn		0.003296
M	Al		0.003550	M	Fe		0.002536	M	Nb	<	0.000460	O	Si	<	0.032000	O	Zr	<	0.002700
M	As	<	0.001400	M	Ga	<	0.000460	M	Nd	<	0.000910	M	Sm	<	0.000460				
M	Au	<	0.001400	M	Gd	<	0.000460	O	Ni	<	0.001600	M	Sn	<	0.002300				
O	B		0.006847	M	Ge	<	0.001400	M	Os	<	0.000460	O	Sr		0.000278				
O	Ba		0.000963	M	Hf	<	0.000460	O	P		0.015216	M	Ta	<	0.000460				
O	Be	<	0.000120	M	Hg	<	0.000460	M	Pb	<	0.000460	M	Tb	<	0.000460				
M	Bi	<	0.000460	M	Ho	<	0.000460	M	Pd	<	0.003200	M	Te	<	0.007300				
O	Ca		0.053258	M	In	<	0.000460	M	Pr	<	0.000460	M	Th	<	0.000460				
O	Cd	<	0.000360	M	Ir	<	0.000460	M	Pt	<	0.001900	O	Ti	<	0.001700				
M	Ce	<	0.002300	M	K		0.048186	M	Rb		0.002409	M	Tl		0.003043				
M	Co	<	0.000910	M	La	<	0.002800	M	Re	<	0.000460	M	Tm	<	0.000460				
M	Cr	<	0.002300	O	Li		0.027897	M	Rh	<	0.000460	M	U	<	0.000460				
M	Cs		0.001039	M	Lu	<	0.000460	M	Ru	<	0.000460	M	V	<	0.000460				
O	Cu	<	0.003000	s	Mg	<		O	S	<	0.190000	M	W	<	0.000460				
M	Dy	<	0.000460	O	Mn		0.015216	M	Sb		0.020796	O	Y	<	0.000720				
M	Er	<	0.000460	M	Mo	<	0.000910	O	Sc	<	0.000480	M	Yb	<	0.000460				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 24.31 +2 6 $Mg(H_2O)_6^{+2}$

Chemical Compatibility -Soluble in HCl, HNO_3, and H_2SO_4 avoid HF, H_3PO_4 and neutral to basic media. Stable with most metals and inorganic anions forming insoluble silicates, carbonates, hydroxides, oxides, and tungstates in neutral and slightly acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-10% HNO_3 / LDPE container.

Mg Containing Samples (Preparation and Solution) -Metal (Best dissolved in diluted HNO_3); Oxide (Readily soluble in above compatible aqueous acidic solutions); Ores (Carbonate fusion in Pt0 followed by HCl dissolution); Organic Matrices (Sulfuric / peroxide digestion or nitric / sulfuric / perchloric acid decomposition, or dry ash and dissolution in dilute HCl).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 24 amu	42 ppt	n/a	7Li17O, 48Ti+2 , 48Ca+2
ICP-OES 279.553 nm	0.0002 / 0.00003 µg/mL	1	Th
ICP-OES 280.270 nm	0.0003 / 0.00005 µg/mL	1	U, V
ICP-OES 285.213 nm	0.002 / 0.00003 µg/mL	1	U, Hf, Cr, Zr

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

September 01, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **September 01, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Director, Quality Control

Certifying Officer:

Paul Gaines
Chairman / Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
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1.0 ACCREDITATION / REGISTRATION

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ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGMN10
Lot Number:	P2-MN687536
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Manganese
Starting Material:	Mn Metal
Starting Material Lot#:	2275
Starting Material Purity:	99.9909%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10046 ± 30 µg/mL

Density: 1.035 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10045 ± 25 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #2 **10083 ± 68 µg/mL**
ICP Assay NIST SRM 3132 Lot Number: 050429

Assay Method #3 **10031 ± 47 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.001500	M	Eu	<	0.000730	O	Na		0.176713	M	Se	<	0.006600	M	Zn		0.009960
O	Al		0.004337	M	Fe	<	0.650000	M	Nb	<	0.000730	O	Si		0.097995	M	Zr	<	0.000730
M	As	<	0.008000	M	Ga		0.004337	M	Nd	<	0.001500	M	Sm	<	0.000730				
M	Au	<	0.000730	M	Gd	<	0.000730	M	Ni		0.024097	M	Sn	<	0.002200				
M	B		0.069078	M	Ge	<	0.004400	M	Os	<	0.000730	O	Sr		0.000931				
M	Ba	<	0.001500	M	Hf	<	0.000730	i	P	<		M	Ta	<	0.000730				
M	Be	<	0.000730	M	Hg	<	0.002200	M	Pb		0.007389	M	Tb	<	0.000730				
M	Bi	<	0.003000	M	Ho	<	0.000730	M	Pd	<	0.000730	M	Te	<	0.019000				
O	Ca		0.062652	M	In	<	0.003000	M	Pr	<	0.000730	M	Th	<	0.000730				
M	Cd	<	0.001500	M	Ir	<	0.000730	M	Pt	<	0.000730	O	Ti	<	0.006500				
M	Ce	<	0.007300	O	K		0.006425	M	Rb	<	0.006600	M	Tl	<	0.000730				
O	Co		0.014779	M	La	<	0.003000	M	Re	<	0.000730	M	Tm	<	0.000730				
O	Cr		0.273102	O	Li		0.000417	M	Rh	<	0.003000	M	U	<	0.001500				
M	Cs	<	0.000730	M	Lu	<	0.000730	M	Ru	<	0.004400	M	V	<	0.000730				
O	Cu		0.007711	O	Mg		0.321297	i	S	<		M	W	<	0.004400				
M	Dy	<	0.001500	s	Mn	<		M	Sb	<	0.021000	O	Y		0.001365				
M	Er	<	0.001500	M	Mo		0.010281	O	Sc	<	0.004100	M	Yb	<	0.000730				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 54.94 +2 6 $Mn(H_2O)_6^{2+}$

Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4 ,HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5 % HNO_3/LDPE container.

Mn Containing Samples (Preparation and Solution) -Metal (Soluble in dilute acids); Oxides (Soluble in dilute acids); Ores (Dissolve with HCl. If silica is present add HF and then fume off silica by adding H_2SO_4 and heat to SO_3 fumes - dense white fumes).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 55 amu	10 ppt	n/a	40Ar14N1H,39K16O,37Cl18O,40Ar15N,38Ar17O,36Ar18O1H ,38Ar16O1H,37Cl17O1H,23Na32S
ICP-OES 257.610 nm	0.0014 / 0.00002 µg/mL	1	Ce, W, Re
ICP-OES 259.373 nm	0.0016 / 0.00002 µg/mL	1	U, Ta, Mo, Fe, Nb
ICP-OES 260.569 nm	0.0021 / 0.00002 µg/mL	1	Co

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

January 05, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **January 05, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

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ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGMO10
Lot Number:	R2-MO693167
Matrix:	tr. NH4OH H2O
Value / Analyte(s):	10 000 µg/mL ea: Molybdenum
Starting Material:	Ammonium Molybdate
Starting Material Lot#:	2257
Starting Material Purity:	99.9914%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10013 ± 35 µg/mL

Density: 1.011 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10035 ± 67 µg/mL**
ICP Assay NIST SRM 3134 Lot Number: 130418

Assay Method #2 **10005 ± 40 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.001826	M	Eu	<	0.000300	M	Na		0.008750	M	Se	<	0.007480	M	Zn		0.002553
M	Al		0.004455	M	Fe		0.002093	M	Nb	<	0.015030	i	Si	<		M	Zr	<	0.005393
M	As	<	0.003006	M	Ga	<	0.000300	i	Nd	<		M	Sm	<	0.000300				
M	Au	<	0.006012	M	Gd	<	0.000300	M	Ni	<	0.004828	M	Sn		0.001004				
M	B	<	0.035184	M	Ge	<	0.000903	M	Os	<	0.003006	M	Sr		0.001903				
O	Ba		0.015613	M	Hf	<	0.000896	i	P	<		M	Ta	<	0.000300				
M	Be	<	0.003006	M	Hg	<	0.003006	M	Pb	<	0.000409	M	Tb	<	0.000300				
M	Bi	<	0.000401	M	Ho	<	0.000300	M	Pd	<	0.001114	M	Te	<	0.060122				
O	Ca		0.032589	M	In	<	0.015030	M	Pr	<	0.090184	M	Th	<	0.000786				
O	Cd	<	0.051800	M	Ir	<	0.007483	M	Pt	<	0.000388	O	Ti	<	0.093240				
M	Ce	<	0.015030	M	K		1.114508	M	Rb		0.040641	M	Tl		0.013140				
M	Co		0.004032	M	La	<	0.000300	M	Re	<	0.000300	M	Tm	<	0.000300				
M	Cr		0.005931	O	Li		0.000215	M	Rh	<	0.000300	M	U		0.000937				
M	Cs		0.002812	M	Lu	<	0.000300	M	Ru	<	0.003006	M	V	<	0.000759				
M	Cu		0.005172	M	Mg		0.005212	i	S	<		M	W		0.592427				
M	Dy	<	0.000300	M	Mn		0.000952	M	Sb		0.003147	M	Y	<	0.000300				
M	Er	<	0.000300	s	Mo	<		M	Sc	<	0.009019	M	Yb	<	0.000300				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 95.94 +6 6,7,8,9 [MoO4] -2(chemical form as received)

Chemical Compatibility -Mo is received in a NH4OH matrix giving the operator the option of using HCl or HF to stabilize acidic solutions. The [MoO4]-2 is soluble in concentrated HCl [MoOCl5]-2, dilute HF / HNO3 [MoOF5] -2 and basic media [MoO4]-2. Stable at ppm levels with some metals provided it is fluorinated. Do not mix with Alkaline or Rare Earths when HF is present. Stable with most inorganic anions provided it is in the [MoO4]-2 chemical form.

Stability - 2-100 ppb levels stable (alone or mixed with all other metals that are at comparable levels) as the [MoOF5]-2 for months in 1% HNO3 / LDPE container. 1-10,000 ppm single element solutions as the [MoO4] -2 chemically stable for years in 1% NH4OH in a LDPE container.

Mo Containing Samples (Preparation and Solution) -Metal (Soluble in HF / HNO3 or hot dilute HCl); Oxide (soluble in HF or NH4OH) ; Organic Matrices (Dry ash at 450EC in Pt0 and dissolve oxide with HF or HCl).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 95 amu	3 ppt	n/a	40Ar39K16O,79Br16O,190Os2+,190Pt2+
ICP-OES 202.030 nm	0.008 / 0.0002 µg/mL	1	Os, Hf
ICP-OES 203.844 nm	0.012 / 0.002 µg/mL	1	
ICP-OES 204.598 nm	0.012 / 0.001 µg/mL	1	Ir, Ta

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

May 28, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **May 28, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com
tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES !" #$$%&' !(&' () *+, - . / 01234 &5&%#67 &89!%&: &5(" ;) % (<& =) : >&(&5$&) ; 7 &;&%&5$& ? #(&%#6@)% 9$&%3#5' *+, A*B=- . / CD234 &5&%#6 7 &89!%&: &5(" ;) %<(& =) : >&(&5$&) ; E&" (!5F #5' =#6G%#(!) 5 H#G) %#() %&" 3I *5) %5#5!$ J &5(9%&" !" #6') #5 *+, K/ / - %&F!" (&%&' : #59;#$(9%&%LM+7 = &%(!$#(& N9: G&%LM+7 G- / 01PI

2.0 PRODUCT DESCRIPTION

@)% 9$(=) ' &S	+!5F6& T5#6Q(& = 9" () : 4 %#' & +) 69(!) 5
= #(#6) F N9: G&%S	= 4 NT - /
H) (N9: G&%S	+CONT / / R1C
? #(%LJS	CV LWAVPXN, 0
J#69& AT5#6Q(&L" PS	- / / / / YFA H&#S +) ' !9:
+(#%!5F ? #(&%#6S	N#C=, 0
+(#%!5F ? #(&%#6H) (ZS	CC. 1
+(#%!5F ? #(&%#6@9%(QS	KKIKKDRV

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: - / / D0 [0/ YFA H

Density: - I/ 0\ FA HL: &#" 9%&' #(C/ [1] = P

Assay Information:

Assay Method #1 **10070 ± 26 µg/mL**
4 %#W! &(%$ N*+ E + 7 ? H) (N9: G&%S+ && + &$I 1IC

Assay Method #2 **10012 ± 31 µg/mL**
= @T" "#QN+ E + 7 ? 0- DC# H) (N9: G&%S- C/ . - D

Assay Method #3 **10059 ± 20 µg/mL**
= #6$96#&' N*+ E + 7 ? H) (N9: G&%S+ && + &$I 1IC

CE<& = #6$96#(&' J#69& !" # W#69& $#6$96#(&' ;%): (<& ^ &!F<( ) ; # " (#%!5F : #(&%#6(<#(<#" G&&5 $&%!(!&' ' !%&$(6QWI # N#(!) 5#6*5" (!(9(&) ; +(#5' #%" #5' E&$<5) 6) FQLN*+EP+7 ? A7 ? I + && + &$ 1IC ;) %G#6#5$& (%$&#G16(Q

E<& ;) 66') !5F &89#(!) 5" #%& 9" &' !5 (<& $#6$96#!) 5) ; (<& $&%(;!&' W#69& #5' (<& 95$&%(#!5(QI 7 &>) %(&' 95$&%(#!5(!&" %&>%&" &5(&U>#5' &' 95$&%(#!5(!&" &U>%&" " &' #(#>>%U: #(&&Q(<& KDV $) 5;!' &5$& 6&%&69" !5F # $) W&%#F& ;#$() %) ; _ ` CI

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

OE<!" >%)' 9$(!" (%&$&#G&(() N*+E W# #5 95G%)_&5 $<#!5) ; $) : >#%") 5" I E<& 95$&%#(!5(!&" ;) %&#$< $&%(!&' W#6)& #%& %&>) %&' 2 #_!5F !5() #$$) 95((<& +7 ? A7 ? 95$&%#(!5(Q&%)%%#5' (<& : &#" 9%&: &5(2^ &!F<!5F #5' W)6): & ' !6)(!) 5 &%)%%I *5 %#%& $#" &" ^ <&%& 5) N*+E +7 ? A7 ? #%& #W#!6#G&2 (<& (&%: a5G<) 9" & " (' Ia!" " >&$!;!&' I

4.1 Thermometer Calibration

OT6(<&%:) : &(&% #%& N*+E (%&$&#G&((<%)9F< (<&%:) : &(&% (<#(#%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q

4.2 Balance Calibration

OT6#5#6Q(!$#6G#6#5$&" #%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q#5' >%)$&' 9%&I E<& ^ &!F<(" 9" &' ;) %&(" (!5F #%& #559#6Q$) : >#%&' () : #" (&%^ &!F<(" #5' #%& (%&$&#G&(() N*+EI

4.3 Glassware Calibration

OT5 !5G<) 9" & >%)$&' 9%& !" 9" &' () $#6G%#(& #6=6#" " T F6#" " ^ #%& 9" &' !5 (<& : #59;#$(9%5F #5' 89#6(Q $) 5(%6) ; =7 ? A7 ? " I

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

=7 ? A7 ? " #%& (&" (&' ;) % (#%& : &(#6&$!: >9%(!&" GQTU#6*=@D ?+ B+ #5' *=@D ?+ I E<& %&" 96(;%: (<& :) " (" &5" !(!V& : &(<) ' ;) %&#$< &6&: &5(2!" %&>) %&' G&0 ^ I +) 6)(!) 5" (&" (&' GQ*=@D ?+ ^ &%& #5#6Qb&' !5 #5 c H@T Q!(6&%&' =6&#5 7)) : I T5 c H@T Q!(6&%!" KKIKKRDV &;;!$!&5(;) %<(& %&:) W#6) ; >#%!$(6&" ') ^ 5 () / I0 Y: I

,	TF e	/ I/ / / CD/ ?	B9 e	/ I/ / / R1/ "	N# e	,	+& e	/ I/ / 1. / /	,	k5	/ I/ / / CC\
,	T6	/ I/ / 0\ RR ,	d&	/ I/ / - D\ / ,	NG e	/ I/ / - 0/ /	,	+!	/ I/ 1K\ 1R ,	k%	/ I/ / / \ R/
,	T" e	/ I/ / \ K/ / ?	4 # e	/ I/ / / R1/ ?	N' e	/ I/ / / R1/ ?	+: e	/ I/ / / R1/			
?	T9 e	/ I/ / / R1/ ?	4 ' e	/ I/ / / R1/ ,	N! e	/ I/ / / CD/ ?	+5 e	/ I/ / - . / /			
,	f	/ I/ / / K0\ ?	4 & e	/ I/ / 01/ / ?	, " e	/ I/ / / R1/ ,	+%	/ I/ / / CDD			
,	f #	/ I/ / CC\ K ?	X; e	/ I/ / / R1/ ,	@	/ I/ / \ DCD ?	E# e	/ I/ / 1C/ /			
,	f & e	/ I/ / / - 0/ ?	XF e	/ I/ / - . / / ?	@G e	/ I/ / / R1/ ?	EG e	/ I/ / / R1/			
,	f ! e	/ I/ / R- / / ?	X) e	/ I/ / / R1/ ?	@ e	/ I/ / / R1/ ,	E& e	/ I/ / 1R/ /			
,	=#	/ I/ RD- - C ?	*5 e	/ I/ / / R1/ ?	@% e	/ I/ / / R1/ ?	E< e	/ I/ / CD/ /			
,	=' e	/ I/ / / CD/ ?	*% e	/ I/ / / R1/ ?	@(e	/ I/ / / R1/ ,	E!	/ I/ / / DD0			
?	=& e	/ I/ / - . / / ,	h	- I/ 1K. - R ?	7 G e	/ I/ / 01/ / ?	E6 e	/ I/ / / R1/			
,	=) e	/ I/ / / 0. / ?	H# e	/ I/ / / R1/ ?	7 & e	/ I/ / / R1/ ?	E: e	/ I/ / / R1/			
,	=% e	/ I/ / - 1/ / ,	H!	/ I/ / / / \ K ?	7 < e	/ I/ / / R1/ ?	c e	/ I/ / / R1/			
?	=" e	/ I/ / 01/ / ?	H9 e	/ I/ / / R1/ ?	7 9 e	/ I/ / - . / / ,	J e	/ I/ / - \ / /			
,	=9 e	/ I/ / - 1/ / ,	? F	/ I/ CR0. / ,	+	/ I/ 1RC0/ ,	i e	/ I/ / D/ / /			
?	gQ e	/ I/ / / R1/ ,	? 5	/ I/ / / - 0K ?	+G e	/ I/ / - . / / ,	j e	/ I/ / / . 0/			
?	B% e	/ I/ / / R1/ ,	?) e	/ I/ / 1R/ / ,	+$ e	/ I/ / / 0. / ,	j G e	/ I/ / / - 0/			

? O=<&$_&' GQ*=@D ? + , O=<&$_&' GQ*=@D B+ ! O+>&$(%&*5(&%&%&5$& 5 ON) (=<&$_&' d) % " O+) 69!) 5 +(#5' #% B6& &5(

6.0 INTENDED USE

Od) %<(& $#6G%#(!) 5) ; #5#6Q(!$#6!5" (%&: &5(" #5' W#6' #(!) 5) ; #5#6Q(!$#6: &(<) ' " #" #>>%)>%#(&I

@#F& C) ; 1

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

O+( ) %& G&(^ &&5 #>>%)U: #(&6Q.1I O0/ I = ^ <!6& !5 " &#6&' E= E G#FI

Oi <!6& " () %&' !5 (<& " &#6&' E= E G#F2(%#5" >!%#(!) 5) ; (<!" =7 ? A7 ? !" 5&F6F!G6&I T;(&%) >&5!5F (<& " &#6&' E= E G#F (%#5" >!%#(!) 5) ; (<& =7 ? A7 ? ^ !6) $$9%2%&" 96!5F !5 # F%#' 9#6!5$%&#" & !5 (<& #5#6Q(& $) 5$&5(%#(!) 5L" PI *(!" (<& %&" >) 5" !G16(Q) ; (<& 9" &%)(#$$) 95(;) %<!" &;;&$(I i <&5 (<& G) ((6& !" ^ &!F<&' G) (< G&;) %& #5' #;(&%G&!5F >6#$&' !5 " () %#F&2 (<& : #" " ' !;;&%&5$&) G' &%%&' ^ !6G& # : &#" 9%&) ; (%#5" >!%#(!) 5 : #" " 6) " "I

OT;(&%) >&5!5F (<& " &#6&' E= E G#F2_&&> $#> (!F<(6Q" &#6&' ^ <&5 5) (!5 9" & #5' " () %& G&(^ &&5 1I OC1I = ( ) : !5!: !b& (<& &;;&$(") ; (%#5" >!%#(!) 5I c " & #(C/ I [1I = ( ) : !5!: !b& W)6): &(%$ ' !6)(!) 5 &%)%%^ <&5 9" !5F (<& %&>) %&(' &5" !(QI g) 5) (>!>&((& ;%): (<& $) 5(#!5&% g) 5) (%&(9%5 %&:) W&' #6)89) (" () $) 5(#!5&%

Od) %) %& !5;) %:#(!) 52W" !(**www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - CCIKK m+ L\ PN#m1#8P6#%F&6Q !) 5!$!5 5#(9%&

Chemical Compatibility -+) 6)G6& !5 X= 62XN, 02 XC+, 1 #5' Xd #89&) 9" : #(%$&" I +(#G6& ^ !(< #6): &(#6' #5' !5) %F6#5!$ #5!) 5" I

Stability - CO/ / >>G6&W&6' "(#G6& ;) %) 5(<" !5 - V XN, 0 AHg@B $) 5(#!5&% - O/ 2/ / >>: ") 6)(!) 5" $<&: !$#6&Q" (#G6& ;) %Q&#% !5 - OV XN, 0 AHg@B $) 5(#!5&%

Na Containing Samples (Preparation and Solution) - ? &(#6Lg!" ") 6W&" W&%Q%>!' 6Q!5 ^ #(&%Pn %&" LH!(<!9: $#%G) 5#(& ;9" !) 5 !5 F%#><!(& $%)$!G6& ;) 6) ^ &' GQX= 6' !" ") 6)(!) 5 OG6#5_ 6&W&6') ; N# !5 6(<!9: $#%G) 5#(& $%(!$#6Pn %F6#5!$? #(%$&" L+ 969%$ A>&%)U' & ' !F&" (!) 5) %5!(%$A'969%$A>&%<6) %$ #$!' ' &$) : >) " !(!) 5PI

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	Estimated D.L.	Order	Interferences L95' &%65&' !5' !$#(&" "&W&%&P
*=@?+ C0 #: 9	0-/ >>(	5##	1\ E!mC 21\ = #mC
*=@?OB+ 00/ IC0. 5:	CI/ A/ I/ K YFA H	-	@ 2 k5
*=@?OB+ DRRIKKD 5:	/ I/ 0 A/ I/ / \ YFA H	-	C5') %&%#%!#(!) 5 ;%): 7 IBI") 5 "): &) >(!$#6' &" !F5"
*=@?OB+ DRKIDKD 5:	/ I/ . A/ I/ / / / K YFA H	-	C5') %&%#%!#(!) 5 ;%): 7 IBI") 5 "): &) >(!$#6' &" !F5"

8.0 HAZARDOUS INFORMATION

O@6&#" & %&;&%)((<& +#;&(Q.g #(# +<&&(;) %5;) %:#(!) 5 %&F#%!5F (<!" =7 ? A7 ? I

9.0 HOMOGENEITY

OE<!" ") 6)(!) 5 ^ #" : !U&' #$$) %!5F () #5 !5G<) 9" & >%)$&' 9%& #5' !" F9#%#5(&&' () G& <) :) F&5&) 9" I X) :) F&5&!(Q' #(# !5' !$#(& (<#((<& &5' 9" &%' <) 96 (#_& # : !5!: 9: "#: >6&" !b&) ; / IC : H() #" " 9%& <) :) F&5&!(QI

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

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10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

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10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

O7 &;&%&5$& ? #(&%#6@)% 9$&%OT $$%&' !(&' A TCHT = &%{!$#(& N9: G&%RR0I/ C

!" #$%!&() *! +#- .(/00 (1* ' 2!"3"$ 4(5#&* .(7 2#&-&%!8, #$.() %4(:;0</ .(=>?@*3*A2"!* B(C00DDE0<E@F;0 9FCF90/0 .(G%HF;0 9FCF90I: @&!"#$%!&6*! +#- 9 "J @&!*KL &!"#$%!&6*! +#- 9 "J

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

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11.2 Lot Expiration Date

OJanuary 25, 2025

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OE<& 6) (&U>!%#(!) 5 ' #(& %&;6&$(" (<& >&%) ') ; (!: & (<#((<& " (#G66(Q) ; # =7 ? A7 ? $#5 G& " 9>>) %&' GQ6) 5F (&%: " (#G66(Q" (9' !&" $) 5' 9$(&') 5 >%)>&%&Q" () %&' #5' <#5' 6&' =7 ? A7 ? " I H) (&U>!%#(!) 5 !" 6: !(&' >% #%6&QGQ (%&5" >!%#(!) 5 L6) " ") ; ^ #(&% ;)% (<& ") 6) (!) 5P#5' !5;%&89&5(6&QGQ$<&: !$#6" (#G66(Q

11.3 Period of Validity

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OE<!" =7 ? A7 ? " <) 96 5) (G& 9" &' 6) 5F&%<(#5) 5& Q&#%L) %" !U:) 5(<" !5 (<& $#" &) ; # 0/ : HG) ((&P ;)% (<& ' #(&) ;) >&5!5F (<& #69: !5!b&' G#F) %#;(&%<(& ' #(& F!W&5 !5 + &$I - - IC2^ <!$<&W&%$) : &" ;!%(I E<!" !" $) 5(!5F&5(9>) 5 (<& =7 ? A7 ? G&!5F " () %&' #5' <#5' 6&' !5 #$$) %#5$& ^ !(< (<& !5" (%)$(!) 5" F!W&5 !5 + &$I . I- I

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

? !$<#&6f)) (<
g! %&$() %2M9#6(Q=) 5(%6

Certifying Officer:

@#964 #!5&"
= <#!%:#5 A+ &5!) %E&$<5!$#6g !%&$() %

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGNI10
Lot Number:	P2-NI686384
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Nickel
Starting Material:	Ni Metal
Starting Material Lot#:	2277 and 2282
Starting Material Purity:	99.9992%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9979 ± 30 µg/mL

Density: 1.038 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9971 ± 54 µg/mL**
ICP Assay NIST SRM 3136 Lot Number: 120619

Assay Method #2 **9970 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **9993 ± 33 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag		0.002606	M	Eu	<	0.001100	O	Na		0.004965	O	Se	<	0.067000	M	Zn		0.006578
M	Al	<	0.013000	O	Fe		0.018618	M	Nb	<	0.001100	O	Si		0.010923	M	Zr	<	0.001100
O	As	<	0.067000	M	Ga	<	0.001100	M	Nd	<	0.001100	M	Sm	<	0.001100				
M	Au	<	0.002100	M	Gd	<	0.001100	s	Ni	<		M	Sn	<	0.016000				
M	B	<	0.017000	M	Ge	<	0.004200	M	Os		0.002110	O	Sr	<	0.000940				
M	Ba	<	0.001100	M	Hf	<	0.001100	i	P	<		M	Ta	<	0.001100				
O	Be	<	0.000410	M	Hg		0.014895	M	Pb		0.006578	M	Tb	<	0.001100				
M	Bi	<	0.004200	M	Ho	<	0.001100	M	Pd	<	0.001100	M	Te	<	0.015000				
O	Ca		0.003351	M	In	<	0.001100	M	Pr	<	0.001100	M	Th	<	0.001100				
M	Cd		0.001365	M	Ir		0.004716	M	Pt	<	0.001100	M	Ti	<	0.004200				
M	Ce	<	0.001100	O	K		0.004716	M	Rb	<	0.001100	M	Tl	<	0.001100				
O	Co		0.017377	M	La	<	0.001100	M	Re		0.001737	M	Tm	<	0.001100				
O	Cr	<	0.006700	O	Li	<	0.000140	M	Rh	<	0.006300	M	U	<	0.001100				
M	Cs	<	0.007300	M	Lu	<	0.001100	M	Ru	<	0.019000	M	V	<	0.002100				
M	Cu		0.004096	O	Mg		0.000372	i	S	<		M	W	<	0.006300				
M	Dy	<	0.001100	O	Mn	<	0.001900	M	Sb		0.005833	O	Y	<	0.000540				
M	Er	<	0.001100	M	Mo	<	0.008400	M	Sc	<	0.002100	M	Yb	<	0.001100				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 58.69 +2 6 Ni(H2O)62+

Chemical Compatibility -Stable in HCl, HNO3, H2SO4 ,HF, H3PO4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO3 / LDPE container.

Ni Containing Samples (Preparation and Solution) -Metal (Soluble in HNO3); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO3).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 60 amu	100 ppt	n/a	43Ca16O1H , 44Ca16O, 23Na37Cl
ICP-OES 221.647 nm	0.01 / 0.0009 µg/mL	1	Si
ICP-OES 231.604 nm	0.02 / 0.002 µg/mL	1	Sb, Ta, Co
ICP-OES 232.003 nm	0.02 / 0.006 µg/mL	1	Cr, Re, Os, Nb, Ag, Pt, Fe

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

December 02, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **December 02, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
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fax: 540.585.3012
info@inorganicventures.com

CERTIFICATE OF ANALYSIS

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGPB10
Lot Number:	P2-PB686383
Matrix:	0.5% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Lead
Starting Material:	Lead Nitrate
Starting Material Lot#:	2299
Starting Material Purity:	99.9974%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10031 ± 30 µg/mL

Density: 1.015 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10060 ± 63 µg/mL**
ICP Assay NIST SRM 3128 Lot Number: 101026

Assay Method #2 **10048 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **10007 ± 32 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag		0.000850	M	Eu	<	0.000310	O	Na		0.005780	M	Se	<	0.004600	M	Zn		0.005440
O	Al		0.234602	O	Fe		0.023460	M	Nb	<	0.000310	O	Si		0.047600	M	Zr	<	0.000610
M	As	<	0.001900	M	Ga	<	0.000310	M	Nd	<	0.000310	M	Sm	<	0.000310				
M	Au	<	0.002200	M	Gd	<	0.004300	M	Ni	<	0.001600	M	Sn	<	0.000610				
O	B	<	0.005200	M	Ge	<	0.000610	M	Os	<	0.000310	O	Sr		0.000442				
O	Ba		0.001530	M	Hf	<	0.000310	O	P	<	0.052000	M	Ta	<	0.000310				
O	Be	<	0.000630	M	Hg	<	0.001600	s	Pb	<		M	Tb	<	0.000310				
O	Bi		0.021080	M	Ho	<	0.000610	M	Pd	<	0.000310	M	Te	<	0.004300				
O	Ca		0.037400	M	In	<	0.000310	M	Pr	<	0.000310	M	Th	<	0.000310				
M	Cd	<	0.000610	M	Ir	<	0.000310	M	Pt	<	0.000310	M	Ti		0.002992				
M	Ce	<	0.000910	O	K		0.008840	M	Rb	<	0.000610	M	Tl		0.037400				
M	Co	<	0.000610	M	La	<	0.000610	M	Re	<	0.000310	M	Tm	<	0.000610				
M	Cr	<	0.003400	O	Li		0.000108	O	Rh	<	0.006300	M	U	<	0.000310				
M	Cs		0.002686	M	Lu	<	0.000310	M	Ru	<	0.000310	M	V	<	0.000310				
M	Cu	<	0.002500	O	Mg		0.004760	O	S	<	0.052000	M	W	<	0.002200				
M	Dy	<	0.000310	M	Mn	<	0.000310	M	Sb	<	0.001300	M	Y	<	0.000310				
M	Er	<	0.000310	O	Mo	<	0.005400	M	Sc	<	0.000310	M	Yb	<	0.000310				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 207.20 +2 6 $Pb(H_2O)_6^{+2}$

Chemical Compatibility - Soluble in HCl, HF and HNO_3. Avoid H_2SO_4. Stable with most metals and inorganic anions forming insoluble carbonate, borate, sulfate, sulfite, sulfide, phosphate, oxalate, chromate, tannate, iodate, and cyanide in neutral aqueous media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5% HNO_3 / LDPE container.

Pb Containing Samples (Preparation and Solution) -Metal (Best dissolved in 1:1 H_2O / HNO_3); Oxides (The many different Pb oxides are soluble in HNO_3 with the exception of PbO_2 which is soluble in HCl or HF); Ores and Alloys (Best attacked using 1:1 H_2O / HNO_3); Organic Matrices (Dry ash and dissolve in dilute HCl).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 208 amu	5 ppt	n/a	192Pt16O, 192Os16O
ICP-OES 168.215 nm	0.03 / 0.003 µg/mL	1	Co
ICP-OES 217.000 nm	0.09 / 0.03 µg/mL	1	W, Ir, Hf, Sb, Th
ICP-OES 220.353 nm	0.04 / 0.006 µg/mL	1	Bi, Nb

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

December 02, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **December 02, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGSB10
Lot Number:	R2-SB688559
Matrix:	3% (v/v) HNO3 3% (w/v) tartaric acid
Value / Analyte(s):	10 000 µg/mL ea: Antimony
Starting Material:	Antimony Metal
Starting Material Lot#:	1857
Starting Material Purity:	99.9894%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10003 ± 47 µg/mL

Density: 1.061 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10003 ± 41 µg/mL**
ICP Assay NIST SRM 3102a Lot Number: 140911

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.000200	M	Eu	<	0.000300	O	Na		0.140000	M	Se	<	0.007300	O	Zn		0.005000
M	Al		0.003200	O	Fe		0.060000	M	Nb	<	0.000100	O	Si		0.150000	O	Zr	<	0.006300
M	As	<	0.004400	M	Ga	<	0.000400	M	Nd	<	0.000100	M	Sm	<	0.000100				
M	Au	<	0.000210	M	Gd	<	0.000100	O	Ni		0.004800	M	Sn	<	0.001800				
M	B	<	0.011000	M	Ge	<	0.000600	M	Os	<	0.000110	O	Sr		0.000750				
O	Ba	<	0.004900	M	Hf	<	0.000100	O	P		0.540000	M	Ta		0.003300				
M	Be	<	0.000400	M	Hg	<	0.000110	M	Pb	<	0.000400	M	Tb	<	0.000100				
M	Bi	<	0.000200	M	Ho	<	0.000100	M	Pd	<	0.000210	M	Te	<	0.000600				
O	Ca		0.110000	M	In	<	0.000100	M	Pr	<	0.001600	M	Th	<	0.000100				
M	Cd	<	0.000200	M	Ir	<	0.000110	M	Pt	<	0.000600	M	Ti	<	0.002800				
M	Ce		0.006500	O	K		0.020000	M	Rb	<	0.001000	M	Tl	<	0.000100				
M	Co	<	0.000200	O	La	<	0.016000	M	Re	<	0.000100	M	Tm	<	0.000100				
M	Cr		0.006900	O	Li	<	0.000430	M	Rh	<	0.000300	M	U	<	0.000100				
M	Cs	<	0.000200	M	Lu	<	0.000100	M	Ru	<	0.000310	M	V	<	0.000800				
M	Cu	<	0.000600	O	Mg		0.021000	n	S	<		M	W	<	0.000200				
M	Dy	<	0.000100	O	Mn		0.001900	s	Sb	<		M	Y	<	0.000100				
M	Er	<	0.000100	M	Mo	<	0.000500	O	Sc	<	0.002300	M	Yb	<	0.000100				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 121.75 +3 6 Sb(O)C4H4O6-1

Chemical Compatibility -Stable in conc. HCl, dilute or conc. HF. Stable in dilute HNO3 as the fluoride or tartrate complex. Avoid basic media. Stable with most metals and inorganic anions in acidic media as the tartrate provided the acidity is not too high or the acid is oxidizing causing loss of the stabilizing tartrate ion. The fluoride complex of antimony is stable in strong acid but you should only mix with other metals that are fluorinated.

Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-2% HNO3 / LDPE container.

Sb Containing Samples (Preparation and Solution) -Metal and alloys (Soluble in H2O / HF / HNO3 mixture); Oxides (Soluble in HCl and tartaric acid or H2O / HF / HNO3 mixtures); Ores (fusion with Na2CO3 in Pt0 followed by dissolving the fuseate in a H2O / HF / HNO3 mixture); Organic based (sulfuric acid / hydrogen peroxide digestion)

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 121 amu	5 ppt	N/A	105Pd16O, 89Y16O2
ICP-OES 206.833 nm	0.03/0.003 µg/mL	1	Ta, Cr, Ge, Hf
ICP-OES 217.581 nm	0.05/0.005 µg/mL	1	Nb, W, Re, Fe
ICP-OES 231.147 nm	0.06/0.006 µg/mL	1	Ni, Co, Pt

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

April 30, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- April 30, 2024

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

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ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGSE10
Lot Number:	P2-SE684206
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Selenium
Starting Material:	Se Metal
Starting Material Lot#:	1962
Starting Material Purity:	99.9991%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9992 ± 61 µg/mL

Density: 1.035 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9993 ± 67 µg/mL**
ICP Assay NIST SRM 3149 Lot Number: 100901

Assay Method #2 **9992 ± 73 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.002242	M	Eu	<	0.000373	O	Na		0.013700	s	Se	<		O	Zn		0.002382
M	Al		0.004465	M	Fe		0.008506	O	Nb	<	0.002975	O	Si		0.006270	M	Zr	<	0.001868
O	As	<	0.022040	M	Ga	<	0.000373	M	Nd	<	0.000373	M	Sm	<	0.000373				
M	Au	<	0.000373	M	Gd	<	0.000373	O	Ni		0.001849	M	Sn		0.000850				
O	B	<	0.007714	M	Ge	<	0.002616	M	Os	<	0.000373	M	Sr	<	0.001121				
M	Ba	<	0.001495	M	Hf	<	0.000373	O	P	<	0.022040	M	Ta	<	0.000373				
M	Be	<	0.001495	M	Hg	<	0.002240	M	Pb		0.006379	M	Tb	<	0.006353				
M	Bi	<	0.000373	M	Ho	<	0.000373	M	Pd	<	0.000373	M	Te	<	0.012707				
O	Ca		0.006552	M	In	<	0.000373	M	Pr	<	0.001495	M	Th	<	0.002990				
M	Cd		0.001169	M	Ir	<	0.000373	M	Pt	<	0.000373	M	Ti	<	0.003363				
M	Ce	<	0.000373	O	K		0.002006	M	Rb	<	0.001868	M	Tl		0.008613				
M	Co	<	0.000373	M	La	<	0.001121	M	Re	<	0.000373	M	Tm	<	0.000373				
M	Cr		0.002870	O	Li		0.000062	M	Rh	<	0.000373	M	U	<	0.000373				
M	Cs	<	0.001121	M	Lu	<	0.000373	M	Ru	<	0.001493	M	V	<	0.000747				
M	Cu	<	0.000747	O	Mg		0.001159	O	S		0.024674	M	W	<	0.002242				
M	Dy	<	0.000373	M	Mn	<	0.000373	M	Sb	<	0.002242	M	Y	<	0.000373				
M	Er	<	0.000373	O	Mo	<	0.003195	M	Sc	<	0.001121	M	Yb	<	0.000373				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 78.96 +4 6 H_2SeO_3

Chemical Compatibility -Soluble in HCl, HNO_3,H_3PO_4, H_2SO_4 and HF aqueous matrices and water. It is stable with most inorganic anions but many cationic metals form the insoluble selenites under pH neutral conditions. When fluorinated and/or under acidic conditions precipitation is typically not a problem at moderate to low concentrations.

Stability - 2-100 ppb levels stable for months alone or mixed with other elements at equivalent levels in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Se Containing Samples (Preparation and Solution) -Metal (soluble in HNO_3); Oxides (readily soluble in water); Minerals and alloys (acid digestion with HNO_3or HNO_3 / HF); Organic Matrices (acid digestion with hot concentrated H_2SO_4 accompanied by the careful dropwise addition of H_2O_2 until clear).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 82 amu	200 ppt	N/A	12C35Cl2
ICP-OES 196.026 nm	0.08/0.006 µg/mL	1	Fe
ICP-OES 203.985 nm	0.2/0.05 µg/mL	1	Sb, Ir, Cr, Ta
ICP-OES 206.279 nm	0.3/0.16 µg/mL	1	Cr, Pt

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

September 13, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **September 13, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

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ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGTL10
Lot Number:	R2-TL691937
Matrix:	5% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Thallium
Starting Material:	TlNO3
Starting Material Lot#:	2118
Starting Material Purity:	99.9998%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9987 ± 49 µg/mL

Density: 1.035 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9968 ± 68 µg/mL**
ICP Assay NIST SRM 3158 Lot Number: 151215

Assay Method #2 **10001 ± 58 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The follow ing equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.000200	M	Eu	<	0.000200	O	Na		0.002479	M	Se	<	0.011019	O	Zn		0.002288
O	Al	<	0.004184	O	Fe	<	0.002824	M	Nb	<	0.000200	O	Si		0.003744	M	Zr	<	0.000200
M	As	<	0.002003	M	Ga	<	0.000200	M	Nd	<	0.000200	M	Sm	<	0.000200				
O	Au	<	0.002824	M	Gd	<	0.000200	M	Ni		0.001717	M	Sn	<	0.000601				
O	B	<	0.004184	M	Ge	<	0.000801	M	Os	<	0.000198	O	Sr	<	0.000313				
M	Ba	<	0.000400	M	Hf	<	0.000200	O	P	<	0.010460	M	Ta	<	0.000200				
O	Be	<	0.000104	M	Hg	<	0.000794	M	Pb		0.000807	M	Tb	<	0.000200				
M	Bi	<	0.005209	M	Ho	<	0.000200	M	Pd	<	0.000400	M	Te	<	0.005008				
O	Ca		0.002426	M	In	<	0.000200	M	Pr	<	0.000200	M	Th	<	0.000200				
M	Cd		0.001312	M	Ir	<	0.000198	M	Pt	<	0.000801	O	Ti	<	0.001255				
M	Ce	<	0.000200	O	K		0.006150	M	Rb	<	0.000200	s	Tl	<					
M	Co	<	0.000601	M	La	<	0.000200	M	Re	<	0.000200	M	Tm	<	0.000200				
M	Cr	<	0.000801	O	Li	<	0.000177	M	Rh	<	0.000200	M	U	<	0.000200				
M	Cs	<	0.003606	M	Lu	<	0.000200	M	Ru	<	0.000397	M	V	<	0.002203				
M	Cu	<	0.001001	O	Mg		0.000527	O	S	<	0.015690	M	W	<	0.000601				
M	Dy	<	0.000200	M	Mn	<	0.000801	M	Sb	<	0.000400	M	Y	<	0.000200				
M	Er	<	0.000200	M	Mo	<	0.001202	O	Sc	<	0.000711	M	Yb	<	0.000200				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 204.38 +1 6 Tl(H2O)61+

Chemical Compatibility - Soluble in HCl, HNO3, and H2SO4. Stable with most metals and inorganic anions. The sulfite, thiocyanate and oxalate are moderately soluble; the phosphate and arsenite are slightly soluble and the sulfide is insoluble.

Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5% HNO3 / LDPE container.

Tl Containing Samples (Preparation and Solution) -Metal (Best dissolved in HNO3 which forms chiefly the Tl1+ ion.); Oxide (The thallous oxide is readily soluble in water. The thallic oxide requires high levels of acid); Ores (Carbonate fusion in Pt0 followed by HCl dissolution); Organic Matrices (Sulfuric/peroxide digestion or dry ash and dissolution in HCl).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 205 amu	2 ppt	N/A	189Os16O
ICP-OES 190.864 nm	0.04 / 0.004 µg/mL	1	V, Ti
ICP-OES 276.787 nm	0.1 / 0.01 µg/mL	1	Ta, V, Fe, Cr
ICP-OES 351.924 nm	0.2 / 0.02 µg/mL	1	Th, Ce, Zr

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

April 08, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- April 08, 2024

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGV10
Lot Number:	R2-V688296
Matrix:	7% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Vanadium
Starting Material:	Vanadium pentoxide
Starting Material Lot#:	1782
Starting Material Purity:	99.9907%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10026 ± 30 µg/mL

Density: 1.105 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10025 ± 56 µg/mL**
ICP Assay NIST SRM 3165 Lot Number: 160906

Assay Method #2 **10027 ± 30 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.000510	M	Eu	<	0.000110	M	Na		0.095000	M	Se	<	0.002300	M	Zn		0.008900
O	Al		0.051000	O	Fe		0.350000	M	Nb	<	0.000710	O	Si		0.260000	M	Zr	<	0.002500
M	As	<	0.000410	M	Ga	<	0.007100	M	Nd	<	0.000210	M	Sm	<	0.000110				
M	Au	<	0.000410	M	Gd	<	0.000110	M	Ni		0.011000	M	Sn	<	0.003300				
M	B	<	0.006000	M	Ge	<	0.000110	M	Os	<	0.000410	M	Sr		0.001400				
M	Ba		0.001800	M	Hf	<	0.000110	O	P	<	0.120000	M	Ta	<	0.000110				
M	Be	<	0.000110	M	Hg	<	0.000310	M	Pb	<	0.002300	M	Tb	<	0.000110				
M	Bi	<	0.000610	M	Ho	<	0.000110	M	Pd	<	0.000610	M	Te	<	0.000610				
M	Ca		0.180000	M	In	<	0.000110	M	Pr	<	0.000110	M	Th	<	0.000210				
M	Cd	<	0.000410	M	Ir	<	0.000110	M	Pt	<	0.000410	M	Ti	<	0.021000				
M	Ce	<	0.000310	M	K		0.400000	M	Rb	<	0.000410	M	Tl	<	0.000110				
M	Co	<	0.001100	M	La	<	0.000110	M	Re	<	0.000110	M	Tm	<	0.000110				
O	Cr		0.190000	M	Li	<	0.001400	M	Rh	<	0.000110	M	U	<	0.000310				
M	Cs		0.005700	M	Lu	<	0.000110	M	Ru	<	0.000410	s	V	<					
M	Cu	<	0.001800	M	Mg		0.009200	n	S	<		M	W	<	0.003100				
M	Dy	<	0.000110	M	Mn		0.008700	M	Sb		0.076000	M	Y	<	0.000110				
M	Er	<	0.000110	M	Mo		0.086000	M	Sc	<	0.000310	M	Yb	<	0.000110				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 50.94 +5 6 H2V10O284-

Chemical Compatibility -Soluble in HCl, HNO3, H2SO4, HF, H3PO4 and strong basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO3 / LDPE container.

V Containing Samples (Preparation and Solution) -Metal (Fusion with NaOH or KOH in Ni0 or Na2CO3 / KNO3); Oxides (V2O3 - use HCl, V2O4 - use HCl or HNO3, V2O5 - use concentrated acids); Ores (Na2CO3 / KNO3 in Pt0 caution - nitrates attack Pto followed by water extraction of fuseate); Organic Matrices (Ash at 450 EC followed by dissolving according to V2O5 above) .

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 51 amu	4 ppt	N/A	34S16O1H, 35Cl16O, 38Ar13C, 36Ar15N, 36Ar14N1H, 37Cl14N,36S15N, 33S18O, 34S17O, 102Ru+2,02Pd+2
ICP-OES 290.882 nm	0.008 / 0.0008 µg/mL	1	Hf, Nb
ICP-OES 292.402 nm	0.006 / 0.001 µg/mL	1	Th
ICP-OES 309.311 nm	0.005 / 0.001 µg/mL	1	Mg, U, Th

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

March 01, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **March 01, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGZN10
Lot Number:	P2-ZN686137
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Zinc
Starting Material:	Zn Shot
Starting Material Lot#:	2201
Starting Material Purity:	99.9993%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10040 ± 30 µg/mL

Density: 1.033 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10009 ± 54 µg/mL**
ICP Assay NIST SRM 3168a Lot Number: 120629

Assay Method #2 **10049 ± 33 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **10041 ± 28 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.003057	M	Eu	<	0.000509	O	Na		0.001874	M	Se	<	0.023441	s	Zn	<
O	Al	<	0.005720	O	Fe		0.006348	M	Nb	<	0.000509	O	Si	<	0.057200	M	Zr	< 0.000509
M	As	<	0.003057	M	Ga	<	0.007134	M	Nd	<	0.000509	M	Sm	<	0.000509			
M	Au	<	0.000510	M	Gd	<	0.000509	M	Ni	<	0.000509	M	Sn	<	0.000509			
O	B	<	0.017160	M	Ge	<	0.003057	M	Os	<	0.000510	M	Sr	<	0.000509			
M	Ba	<	0.000509	M	Hf	<	0.000509	O	P	<	0.057200	M	Ta	<	0.000509			
M	Be	<	0.000509	M	Hg	<	0.001021	O	Pb		0.023870	M	Tb	<	0.000509			
M	Bi	<	0.005095	M	Ho	<	0.000509	M	Pd	<	0.002038	M	Te	<	0.023441			
O	Ca		0.033793	M	In	<	0.000509	M	Pr	<	0.000509	M	Th	<	0.000509			
O	Cd		0.003924	M	Ir	<	0.000510	M	Pt	<	0.000509	M	Ti	<	0.000509			
M	Ce	<	0.000509	O	K		0.001499	M	Rb	<	0.002038	M	Tl	<	0.009172			
M	Co	<	0.000509	M	La	<	0.000509	M	Re	<	0.000509	M	Tm	<	0.000509			
O	Cr		0.001549	O	Li	<	0.000457	M	Rh	<	0.000509	M	U	<	0.000509			
M	Cs	<	0.000509	M	Lu	<	0.000509	M	Ru	<	0.006129	M	V	<	0.000509			
O	Cu	<	0.010296	O	Mg		0.000349	O	S	<	0.034320	M	W	<	0.001019			
M	Dy	<	0.000509	M	Mn	<	0.000509	M	Sb	<	0.001019	M	Y	<	0.000509			
M	Er	<	0.000509	M	Mo	<	0.000509	M	Sc	<	0.000509	M	Yb	<	0.000509			

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 65.39 +2 4 Zn(OH)(aq)1+
Chemical Compatibility -Stable in HCl, HNO3, H2SO4 ,HF, H3PO4. Avoid basic media forming insoluble carbonate and hydroxide. Stable with most metals and inorganic anions in acidic media.
Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO3 / LDPE container.
Zn Containing Samples (Preparation and Solution) -Metal (soluble in HNO3); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO3); Organic based (dry ash at 4500C and dissolve ash in HCl) (sulfuric/peroxide acid digestion)
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 66 amu	7 ppt	N/A	50Ti16O,50Cr16O, 50V16O, 34S16O2, 32S16O18O, 32S17O2, 33S16O17O, 32S34S, 33S2
ICP-OES 202.548 nm	0.004/0.0002 µg/mL	1	Nb, Cu, Co, Hf
ICP-OES 206.200 nm	0.006/0.0006 µg/mL	1	Sb, Ta, Bi, Os
ICP-OES 213.856 nm	0.002/0.0004 µg/mL	1	Ni, Cu, V

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

December 05, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **December 05, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 6020B UCT-KED

HSA-59-9-10.5

Total Metals

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-01 A	SDG:	21I0042
Sampled:	08/30/21 11:55	Prepared:	09/21/21 12:40	File ID:	XDT_m1210922-036
% Solids:	38.24	Preparation:	SWN EPA 3050B	Analyzed:	09/22/21 17:12
Batch:	BJI0584	Sequence:	SJI0372	Initial/Final:	1.074 g Wet / 50 mL
Instrument:	ICPMS1			Calibration:	EI00074

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	MDL	MRL	Q
7440-50-8	Copper-63	65.4	50	1.06	3.04	D

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 6020B UCT-KED

HSA-60-9-10.5

Total Metals

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-02 A	SDG:	21I0042
Sampled:	08/30/21 14:20	Prepared:	09/21/21 12:40	File ID:	XDT_m1210922-035
% Solids:	27.05	Preparation:	SWN EPA 3050B	Analyzed:	09/22/21 17:02
Batch:	BJI0584	Sequence:	SJI0372	Initial/Final:	1.03 g Wet / 50 mL
Instrument:	ICPMS1			Calibration:	EI00074

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	MDL	MRL	Q
7440-50-8	Copper-63	49.2	50	1.56	4.49	D

PREPARATION BATCH SUMMARY

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Batch: BJI0584 Batch Matrix: Solid Preparation: SWN EPA 3050B

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
HSA-59-9-10.5	21I0042-01	XDT_m1210922-036	09/21/21 12:40	
HSA-60-9-10.5	21I0042-02	XDT_m1210922-035	09/21/21 12:40	
Blank	BJI0584-BLK1	XDT_m1210922-032	09/21/21 12:40	BJI0584 SWN
LCS	BJI0584-BS1	XDT_m1210922-034	09/21/21 12:40	BJI0584 SWN
HSA-59-9-10.5	BJI0584-DUP1	XDT_m1210922-037	09/21/21 12:40	BJI0584 SWN
HSA-59-9-10.5	BJI0584-MS1	XDT_m1210922-038	09/21/21 12:40	BJI0584 SWN
HSA-59-9-10.5	BJI0584-MSD1	XDT_m1210922-061	09/21/21 12:40	BJI0584 SWN

Form I

METHOD BLANK DATA SHEET

EPA 6020B UCT-KED

Total Metals

Blank

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Batch: BJI0584
Laboratory ID: BJI0584-BLK1
Prepared: 09/21/21 12:40
Matrix: Solid
Preparation: SWN EPA 3050B
Analyzed: 09/22/21 16:44
Sequence: SJI0372
Calibration: EI00074
Instrument: ICPMS1

CAS NO.	Analyte	Concentration (mg/kg wet)	Dilution Factor	MDL	MRL	Q
7440-50-8	Copper-63	ND	20	0.17	0.50	U
7440-50-8	Copper-65	ND	20	0.35	0.50	U

LCS / LCS DUPLICATE RECOVERY

EPA 6020B UCT-KED

Total Metals

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/22/21 16:57
Batch:	BJI0584	Laboratory ID:	BJI0584-BS1
Preparation:	SWN EPA 3050B	Sequence Name:	LCS
Initial/Final:	1 g / 50 mL		

COMPOUND	SPIKE ADDED (mg/kg wet)	LCS CONCENTRATION (mg/kg wet)	Q	LCS % REC. #	QC LIMITS REC.
Copper-63	25.0	25.9		104	80 - 120
Copper-65	25.0	25.6		102	80 - 120

* Indicates values outside of QC limits

DUPLICATES

EPA 6020B UCT-KED

Total Metals

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Solid
Laboratory ID: BJI0584-DUP1
Batch: BJI0584
Lab Source ID: 21I0042-01
Preparation: SWN EPA 3050B
Initial/Final: 1.074 g / 50 mL
Source Sample Name: HSA-59-9-10.5
% Solids: 38.24

ANALYTE	CONTROL LIMIT	SAMPLE CONCENTRATION (mg/kg dry)	C	DUPLICATE CONCENTRATION (mg/kg dry)	C	RPD %	Q
Copper-63	20	65.4	D	69.6	D	6.20	

*: Values outside of QC limits
L: Analyte concentration is <=5 times the reporting limit and the replicate control limit defaults to Dup = +/- RL instead of 20% RPD

MS / MS DUPLICATE RECOVERY

EPA 6020B UCT-KED

Total Metals

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/22/21 17:21
Batch:	BJI0584	Laboratory ID:	BJI0584-MS1
Preparation:	SWN EPA 3050B	Sequence Name:	Matrix Spike
Initial/Final:	1.071 g / 50 mL	Source Sample:	HSA-59-9-10.5

COMPOUND	SPIKE ADDED (mg/kg dry)	SAMPLE CONCENTRATION (mg/kg dry)	Q	MS CONCENTRATION (mg/kg dry)	Q	MS % REC. #		QC LIMITS REC.
Copper-63	61.0	65.4	D	107	*, D	68.7	*	75 - 125

* Values outside of QC limits

MS / MS DUPLICATE RECOVERY

EPA 6020B UCT-KED

Total Metals

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/22/21 19:55
Batch:	BJI0584	Laboratory ID:	BJI0584-MSD1
Preparation:	SWN EPA 3050B	Sequence Name:	Matrix Spike Dup
Initial/Final:	1.077 g / 50 mL	Source Sample:	HSA-59-9-10.5

COMPOUND	SPIKE ADDED (mg/kg dry)	MSD CONCENTRATION (mg/kg dry)	Q	MSD % REC. #	% RPD #		QC LIMITS RPD	QC LIMITS REC.
Copper-63	60.7	139	*, D	122	26.0	*	20	75 - 125

* Values outside of QC limits

INITIAL CALIBRATION DATA

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EI00074
Instrument: ICPMS1
Calibration Date: 09/22/2021 14:30

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
		RF		RF		RF		RF		RF		RF
Copper-63	0	0	0.5	1236	10	1292.7	20	1265.8	50	1229.96	100	1185.36
Copper-65	0	0	0.5	698	10	692.6	20	668.15	50	640.36	100	629

INITIAL CALIBRATION DATA

EPA 6020B UCT-KED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EI00074	Instrument:	ICPMS1
Calibration Date:	09/22/2021 14:30		

COMPOUND	Mean RF	RF RSD	Linear COD	Quad COD	COD Limit	Q
Copper-63	1034.97	49.1	0.9996		0.998	
Copper-65	554.685	49.2	0.9998		0.998	

INITIAL AND CONTINUING CALIBRATION CHECK

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: ICPMS1
Calibration: EI00074
Control Limt: +/- 10.00%
Sequence: SJI0372

Lab Sample ID	Analyte	True	Found	%R	Units	Method
SJI0372-ICV1	Copper-63	50.000	50.0	100	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	49.8	99.7	ug/L	PA 6020B UCT-KE
SJI0372-CCV1	Copper-63	50.000	49.5	99.0	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	49.4	98.9	ug/L	PA 6020B UCT-KE
SJI0372-CCV2	Copper-63	50.000	50.7	101	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	50.3	101	ug/L	PA 6020B UCT-KE
SJI0372-CCV3	Copper-63	50.000	50.6	101	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	51.1	102	ug/L	PA 6020B UCT-KE
SJI0372-CCV4	Copper-63	50.000	51.7	103	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	51.4	103	ug/L	PA 6020B UCT-KE
SJI0372-CCV5	Copper-63	50.000	49.7	99.3	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	49.2	98.5	ug/L	PA 6020B UCT-KE
SJI0372-CCV6	Copper-63	50.000	50.4	101	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	50.7	101	ug/L	PA 6020B UCT-KE
SJI0372-CCV7	Copper-63	50.000	51.7	103	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	51.5	103	ug/L	PA 6020B UCT-KE
SJI0372-CCV8	Copper-63	50.000	51.4	103	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	51.2	102	ug/L	PA 6020B UCT-KE
SJI0372-CCV9	Copper-63	50.000	51.2	102	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	50.8	102	ug/L	PA 6020B UCT-KE
SJI0372-CCVA	Copper-63	50.000	52.6	105	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	52.6	105	ug/L	PA 6020B UCT-KE
SJI0372-CCVB	Copper-63	50.000	52.7	105	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	52.3	105	ug/L	PA 6020B UCT-KE
SJI0372-CCVC	Copper-63	50.000	52.9	106	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	52.9	106	ug/L	PA 6020B UCT-KE
SJI0372-CCVD	Copper-63	50.000	52.7	105	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	52.7	105	ug/L	PA 6020B UCT-KE
SJI0372-CCVE	Copper-63	50.000	51.2	102	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	51.3	103	ug/L	PA 6020B UCT-KE
SJI0372-CCVF	Copper-63	50.000	51.1	102	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	50.1	100	ug/L	PA 6020B UCT-KE
SJI0372-CCVG	Copper-63	50.000	51.3	103	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	50.5	101	ug/L	PA 6020B UCT-KE

INITIAL AND CONTINUING CALIBRATION CHECK

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: ICPMS1
Calibration: EI00074
Control Limt: +/- 10.00%
Sequence: SJI0372

Lab Sample ID	Analyte	True	Found	%R	Units	Method
SJI0372-CCVH	Copper-63	50.000	51.6	103	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	51.5	103	ug/L	PA 6020B UCT-KE
SJI0372-CCVI	Copper-63	50.000	51.7	103	ug/L	PA 6020B UCT-KE
	Copper-65	50.000	51.3	103	ug/L	PA 6020B UCT-KE

* Values outside of QC limits

INSTRUMENT BLANKS
EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: ICPMS1
Calibration: EI00074
Sequence: SJI0372
Date Analyzed: 09/22/21 15:03

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SJI0372-IBL1	Copper-63	0.00700	0.173	0.500	ug/L	
SJI0372-IBL1	Copper-65	-0.00600	0.35	0.500	ug/L	
SJI0372-ICB1	Copper-63	0.00100	0.173	0.500	ug/L	
SJI0372-ICB1	Copper-65	-0.00100	0.35	0.500	ug/L	
SJI0372-CCB1	Copper-63	0.00200	0.173	0.500	ug/L	
SJI0372-CCB1	Copper-65	0.00300	0.35	0.500	ug/L	
SJI0372-IBL2	Copper-63	0.0200	0.173	0.500	ug/L	
SJI0372-IBL2	Copper-65	0.0120	0.35	0.500	ug/L	
SJI0372-IBL3	Copper-63	0.00300	0.173	0.500	ug/L	
SJI0372-IBL3	Copper-65	0.00300	0.35	0.500	ug/L	
SJI0372-CCB2	Copper-63	0.0120	0.173	0.500	ug/L	
SJI0372-CCB2	Copper-65	0.00	0.35	0.500	ug/L	
SJI0372-CCB3	Copper-63	0.00500	0.173	0.500	ug/L	
SJI0372-CCB3	Copper-65	-0.00300	0.35	0.500	ug/L	
SJI0372-IBL4	Copper-63	0.0140	0.173	0.500	ug/L	
SJI0372-IBL4	Copper-65	0.00900	0.35	0.500	ug/L	
SJI0372-IBL5	Copper-63	0.00800	0.173	0.500	ug/L	
SJI0372-IBL5	Copper-65	0.0180	0.35	0.500	ug/L	
SJI0372-CCB4	Copper-63	0.0110	0.173	0.500	ug/L	
SJI0372-CCB4	Copper-65	-0.00400	0.35	0.500	ug/L	
SJI0372-CCB5	Copper-63	0.00500	0.173	0.500	ug/L	
SJI0372-CCB5	Copper-65	0.00800	0.35	0.500	ug/L	
SJI0372-IBL6	Copper-63	0.00500	0.173	0.500	ug/L	
SJI0372-IBL6	Copper-65	-0.00500	0.35	0.500	ug/L	
SJI0372-CCB6	Copper-63	-0.00400	0.173	0.500	ug/L	
SJI0372-CCB6	Copper-65	-0.00800	0.35	0.500	ug/L	
SJI0372-IBL7	Copper-63	0.00500	0.173	0.500	ug/L	
SJI0372-IBL7	Copper-65	0.00100	0.35	0.500	ug/L	
SJI0372-IBL8	Copper-63	0.0280	0.173	0.500	ug/L	
SJI0372-IBL8	Copper-65	0.0190	0.35	0.500	ug/L	
SJI0372-CCB7	Copper-63	0.00	0.173	0.500	ug/L	
SJI0372-CCB7	Copper-65	-0.00900	0.35	0.500	ug/L	
SJI0372-IBL9	Copper-63	0.00200	0.173	0.500	ug/L	
SJI0372-IBL9	Copper-65	-0.0120	0.35	0.500	ug/L	

INSTRUMENT BLANKS
EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
Client: GeoEngineers
Instrument ID: ICPMS1
Sequence: SJI0372

SDG: 21I0042
Project: South State Street PRDI
Calibration: EI00074
Date Analyzed: 09/22/21 22:48

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SJI0372-CCB8	Copper-63	0.00	0.173	0.500	ug/L	
SJI0372-CCB8	Copper-65	-0.00600	0.35	0.500	ug/L	
SJI0372-CCB9	Copper-63	0.0130	0.173	0.500	ug/L	
SJI0372-CCB9	Copper-65	-0.00600	0.35	0.500	ug/L	
SJI0372-IBLA	Copper-63	0.00800	0.173	0.500	ug/L	
SJI0372-IBLA	Copper-65	0.0140	0.35	0.500	ug/L	
SJI0372-CCBA	Copper-63	0.00700	0.173	0.500	ug/L	
SJI0372-CCBA	Copper-65	0.00100	0.35	0.500	ug/L	
SJI0372-IBLB	Copper-63	-0.00200	0.173	0.500	ug/L	
SJI0372-IBLB	Copper-65	0.00300	0.35	0.500	ug/L	
SJI0372-CCBB	Copper-63	0.0120	0.173	0.500	ug/L	
SJI0372-CCBB	Copper-65	0.00900	0.35	0.500	ug/L	
SJI0372-IBLC	Copper-63	0.00400	0.173	0.500	ug/L	
SJI0372-IBLC	Copper-65	0.0100	0.35	0.500	ug/L	
SJI0372-CCBC	Copper-63	0.00	0.173	0.500	ug/L	
SJI0372-CCBC	Copper-65	-0.00200	0.35	0.500	ug/L	
SJI0372-IBLD	Copper-63	0.00800	0.173	0.500	ug/L	
SJI0372-IBLD	Copper-65	0.00500	0.35	0.500	ug/L	
SJI0372-CCBD	Copper-63	-0.00600	0.173	0.500	ug/L	
SJI0372-CCBD	Copper-65	0.00600	0.35	0.500	ug/L	
SJI0372-CCBE	Copper-63	-0.00900	0.173	0.500	ug/L	
SJI0372-CCBE	Copper-65	0.00	0.35	0.500	ug/L	
SJI0372-IBLE	Copper-63	-0.00600	0.173	0.500	ug/L	
SJI0372-IBLE	Copper-65	0.00900	0.35	0.500	ug/L	
SJI0372-CCBF	Copper-63	0.00	0.173	0.500	ug/L	
SJI0372-CCBF	Copper-65	0.00700	0.35	0.500	ug/L	
SJI0372-IBLF	Copper-63	-0.00500	0.173	0.500	ug/L	
SJI0372-IBLF	Copper-65	0.0190	0.35	0.500	ug/L	
SJI0372-CCBG	Copper-63	-0.00100	0.173	0.500	ug/L	
SJI0372-CCBG	Copper-65	0.0120	0.35	0.500	ug/L	
SJI0372-IBLG	Copper-63	0.00100	0.173	0.500	ug/L	
SJI0372-IBLG	Copper-65	0.00500	0.35	0.500	ug/L	
SJI0372-CCBH	Copper-63	-0.00200	0.173	0.500	ug/L	
SJI0372-CCBH	Copper-65	0.00900	0.35	0.500	ug/L	

INSTRUMENT BLANKS
EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: ICPMS1
Calibration: EI00074
Sequence: SJI0372
Date Analyzed: 09/23/21 05:55

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SJI0372-IBLH	Copper-63	0.00	0.173	0.500	ug/L	
SJI0372-IBLH	Copper-65	0.00500	0.35	0.500	ug/L	
SJI0372-IBLI	Copper-63	0.00	0.173	0.500	ug/L	
SJI0372-IBLI	Copper-65	0.0100	0.35	0.500	ug/L	
SJI0372-CCBI	Copper-63	-0.0110	0.173	0.500	ug/L	
SJI0372-CCBI	Copper-65	0.00300	0.35	0.500	ug/L	

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0372
Instrument: ICPMS1
Calibration: EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
CAL 0	SJI0372-CAL1	XDT_m1210922-009	NA	09/22/21 14:30
CAL 1 - LOW CHECK	SJI0372-CAL2	XDT_m1210922-010	NA	09/22/21 14:35
CAL 2	SJI0372-CAL3	XDT_m1210922-011	NA	09/22/21 14:39
CAL 3	SJI0372-CAL4	XDT_m1210922-012	NA	09/22/21 14:44
CAL 4	SJI0372-CAL5	XDT_m1210922-013	NA	09/22/21 14:49
CAL 5	SJI0372-CAL6	XDT_m1210922-014	NA	09/22/21 14:56
RINSE	SJI0372-IBL1	XDT_m1210922-015	NA	09/22/21 15:03
Initial Cal Check	SJI0372-ICV1	XDT_m1210922-017	NA	09/22/21 15:09
Initial Cal Blank	SJI0372-ICB1	XDT_m1210922-018	NA	09/22/21 15:16
Calibration Check	SJI0372-CCV1	XDT_m1210922-019	NA	09/22/21 15:21
Calibration Blank	SJI0372-CCB1	XDT_m1210922-020	NA	09/22/21 15:28
Instrument RL Check	SJI0372-CRL1	XDT_m1210922-021	NA	09/22/21 15:37
Interference Check A	SJI0372-IFA1	XDT_m1210922-022	NA	09/22/21 15:46
Interference Check B	SJI0372-IFB1	XDT_m1210922-023	NA	09/22/21 15:50
LR200	SJI0372-HCV1	XDT_m1210922-024	NA	09/22/21 15:55
LR300	SJI0372-HCV2	XDT_m1210922-025	NA	09/22/21 15:59
Instrument Blank	SJI0372-IBL2	XDT_m1210922-026	NA	09/22/21 16:07
Instrument Blank	SJI0372-IBL3	XDT_m1210922-027	NA	09/22/21 16:13
Calibration Check	SJI0372-CCV2	XDT_m1210922-028	NA	09/22/21 16:21
Calibration Blank	SJI0372-CCB2	XDT_m1210922-029	NA	09/22/21 16:29
Blank	BJI0584-BLK1	XDT_m1210922-032	Solid	09/22/21 16:44
LCS	BJI0584-BS1	XDT_m1210922-034	Solid	09/22/21 16:57
HSA-60-9-10.5	21I0042-02	XDT_m1210922-035	Solid	09/22/21 17:02
HSA-59-9-10.5	21I0042-01	XDT_m1210922-036	Solid	09/22/21 17:12
HSA-59-9-10.5	BJI0584-DUP1	XDT_m1210922-037	Solid	09/22/21 17:16
HSA-59-9-10.5	BJI0584-DUP1	XDT_m1210922-037	Solid	09/22/21 17:16
HSA-59-9-10.5	BJI0584-MS1	XDT_m1210922-038	Solid	09/22/21 17:21
HSA-59-9-10.5	BJI0584-MS1	XDT_m1210922-038	Solid	09/22/21 17:21
Calibration Check	SJI0372-CCV3	XDT_m1210922-040	NA	09/22/21 17:35

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0372
Instrument: ICPMS1
Calibration: EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Calibration Blank	SJI0372-CCB3	XDT_m1210922-041	NA	09/22/21 17:43
ZZZZZ	21H0321-12	XDT_m1210922-045	Solid	09/22/21 18:06
ZZZZZ	21H0321-12	XDT_m1210922-045	Solid	09/22/21 18:06
ZZZZZ	21H0340-26	XDT_m1210922-046	Solid	09/22/21 18:13
ZZZZZ	21H0340-26	XDT_m1210922-046	Solid	09/22/21 18:13
Instrument Blank	SJI0372-IBL4	XDT_m1210922-047	NA	09/22/21 18:22
Instrument Blank	SJI0372-IBL5	XDT_m1210922-051	NA	09/22/21 18:46
Calibration Check	SJI0372-CCV4	XDT_m1210922-052	NA	09/22/21 18:54
Calibration Blank	SJI0372-CCB4	XDT_m1210922-053	NA	09/22/21 19:04
Calibration Check	SJI0372-CCV5	XDT_m1210922-055	NA	09/22/21 19:14
Calibration Blank	SJI0372-CCB5	XDT_m1210922-056	NA	09/22/21 19:22
HSA-59-9-10.5	BJI0584-MSD1	XDT_m1210922-061	Solid	09/22/21 19:55
HSA-59-9-10.5	BJI0584-MSD1	XDT_m1210922-061	Solid	09/22/21 19:55
Instrument Blank	SJI0372-IBL6	XDT_m1210922-066	NA	09/22/21 20:23
Calibration Check	SJI0372-CCV6	XDT_m1210922-067	NA	09/22/21 20:29
Calibration Blank	SJI0372-CCB6	XDT_m1210922-068	NA	09/22/21 20:36
Instrument Blank	SJI0372-IBL7	XDT_m1210922-073	NA	09/22/21 21:05
ZZZZZ	21I0074-08	XDT_m1210922-074	Water	09/22/21 21:10
ZZZZZ	21I0074-08	XDT_m1210922-074	Water	09/22/21 21:10
Instrument Blank	SJI0372-IBL8	XDT_m1210922-078	NA	09/22/21 21:33
Calibration Check	SJI0372-CCV7	XDT_m1210922-079	NA	09/22/21 21:38
Calibration Blank	SJI0372-CCB7	XDT_m1210922-080	NA	09/22/21 21:45
ZZZZZ	21I0074-02	XDT_m1210922-081	Water	09/22/21 21:50
ZZZZZ	21I0074-02	XDT_m1210922-081	Water	09/22/21 21:50
ZZZZZ	21I0074-04	XDT_m1210922-082	Water	09/22/21 21:54
ZZZZZ	21I0074-04	XDT_m1210922-082	Water	09/22/21 21:54
ZZZZZ	21I0074-06	XDT_m1210922-083	Water	09/22/21 21:59
ZZZZZ	21I0074-06	XDT_m1210922-083	Water	09/22/21 21:59
ZZZZZ	21I0074-06	XDT_m1210922-083	Water	09/22/21 21:59

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0372
Instrument: ICPMS1
Calibration: EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
ZZZZZ	21I0074-10	XDT_m1210922-084	Water	09/22/21 22:03
ZZZZZ	21I0074-10	XDT_m1210922-084	Water	09/22/21 22:03
ZZZZZ	21I0074-10	XDT_m1210922-084	Water	09/22/21 22:03
ZZZZZ	21I0074-12	XDT_m1210922-085	Water	09/22/21 22:08
ZZZZZ	21I0074-12	XDT_m1210922-085	Water	09/22/21 22:08
ZZZZZ	21I0074-14	XDT_m1210922-086	Water	09/22/21 22:13
ZZZZZ	21I0074-14	XDT_m1210922-086	Water	09/22/21 22:13
ZZZZZ	21I0074-14	XDT_m1210922-086	Water	09/22/21 22:13
ZZZZZ	21I0074-16	XDT_m1210922-087	Water	09/22/21 22:17
ZZZZZ	21I0074-16	XDT_m1210922-087	Water	09/22/21 22:17
ZZZZZ	21I0074-16	XDT_m1210922-087	Water	09/22/21 22:17
ZZZZZ	21I0074-18	XDT_m1210922-088	Water	09/22/21 22:22
ZZZZZ	21I0074-20	XDT_m1210922-089	Water	09/22/21 22:28
ZZZZZ	21I0074-20	XDT_m1210922-089	Water	09/22/21 22:28
ZZZZZ	21I0074-20	XDT_m1210922-089	Water	09/22/21 22:28
Instrument Blank	SJI0372-IBL9	XDT_m1210922-090	NA	09/22/21 22:36
Calibration Check	SJI0372-CCV8	XDT_m1210922-091	NA	09/22/21 22:41
Calibration Blank	SJI0372-CCB8	XDT_m1210922-092	NA	09/22/21 22:48
Calibration Check	SJI0372-CCV9	XDT_m1210922-094	NA	09/22/21 22:57
Calibration Blank	SJI0372-CCB9	XDT_m1210922-095	NA	09/22/21 23:05
ZZZZZ	21I0074-22	XDT_m1210922-098	Water	09/22/21 23:19
ZZZZZ	21I0074-22	XDT_m1210922-098	Water	09/22/21 23:19
ZZZZZ	21I0074-22	XDT_m1210922-098	Water	09/22/21 23:19
ZZZZZ	21I0074-24	XDT_m1210922-099	Water	09/22/21 23:23
ZZZZZ	21I0074-24	XDT_m1210922-099	Water	09/22/21 23:23
ZZZZZ	21I0074-24	XDT_m1210922-099	Water	09/22/21 23:23
ZZZZZ	21I0074-26	XDT_m1210922-100	Water	09/22/21 23:27
ZZZZZ	21I0074-26	XDT_m1210922-100	Water	09/22/21 23:27
ZZZZZ	21I0074-26	XDT_m1210922-100	Water	09/22/21 23:27

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0372
Instrument: ICPMS1
Calibration: EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
ZZZZZ	21I0074-30	XDT_m1210922-101	Water	09/22/21 23:31
ZZZZZ	21I0074-30	XDT_m1210922-101	Water	09/22/21 23:31
ZZZZZ	21I0074-30	XDT_m1210922-101	Water	09/22/21 23:31
Instrument Blank	SJI0372-IBLA	XDT_m1210922-105	NA	09/22/21 23:51
Calibration Check	SJI0372-CCVA	XDT_m1210922-106	NA	09/22/21 23:55
Calibration Blank	SJI0372-CCBA	XDT_m1210922-107	NA	09/23/21 00:02
ZZZZZ	21I0074-28	XDT_m1210922-108	Water	09/23/21 00:06
ZZZZZ	21I0074-28	XDT_m1210922-108	Water	09/23/21 00:06
ZZZZZ	21I0074-28	XDT_m1210922-108	Water	09/23/21 00:06
ZZZZZ	21I0060-04	XDT_m1210922-109	Water	09/23/21 00:10
ZZZZZ	21I0060-04	XDT_m1210922-109	Water	09/23/21 00:10
ZZZZZ	21I0060-06	XDT_m1210922-110	Water	09/23/21 00:13
ZZZZZ	21I0060-06	XDT_m1210922-110	Water	09/23/21 00:13
ZZZZZ	21I0060-06	XDT_m1210922-110	Water	09/23/21 00:13
ZZZZZ	21I0060-08	XDT_m1210922-111	Water	09/23/21 00:17
ZZZZZ	21I0060-08	XDT_m1210922-111	Water	09/23/21 00:17
ZZZZZ	21I0060-08	XDT_m1210922-111	Water	09/23/21 00:17
ZZZZZ	21I0060-10	XDT_m1210922-112	Water	09/23/21 00:21
ZZZZZ	21I0060-10	XDT_m1210922-112	Water	09/23/21 00:21
ZZZZZ	21I0060-02	XDT_m1210922-113	Water	09/23/21 00:25
ZZZZZ	21I0060-02	XDT_m1210922-113	Water	09/23/21 00:25
ZZZZZ	21I0060-02	XDT_m1210922-113	Water	09/23/21 00:25
Instrument Blank	SJI0372-IBLB	XDT_m1210922-117	NA	09/23/21 00:45
Calibration Check	SJI0372-CCVB	XDT_m1210922-118	NA	09/23/21 00:50
Calibration Blank	SJI0372-CCBB	XDT_m1210922-119	NA	09/23/21 00:56
ZZZZZ	21I0060-12	XDT_m1210922-120	Water	09/23/21 01:00
ZZZZZ	21I0060-12	XDT_m1210922-120	Water	09/23/21 01:00
ZZZZZ	21I0060-14	XDT_m1210922-121	Water	09/23/21 01:04
ZZZZZ	21I0060-14	XDT_m1210922-121	Water	09/23/21 01:04

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0372
Instrument: ICPMS1
Calibration: EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
ZZZZZ	21I0060-16	XDT_m1210922-122	Water	09/23/21 01:08
ZZZZZ	21I0060-16	XDT_m1210922-122	Water	09/23/21 01:08
ZZZZZ	21I0060-18	XDT_m1210922-123	Water	09/23/21 01:11
ZZZZZ	21I0060-18	XDT_m1210922-123	Water	09/23/21 01:11
ZZZZZ	21I0060-20	XDT_m1210922-124	Water	09/23/21 01:15
ZZZZZ	21I0060-20	XDT_m1210922-124	Water	09/23/21 01:15
ZZZZZ	21I0060-03	XDT_m1210922-125	Water	09/23/21 01:19
ZZZZZ	21I0060-03	XDT_m1210922-125	Water	09/23/21 01:19
ZZZZZ	21I0060-05	XDT_m1210922-126	Water	09/23/21 01:23
ZZZZZ	21I0060-05	XDT_m1210922-126	Water	09/23/21 01:23
ZZZZZ	21I0060-05	XDT_m1210922-126	Water	09/23/21 01:23
ZZZZZ	21I0060-07	XDT_m1210922-127	Water	09/23/21 01:27
ZZZZZ	21I0060-07	XDT_m1210922-127	Water	09/23/21 01:27
ZZZZZ	21I0060-07	XDT_m1210922-127	Water	09/23/21 01:27
ZZZZZ	21I0060-09	XDT_m1210922-128	Water	09/23/21 01:32
ZZZZZ	21I0060-09	XDT_m1210922-128	Water	09/23/21 01:32
Instrument Blank	SJI0372-IBLC	XDT_m1210922-129	NA	09/23/21 01:40
Calibration Check	SJI0372-CCVC	XDT_m1210922-130	NA	09/23/21 01:44
Calibration Blank	SJI0372-CCBC	XDT_m1210922-131	NA	09/23/21 01:50
ZZZZZ	21I0060-11	XDT_m1210922-132	Water	09/23/21 01:54
ZZZZZ	21I0060-11	XDT_m1210922-132	Water	09/23/21 01:54
ZZZZZ	21I0060-13	XDT_m1210922-133	Water	09/23/21 01:58
ZZZZZ	21I0060-13	XDT_m1210922-133	Water	09/23/21 01:58
ZZZZZ	21I0060-15	XDT_m1210922-134	Water	09/23/21 02:02
ZZZZZ	21I0060-15	XDT_m1210922-134	Water	09/23/21 02:02
ZZZZZ	21I0060-17	XDT_m1210922-135	Water	09/23/21 02:06
ZZZZZ	21I0060-17	XDT_m1210922-135	Water	09/23/21 02:06
ZZZZZ	21I0060-19	XDT_m1210922-136	Water	09/23/21 02:09
ZZZZZ	21I0060-19	XDT_m1210922-136	Water	09/23/21 02:09

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0372
Instrument: ICPMS1
Calibration: EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
ZZZZZ	21I0079-08	XDT_m1210922-137	Water	09/23/21 02:13
ZZZZZ	21I0079-08	XDT_m1210922-137	Water	09/23/21 02:13
ZZZZZ	21I0079-08	XDT_m1210922-137	Water	09/23/21 02:13
ZZZZZ	21I0079-08	XDT_m1210922-137	Water	09/23/21 02:13
ZZZZZ	21I0079-08	XDT_m1210922-137	Water	09/23/21 02:13
ZZZZZ	21I0079-08	XDT_m1210922-137	Water	09/23/21 02:13
Instrument Blank	SJI0372-IBLD	XDT_m1210922-141	NA	09/23/21 02:34
Calibration Check	SJI0372-CCVD	XDT_m1210922-142	NA	09/23/21 02:38
Calibration Blank	SJI0372-CCBD	XDT_m1210922-143	NA	09/23/21 02:44
Calibration Check	SJI0372-CCVE	XDT_m1210922-145	NA	09/23/21 02:52
Calibration Blank	SJI0372-CCBE	XDT_m1210922-146	NA	09/23/21 02:59
Instrument Blank	SJI0372-IBLE	XDT_m1210922-156	NA	09/23/21 03:42
Calibration Check	SJI0372-CCVF	XDT_m1210922-157	NA	09/23/21 03:46
Calibration Blank	SJI0372-CCBF	XDT_m1210922-158	NA	09/23/21 03:53
ZZZZZ	21I0102-01	XDT_m1210922-165	Water	09/23/21 04:20
ZZZZZ	21I0102-01	XDT_m1210922-165	Water	09/23/21 04:20
ZZZZZ	21I0102-01	XDT_m1210922-165	Water	09/23/21 04:20
ZZZZZ	21I0102-01	XDT_m1210922-165	Water	09/23/21 04:20
Instrument Blank	SJI0372-IBLF	XDT_m1210922-168	NA	09/23/21 04:37
Calibration Check	SJI0372-CCVG	XDT_m1210922-169	NA	09/23/21 04:41
Calibration Blank	SJI0372-CCBG	XDT_m1210922-170	NA	09/23/21 04:47
Instrument Blank	SJI0372-IBLG	XDT_m1210922-179	NA	09/23/21 05:28
Calibration Check	SJI0372-CCVH	XDT_m1210922-180	NA	09/23/21 05:32
Calibration Blank	SJI0372-CCBH	XDT_m1210922-181	NA	09/23/21 05:38
ZZZZZ	21I0092-02	XDT_m1210922-182	Water	09/23/21 05:42
ZZZZZ	21I0092-02	XDT_m1210922-182	Water	09/23/21 05:42
ZZZZZ	21I0092-02	XDT_m1210922-182	Water	09/23/21 05:42
ZZZZZ	21I0092-04	XDT_m1210922-183	Water	09/23/21 05:47
ZZZZZ	21I0092-04	XDT_m1210922-183	Water	09/23/21 05:47

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 6020B UCT-KED

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Sequence:	SJI0372	Instrument:	ICPMS1
		Calibration:	EI00074

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
ZZZZZ	21I0092-04	XDT_m1210922-183	Water	09/23/21 05:47
ZZZZZ	21I0092-04	XDT_m1210922-183	Water	09/23/21 05:47
ZZZZZ	21I0092-04	XDT_m1210922-183	Water	09/23/21 05:47
Instrument Blank	SJI0372-IBLH	XDT_m1210922-184	NA	09/23/21 05:55
ZZZZZ	21I0092-01	XDT_m1210922-185	Water	09/23/21 05:59
ZZZZZ	21I0092-01	XDT_m1210922-185	Water	09/23/21 05:59
ZZZZZ	21I0092-01	XDT_m1210922-185	Water	09/23/21 05:59
ZZZZZ	21I0092-03	XDT_m1210922-186	Water	09/23/21 06:04
ZZZZZ	21I0092-03	XDT_m1210922-186	Water	09/23/21 06:04
ZZZZZ	21I0092-03	XDT_m1210922-186	Water	09/23/21 06:04
ZZZZZ	21I0092-03	XDT_m1210922-186	Water	09/23/21 06:04
ZZZZZ	21I0092-03	XDT_m1210922-186	Water	09/23/21 06:04
Instrument Blank	SJI0372-IBLI	XDT_m1210922-187	NA	09/23/21 06:11
Calibration Check	SJI0372-CCVI	XDT_m1210922-188	NA	09/23/21 06:16
Calibration Blank	SJI0372-CCBI	XDT_m1210922-189	NA	09/23/21 06:22

ICP INTERFERENCE CHECK SAMPLE

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: ICPMS1
Calibration: EI00074
Sequence: SJI0372
Standard ID: J009989

Lab Sample ID	Analyte	True	Found	%R	Units
SJI0372-IFA1	Copper-63	0	0.0560		ug/L
	Copper-65	0	0.0520		ug/L

* Indicates %R outside of QC limits
NOTE: True value and %R are populated only for analytes found in the interference check standards, and will be seen only if those analytes were requested.

ICP INTERFERENCE CHECK SAMPLE

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: ICPMS1
Calibration: EI00074
Sequence: SJI0372
Standard ID: J009989

Lab Sample ID	Analyte	True	Found	%R	Units
SJI0372-IFB1	Copper-63	20.000	20.058	100	ug/L
	Copper-65	20.000	19.968	99.8	ug/L

* Indicates %R outside of QC limits
NOTE: True value and %R are populated only for analytes found in the interference check standards, and will be seen only if those analytes were requested.

DETECTION LEVEL STANDARD
EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: ICPMS1
Calibration: EI00074
Sequence: SJI0372
Lab Sample ID: SJI0372-CRL1

Analyte	True	Found	%R	Units	QC Limts
Copper-63	0.50000	0.488	97.6	ug/L	50 - 150
Copper-65	0.50000	0.514	103	ug/L	50 - 150

* Values outside of QC limits

HIGH-CONCENTRATION CALIBRATION VERIFICATION

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EI00074
Laboratory ID: SJI0372-HCV1
Sequence: SJI0372
Standard ID: J009626

ANALYTE	EXPECTED (ug/L)	FOUND (ug/L)	% DRIFT	QC LIMIT
Copper-63	200.00	200	-0.2	10.00
Copper-65	200.00	199	-0.7	10.00

* Values outside of QC limits

HIGH-CONCENTRATION CALIBRATION VERIFICATION

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EI00074
Laboratory ID: SJI0372-HCV2
Sequence: SJI0372
Standard ID: J009063

ANALYTE	EXPECTED (ug/L)	FOUND (ug/L)	% DRIFT	QC LIMIT
Copper-63	300.00	293	-2.4	10.00
Copper-65	300.00	291	-2.9	10.00

* Values outside of QC limits

HOLDING TIME SUMMARY

Analysis: EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
HSA-59-9-10.5 21I0042-01	08/30/21 11:55	09/02/21 10:52	09/21/21 12:40	22	180	09/22/21 17:12	23	180	
HSA-60-9-10.5 21I0042-02	08/30/21 14:20	09/02/21 10:52	09/21/21 12:40	21	180	09/22/21 17:02	23	180	
Duplicate BJI0584-DUP1	08/30/21 11:55	09/02/21 10:52	09/21/21 12:40	22	180	09/22/21 17:16	23	180	
Matrix Spike BJI0584-MS1	08/30/21 11:55	09/02/21 10:52	09/21/21 12:40	22	180	09/22/21 17:21	23	180	
Matrix Spike Dup BJI0584-MSD1	08/30/21 11:55	09/02/21 10:52	09/21/21 12:40	22	180	09/22/21 19:55	23	180	

* Indicates hold time exceedance.

METHOD DETECTION AND REPORTING LIMITS

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Solid
Instrument: ICPMS1

Analyte	MDL	RL	Units
Copper-63	0.17	0.50	mg/kg
Copper-65	0.35	0.50	mg/kg

METHOD DETECTION AND REPORTING LIMITS

EPA 6020B UCT-KED

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Water
Instrument: ICPMS1

Analyte	MDL	RL	Units
Copper-63	0.173	0.500	ug/L
Copper-65	0.350	0.500	ug/L

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGAG10
Lot Number:	P2-AG679501
Matrix:	7% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Silver
Starting Material:	Ag Shot
Starting Material Lot#:	2217
Starting Material Purity:	99.9993%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9996 ± 30 µg/mL

Density: 1.053 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10015 ± 56 µg/mL**
ICP Assay NIST SRM 3151 Lot Number: 160729

Assay Method #2 **9992 ± 25 µg/mL**
Volhard NIST SRM 999c Lot Number: 999c

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

s	Ag	<		M	Eu	<	0.000253	O	Na		0.005562	M	Se	<	0.018179	M	Zn		0.005799
O	Al		0.006295	O	Fe		0.002932	M	Nb	<	0.000253	M	Si		0.022484	M	Zr	<	0.005559
M	As	<	0.002403	M	Ga	<	0.000253	M	Nd	<	0.000253	M	Sm	<	0.000253				
M	Au		0.001634	M	Gd	<	0.000253	O	Ni	<	0.005472	M	Sn		0.001927				
O	B	<	0.009978	M	Ge	<	0.000754	M	Os	<	0.000254	O	Sr		0.000086				
M	Ba	<	0.000785	M	Hf	<	0.000253	M	P	<	0.053784	M	Ta	<	0.000253				
M	Be	<	0.002407	M	Hg	<	0.001332	M	Pb		0.003281	M	Tb	<	0.000253				
M	Bi		0.001671	M	Ho	<	0.000253	M	Pd	<	0.001382	M	Te	<	0.003715				
O	Ca		0.007115	M	In	<	0.003483	M	Pr	<	0.000253	M	Th	<	0.000253				
M	Cd	<	0.000253	M	Ir	<	0.000254	M	Pt	<	0.000253	M	Ti	<	0.002706				
M	Ce	<	0.000573	O	K		0.004010	M	Rb	<	0.000253	M	Tl	<	0.000253				
M	Co	<	0.000253	M	La	<	0.000253	M	Re	<	0.000253	M	Tm	<	0.000253				
O	Cr	<	0.005043	O	Li	<	0.000214	M	Rh	<	0.000253	M	U	<	0.000253				
M	Cs	<	0.002769	M	Lu	<	0.000253	M	Ru	<	0.000254	M	V	<	0.000822				
O	Cu		0.004614	O	Mg		0.001034	M	S	<	0.560935	M	W	<	0.002146				
M	Dy	<	0.000253	M	Mn	<	0.000253	M	Sb	<	0.006899	M	Y	<	0.000253				
M	Er	<	0.000253	M	Mo	<	0.000479	M	Sc	<	0.000733	M	Yb	<	0.000253				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 107.87 +1 6 Ag(H2O)6+
Chemical Compatibility -Stable in HNO3, and HF. Avoid basic media. Ag forms more insoluble salts than any other metal. It also is subject to photochemical reduction to the metal in HCl media although 10 µg/mL solutions in 10% HCl [AgClx1-x] are commonly used in the analytical laboratory. The most common solubility problems exist with arsenate, arsenite , bromide, chloride, iodide, carbonate , chromate, cyanide, iodate, oxalate, oxide, sulfate, sulfide, tartrate, and thiocyanate in aqueous media. The addition of nitric acid renders many of these salts soluble.
Stability - 2-100 ppb levels stable for 75+ days when mixed with equivalent levels of all other elements including the precious metals (where chloride is present) when in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO3 / LDPE container.
Ag Containing Samples (Preparation and Solution) -Metal (Soluble in HNO3); Oxides (Soluble in HNO3); Ores (Digestion with conc. HNO3).
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 107 amu	1 ppt	N/A	91Zr16O
ICP-OES 243.779 nm	0.12/0.01 µg/mL	1	Mn, Th, Ni, Rh
ICP-OES 328.068 nm	0.007/0.0007 µg/mL	1	Ce, Rh, V
ICP-OES 338.289 nm	0.013/0.001 µg/mL	1	Ce, Cr, Th

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

June 07, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- June 07, 2023

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Supervisor, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGAS10
Lot Number:	R2-AS691113
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Arsenic
Starting Material:	As Pieces
Starting Material Lot#:	2208
Starting Material Purity:	99.9980%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9981 ± 55 µg/mL

Density: 1.028 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9981 ± 55 µg/mL**
ICP Assay NIST SRM 3103a Lot Number: 100818

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The follow ing equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.001578	M	Eu	<	0.000526	O	Na		0.036136	M	Se	<	0.014204	O	Zn	<	0.003390
O	Al		0.006694	M	Fe		0.002633	O	Nb	<	0.011526	O	Si		0.139479	M	Zr	<	0.003156
s	As	<		M	Ga	<	0.000526	M	Nd	<	0.000526	M	Sm	<	0.000526				
M	Au	<	0.000526	M	Gd	<	0.000526	O	Ni	<	0.005537	M	Sn	<	0.001052				
M	B		0.017011	M	Ge	<	0.000526	M	Os	<	0.000526	M	Sr	<	0.000526				
M	Ba	<	0.000526	M	Hf	<	0.000526	O	P	<	0.056500	M	Ta	<	0.000526				
O	Be	<	0.001130	M	Hg	<	0.002104	M	Pb	<	0.000526	M	Tb	<	0.000526				
M	Bi	<	0.002104	M	Ho	<	0.000526	M	Pd	<	0.000526	M	Te	<	0.003682				
O	Ca		0.005657	M	In	<	0.000526	M	Pr	<	0.002630	M	Th	<	0.000526				
M	Cd	<	0.000526	M	Ir	<	0.000526	M	Pt	<	0.000526	O	Ti	<	0.001017				
M	Ce	<	0.000526	O	K		0.003865	M	Rb	<	0.002104	M	Tl	<	0.000526				
M	Co	<	0.003156	M	La	<	0.000526	M	Re	<	0.000526	M	Tm	<	0.000526				
M	Cr		0.000877	M	Li	<	0.000526	M	Rh	<	0.000526	M	U	<	0.000526				
M	Cs	<	0.002104	M	Lu	<	0.000526	M	Ru	<	0.000526	M	V	<	0.001578				
M	Cu	<	0.003156	O	Mg		0.000235	O	S	<	0.056500	M	W	<	0.000526				
M	Dy	<	0.000526	M	Mn	<	0.001052	M	Sb	<	0.000526	M	Y	<	0.000526				
M	Er	<	0.000526	M	Mo	<	0.000526	M	Sc	<	0.002104	M	Yb	<	0.000526				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 74.92 ; mix of +3 and +5 ; 6 ; H_3AsO_4 and $HAsO_2$

Chemical Compatibility - Arsenic has no cationic chemistry. It is soluble in HCl, HNO_3,H_3PO_4, H_2SO_4 and HF aqueous matrices water and NH_4OH . It is stable with most inorganic anions (forms arsenate when boiled with chromate) but many cationic metals form the insoluble arsenates under pH neutral conditions. When fluorinated and / or under acidic conditions arsenate formation is typically not a problem at moderate to low concentrations.

Stability - 2-100 ppb levels stable for months alone or mixed with other elements at equivalent levels in 1% HNO_3 / LDPE container.

As Containing Samples (Preparation and Solution) - Metal (soluble in 1:1 H_2O / HNO_3); Oxides (the oxide exists in crystalline and amorphous forms where the amorphic form is more water soluble. The oxides typically dissolve in dilute acidic solutions when boiled); Minerals (one gram of powered sample is fused in a Ni crucible with 10 grams of a 1:1 mix of K_2CO_3 and KNO_3 and the melt extracted with hot water); Organic Matrices (0.2 to 0.5 grams of sample are fused with 15 grams of a 1:1 Na_2CO_3 / Na_2O_2 mix in a Ni crucible. The fuseate is extracted with water and acidified with HNO_3).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 75 amu	20 ppt	N/A	40Ar35Cl, 59Co16O, 36Ar38Ar1H,8Ar37Cl,Ar39K, 150Nd2+,150Sm2+
ICP-OES 189.042 nm	0.05/0.005 µg/mL	1	Cr
ICP-OES 193.696 nm	0.1/0.01 µg/mL	1	V, Ge
ICP-OES 228.812 nm	0.1/0.01 µg/mL	1	Cd, Pt, Ir, Co

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

March 25, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **March 25, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCD10
Lot Number:	P2-CD675954
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Cadmium
Starting Material:	Cd Shot
Starting Material Lot#:	1954
Starting Material Purity:	99.9998%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10014 ± 30 µg/mL

Density: 1.029 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10021 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #2 **10038 ± 43 µg/mL**
ICP Assay NIST SRM 3108 Lot Number: 130116

Assay Method #3 **9996 ± 30 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag		0.000834	O	Eu	<	0.002146	O	Na		0.003359	M	Se	<	0.003997	O	Zn		0.000251
O	Al		0.002435	O	Fe	<	0.001180	M	Nb	<	0.000399	O	Si		0.009519	M	Zr	<	0.000399
M	As	<	0.003997	M	Ga	<	0.000399	M	Nd	<	0.000399	M	Sm	<	0.000799				
M	Au	<	0.002809	M	Gd	<	0.000399	M	Ni	<	0.002398	M	Sn	<	0.000799				
M	B	<	0.005197	M	Ge	<	0.004397	M	Os	<	0.000401	O	Sr	<	0.000107				
M	Ba	<	0.000399	M	Hf	<	0.000399	O	P	<	0.023606	M	Ta	<	0.000399				
O	Be	<	0.000107	O	Hg	<	0.010730	M	Pb	<	0.001599	M	Tb	<	0.000399				
M	Bi	<	0.000399	M	Ho	<	0.000399	M	Pd	<	0.000799	M	Te	<	0.005596				
O	Ca		0.001399	O	In	<	0.015558	M	Pr	<	0.000399	M	Th	<	0.000399				
s	Cd	<		M	Ir	<	0.000401	M	Pt	<	0.000399	O	Ti	<	0.000536				
M	Ce	<	0.000399	O	K		0.004479	M	Rb	<	0.000399	M	Tl		0.000625				
M	Co	<	0.000399	M	La	<	0.000399	M	Re	<	0.000399	M	Tm	<	0.000399				
M	Cr	<	0.001199	O	Li	<	0.000214	M	Rh	<	0.000399	M	U	<	0.000399				
M	Cs	<	0.000399	M	Lu	<	0.000399	M	Ru	<	0.000401	M	V	<	0.001599				
O	Cu	<	0.003219	O	Mg		0.000083	O	S	<	0.021460	M	W	<	0.000799				
M	Dy	<	0.000399	O	Mn	<	0.000429	M	Sb	<	0.001599	M	Y	<	0.000399				
M	Er	<	0.000399	M	Mo	<	0.000399	O	Sc	<	0.000429	M	Yb	<	0.000399				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 112.41 +2 4 Cd2(OH) (aq)3+ and Cd(OH)(aq)
Chemical Compatibility -Stable in HCl, HNO3, H2SO4 , and HF. Avoid basic media forming insoluble carbonate and hydroxide.
Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5 % HNO3 / LDPE container.
Cd Containing Samples (Preparation and Solution) -Metal (soluble in HNO3); Oxides (soluble in HCl or HNO3); Ores (dissolve in HCl /HNO3 then take to fumes with H2SO4. The silica and lead sulfate are filtered off after the addition of water); Organic based (dry ash at 450°C and dissolve ash in HCl), (sulfuric / peroxide acid digestion).
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 111 amu	11 ppt	n/a	95Mo16O
ICP-OES 214.438 nm	0.003 / 0.0003 µg/mL	1	Pt, Ir
ICP-OES 226.502 nm	0.003 / 0.0003 µg/mL	1	Ir
ICP-OES 228.802 nm	0.003 / 0.0003 µg/mL	1	Co, Ir, As, Pt

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

March 07, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **March 07, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Supervisor, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCO10
Lot Number:	N2-CO671028
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Cobalt
Starting Material:	COBALT
Starting Material Lot#:	1749
Starting Material Purity:	99.9978%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9988 ± 34 µg/mL

Density: 1.057 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9973 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #2 **10024 ± 50 µg/mL**
ICP Assay NIST SRM traceable to 3113 Lot Number: M2-CO661665

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

O	Ag		0.022956	M	Eu	<	0.000422	O	Na		0.008125	M	Se	<	0.009290	M	Zn		0.007197
O	Al		0.013621	O	Fe		0.048700	M	Nb	<	0.000422	O	Si		0.017539	M	Zr	<	0.014357
i	As	<		M	Ga	<	0.000844	M	Nd	<	0.017735	M	Sm	<	0.001689				
M	Au	<	0.000583	M	Gd		0.003247	O	Ni	<	0.043642	M	Sn	<	0.005067				
M	B	<	0.013512	M	Ge	<	0.004645	M	Os	<	0.000583	O	Sr		0.000841				
O	Ba		0.071210	M	Hf	<	0.000422	n	P	<		M	Ta	<	0.000422				
O	Be	<	0.001771	M	Hg	<	0.002334	M	Pb		0.010094	M	Tb	<	0.001689				
M	Bi		0.000614	M	Ho	<	0.000422	M	Pd	<	0.000422	M	Te	<	0.008445				
O	Ca		0.025034	M	In	<	0.003378	M	Pr	<	0.006756	M	Th	<	0.000422				
M	Cd	<	0.000844	M	Ir	<	0.000583	M	Pt	<	0.000422	M	Ti	<	0.002533				
M	Ce		0.002721	O	K		0.005785	M	Rb	<	0.001689	M	Tl	<	0.000422				
s	Co	<		M	La		0.000877	M	Re		0.016853	M	Tm	<	0.000422				
M	Cr	<	0.020269	O	Li		0.000262	M	Rh	<	0.000422	M	U	<	0.000422				
M	Cs		0.000877	M	Lu	<	0.000422	M	Ru	<	0.000583	M	V	<	0.001689				
M	Cu		0.007197	O	Mg		0.003444	n	S	<		M	W	<	0.000844				
M	Dy	<	0.000422	O	Mn	<	0.006072	M	Sb	<	0.005911	M	Y		0.001228				
M	Er	<	0.000422	M	Mo	<	0.005911	M	Sc	<	0.001689	M	Yb	<	0.003378				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 58.93 +2 6 $Co(H_2O)_6^{2+}$
Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4 ,HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.
Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.
Co Containing Samples (Preparation and Solution) - Metal (soluble in HNO_3); Oxides (Soluble in HCl); Ores (dissolve in HCl / HNO_3).
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 59 amu	2 ppt	n/a	42Ca16O1H , 40Ar18O1H , 36Ar23Na, 43Ca16O, 24Mg35Cl
ICP-OES 228.616 nm	0.01/0.001 µg/mL	1	
ICP-OES 237.862 nm	0.01/0.002 µg/mL	1	W, Re, Al, Ta
ICP-OES 238.892 nm	0.01/0.002 µg/mL	1	Fe, W, Ta

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

January 15, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **January 15, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Supervisor, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

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ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCR(3)10
Lot Number:	P2-CR684202
Matrix:	10% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Chromium
Starting Material:	Cr METAL
Starting Material Lot#:	2077
Starting Material Purity:	99.9942%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10056 ± 49 µg/mL

Density: 1.084 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10061 ± 71 µg/mL**
ICP Assay NIST SRM 3112a Lot Number: 170630

Assay Method #2 **10052 ± 64 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\ (u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\ (u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.000540	M	Eu	<	0.003200	O	Na		0.130027	M	Se	<	0.012000	O	Zn	<	0.002700
O	Al		0.016626	O	Fe		0.202502	M	Nb	<	0.022000	n	Si	<		M	Zr	<	0.020000
M	As		0.003836	O	Ga	<	0.031000	M	Nd	<	0.000540	M	Sm	<	0.035000				
M	Au	<	0.000540	M	Gd	<	0.000540	O	Ni		0.009165	M	Sn		0.004049				
M	B	<	0.049000	M	Ge	<	0.005400	M	Os	<	0.088000	O	Sr	<	0.000250				
O	Ba	<	0.002000	M	Hf	<	0.000540	i	P	<		M	Ta	<	0.000540				
O	Be	<	0.000250	M	Hg	<	0.001600	M	Pb		0.002557	M	Tb	<	0.000540				
M	Bi		0.008952	M	Ho	<	0.000540	M	Pd	<	0.001100	M	Te	<	0.004800				
O	Ca		0.074605	M	In	<	0.001100	M	Pr	<	0.000540	M	Th	<	0.000540				
M	Cd	<	0.000540	M	Ir	<	0.000540	M	Pt	<	0.000540	O	Ti		0.013428				
M	Ce	<	0.000540	O	K		0.034105	i	Rb	<		M	Tl	<	0.001100				
O	Co	<	0.002900	M	La	<	0.001100	M	Re	<	0.002700	O	Tm	<	0.001800				
s	Cr	<		O	Li	<	0.000130	M	Rh	<	0.032000	M	U	<	0.001100				
M	Cs	<	0.019000	M	Lu	<	0.000540	M	Ru	<	0.094000	O	V		0.159869				
O	Cu		0.010018	O	Mg		0.001449	i	S	<		M	W	<	0.028000				
M	Dy	<	0.000540	O	Mn	<	0.014000	M	Sb	<	0.008600	M	Y	<	0.001100				
M	Er	<	0.016000	O	Mo	<	0.013000	O	Sc	<	0.001400	M	Yb	<	0.000540				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 52.00 +3 6 $Cr(H_2O)_6^{3+}$

Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4, HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Cr3 Containing Samples (Preparation and Solution) -Metal (soluble in HCl); Oxides/Ores (Chrome ore/oxides are very difficult to dissolve. The following procedures [A-D] are commonly used: A. Fusion with $KHSO_4$ and extraction with hot KCl. The residue fused with Na_2CO_3 and $KClO_3$, 3:1. B. Fusion with $NaKSO_4$ and NaF 2:1, C. Fusion with magnesia or lime and sodium or potassium carbonates, 4:1. D. Fusion with Na_2O_2 or NaOH and KNO_3 or NaOH and Na_2O_2. Nickel, iron, copper, or silver crucibles should be used for D. Platinum may be used for A, B, C); Organic Matrices (ash at 4500C followed by one of the fusion methods above or sulfuric/hydrogen peroxide acid digestions may be applicable to non oxide containing samples).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 52 amu	40 ppt	N/A	36S16O, 36Ar16O - The 50Cr, 53Cr, 54Cr lines suffer from many more potential interferences from sulfur, chlorine and argon compounds of oxygen, nitrogen and carbon.
ICP-OES 205.552 nm	0.006/0.0008 µg/mL	1	Os
ICP-OES 276.654 nm	0.01/0.001 µg/mL	1	Cu, Ta, V
ICP-OES 284.325 nm	0.008/0.0007 µg/mL	1	

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

November 02, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **November 02, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCU10
Lot Number:	P2-CU682108
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Copper
Starting Material:	Cu Metal
Starting Material Lot#:	2095
Starting Material Purity:	99.9996%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10013 ± 30 µg/mL

Density: 1.032 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9977 ± 50 µg/mL**
ICP Assay NIST SRM 3114 Lot Number: 121207

Assay Method #2 **10024 ± 26 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **10007 ± 46 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.007542	M	Eu	<	0.000942	O	Na		0.001434	M	Se	<	0.016971	M	Zn	<	0.005657
O	Al	<	0.000609	O	Fe		0.008700	M	Nb	<	0.000942	O	Si		0.003052	M	Zr	<	0.000942
M	As	<	0.010371	M	Ga	<	0.000942	M	Nd	<	0.000942	M	Sm	<	0.000942				
M	Au	<	0.001885	M	Gd	<	0.000942	M	Ni		0.003781	M	Sn	<	0.005657				
O	B		0.003663	M	Ge	<	0.005657	M	Os	<	0.000942	M	Sr	<	0.000942				
M	Ba		0.004253	M	Hf	<	0.000942	O	P	<	0.031668	M	Ta	<	0.000942				
M	Be	<	0.000942	O	Hg	<	0.007064	M	Pb		0.005789	M	Tb	<	0.000942				
M	Bi	<	0.000942	M	Ho	<	0.000942	M	Pd	<	0.000942	M	Te	<	0.004714				
O	Ca		0.002304	M	In	<	0.000942	M	Pr	<	0.000942	M	Th	<	0.000942				
M	Cd	<	0.000942	M	Ir	<	0.000942	M	Pt	<	0.000942	O	Ti	<	0.002801				
M	Ce	<	0.000942	O	K		0.000763	M	Rb	<	0.000942	M	Tl	<	0.000942				
M	Co		0.001890	M	La	<	0.000942	M	Re	<	0.000942	M	Tm	<	0.000942				
M	Cr	<	0.005657	O	Li	<	0.000243	i	Rh	<		M	U	<	0.000942				
M	Cs	<	0.000942	M	Lu	<	0.000942	M	Ru	<	0.039588	M	V	<	0.003771				
s	Cu	<		O	Mg		0.000320	O	S		0.007174	M	W	<	0.005657				
M	Dy	<	0.000942	O	Mn		0.000793	M	Sb	<	0.001885	M	Y	<	0.000942				
M	Er	<	0.000942	M	Mo	<	0.005657	M	Sc	<	0.000942	M	Yb	<	0.000942				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 63.55 +2 6 $Cu(H_2O)_6^{2+}$

Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4, HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Cu Containing Samples (Preparation and Solution) -Metal (soluble in HNO_3); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO_3).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 63 amu	10 ppt	n/a	40Ar23Na 47Ti16O, 14N12C37Cl, 16O12C35Cl, 23Na40Ca
ICP-OES 219.958 nm	0.01/.002 µg/mL	1	Th, Ta, Nb, U, Hf
ICP-OES 224.700 nm	0.01/.001 µg/mL	1	Pb, Ir, Ni, W
ICP-OES 324.754 nm	0.06/.001 µg/mL		Nb, U, Th, Mo, Hf

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

August 24, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **August 24, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGMN10
Lot Number:	P2-MN687536
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Manganese
Starting Material:	Mn Metal
Starting Material Lot#:	2275
Starting Material Purity:	99.9909%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10046 ± 30 µg/mL

Density: 1.035 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10045 ± 25 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #2 **10083 ± 68 µg/mL**
ICP Assay NIST SRM 3132 Lot Number: 050429

Assay Method #3 **10031 ± 47 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.001500	M	Eu	<	0.000730	O	Na		0.176713	M	Se	<	0.006600	M	Zn		0.009960
O	Al		0.004337	M	Fe	<	0.650000	M	Nb	<	0.000730	O	Si		0.097995	M	Zr	<	0.000730
M	As	<	0.008000	M	Ga		0.004337	M	Nd	<	0.001500	M	Sm	<	0.000730				
M	Au	<	0.000730	M	Gd	<	0.000730	M	Ni		0.024097	M	Sn	<	0.002200				
M	B		0.069078	M	Ge	<	0.004400	M	Os	<	0.000730	O	Sr		0.000931				
M	Ba	<	0.001500	M	Hf	<	0.000730	i	P	<		M	Ta	<	0.000730				
M	Be	<	0.000730	M	Hg	<	0.002200	M	Pb		0.007389	M	Tb	<	0.000730				
M	Bi	<	0.003000	M	Ho	<	0.000730	M	Pd	<	0.000730	M	Te	<	0.019000				
O	Ca		0.062652	M	In	<	0.003000	M	Pr	<	0.000730	M	Th	<	0.000730				
M	Cd	<	0.001500	M	Ir	<	0.000730	M	Pt	<	0.000730	O	Ti	<	0.006500				
M	Ce	<	0.007300	O	K		0.006425	M	Rb	<	0.006600	M	Tl	<	0.000730				
O	Co		0.014779	M	La	<	0.003000	M	Re	<	0.000730	M	Tm	<	0.000730				
O	Cr		0.273102	O	Li		0.000417	M	Rh	<	0.003000	M	U	<	0.001500				
M	Cs	<	0.000730	M	Lu	<	0.000730	M	Ru	<	0.004400	M	V	<	0.000730				
O	Cu		0.007711	O	Mg		0.321297	i	S	<		M	W	<	0.004400				
M	Dy	<	0.001500	s	Mn	<		M	Sb	<	0.021000	O	Y		0.001365				
M	Er	<	0.001500	M	Mo		0.010281	O	Sc	<	0.004100	M	Yb	<	0.000730				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 54.94 +2 6 $Mn(H_2O)_6^{2+}$

Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4 ,HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5 % HNO_3/LDPE container.

Mn Containing Samples (Preparation and Solution) -Metal (Soluble in dilute acids); Oxides (Soluble in dilute acids); Ores (Dissolve with HCl. If silica is present add HF and then fume off silica by adding H_2SO_4 and heat to SO_3 fumes - dense white fumes).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 55 amu	10 ppt	n/a	40Ar14N1H,39K16O,37Cl18O,40Ar15N,38Ar17O,36Ar18O1H ,38Ar16O1H,37Cl17O1H,23Na32S
ICP-OES 257.610 nm	0.0014 / 0.00002 µg/mL	1	Ce, W, Re
ICP-OES 259.373 nm	0.0016 / 0.00002 µg/mL	1	U, Ta, Mo, Fe, Nb
ICP-OES 260.569 nm	0.0021 / 0.00002 µg/mL	1	Co

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

January 05, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **January 05, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGNI10
Lot Number:	P2-NI686384
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Nickel
Starting Material:	Ni Metal
Starting Material Lot#:	2277 and 2282
Starting Material Purity:	99.9992%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9979 ± 30 µg/mL

Density: 1.038 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9971 ± 54 µg/mL**
ICP Assay NIST SRM 3136 Lot Number: 120619

Assay Method #2 **9970 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **9993 ± 33 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag		0.002606	M	Eu	<	0.001100	O	Na		0.004965	O	Se	<	0.067000	M	Zn		0.006578
M	Al	<	0.013000	O	Fe		0.018618	M	Nb	<	0.001100	O	Si		0.010923	M	Zr	<	0.001100
O	As	<	0.067000	M	Ga	<	0.001100	M	Nd	<	0.001100	M	Sm	<	0.001100				
M	Au	<	0.002100	M	Gd	<	0.001100	s	Ni	<		M	Sn	<	0.016000				
M	B	<	0.017000	M	Ge	<	0.004200	M	Os		0.002110	O	Sr	<	0.000940				
M	Ba	<	0.001100	M	Hf	<	0.001100	i	P	<		M	Ta	<	0.001100				
O	Be	<	0.000410	M	Hg		0.014895	M	Pb		0.006578	M	Tb	<	0.001100				
M	Bi	<	0.004200	M	Ho	<	0.001100	M	Pd	<	0.001100	M	Te	<	0.015000				
O	Ca		0.003351	M	In	<	0.001100	M	Pr	<	0.001100	M	Th	<	0.001100				
M	Cd		0.001365	M	Ir		0.004716	M	Pt	<	0.001100	M	Ti	<	0.004200				
M	Ce	<	0.001100	O	K		0.004716	M	Rb	<	0.001100	M	Tl	<	0.001100				
O	Co		0.017377	M	La	<	0.001100	M	Re		0.001737	M	Tm	<	0.001100				
O	Cr	<	0.006700	O	Li	<	0.000140	M	Rh	<	0.006300	M	U	<	0.001100				
M	Cs	<	0.007300	M	Lu	<	0.001100	M	Ru	<	0.019000	M	V	<	0.002100				
M	Cu		0.004096	O	Mg		0.000372	i	S	<		M	W	<	0.006300				
M	Dy	<	0.001100	O	Mn	<	0.001900	M	Sb		0.005833	O	Y	<	0.000540				
M	Er	<	0.001100	M	Mo	<	0.008400	M	Sc	<	0.002100	M	Yb	<	0.001100				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 58.69 +2 6 Ni(H2O)62+

Chemical Compatibility -Stable in HCl, HNO3, H2SO4 ,HF, H3PO4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO3 / LDPE container.

Ni Containing Samples (Preparation and Solution) -Metal (Soluble in HNO3); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO3).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 60 amu	100 ppt	n/a	43Ca16O1H , 44Ca16O, 23Na37Cl
ICP-OES 221.647 nm	0.01 / 0.0009 µg/mL	1	Si
ICP-OES 231.604 nm	0.02 / 0.002 µg/mL	1	Sb, Ta, Co
ICP-OES 232.003 nm	0.02 / 0.006 µg/mL	1	Cr, Re, Os, Nb, Ag, Pt, Fe

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

December 02, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **December 02, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGZN10
Lot Number:	P2-ZN686137
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Zinc
Starting Material:	Zn Shot
Starting Material Lot#:	2201
Starting Material Purity:	99.9993%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10040 ± 30 µg/mL

Density: 1.033 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10009 ± 54 µg/mL**
ICP Assay NIST SRM 3168a Lot Number: 120629

Assay Method #2 **10049 ± 33 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **10041 ± 28 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.003057	M	Eu	<	0.000509	O	Na		0.001874	M	Se	<	0.023441	s	Zn	<
O	Al	<	0.005720	O	Fe		0.006348	M	Nb	<	0.000509	O	Si	<	0.057200	M	Zr	< 0.000509
M	As	<	0.003057	M	Ga	<	0.007134	M	Nd	<	0.000509	M	Sm	<	0.000509			
M	Au	<	0.000510	M	Gd	<	0.000509	M	Ni	<	0.000509	M	Sn	<	0.000509			
O	B	<	0.017160	M	Ge	<	0.003057	M	Os	<	0.000510	M	Sr	<	0.000509			
M	Ba	<	0.000509	M	Hf	<	0.000509	O	P	<	0.057200	M	Ta	<	0.000509			
M	Be	<	0.000509	M	Hg	<	0.001021	O	Pb		0.023870	M	Tb	<	0.000509			
M	Bi	<	0.005095	M	Ho	<	0.000509	M	Pd	<	0.002038	M	Te	<	0.023441			
O	Ca		0.033793	M	In	<	0.000509	M	Pr	<	0.000509	M	Th	<	0.000509			
O	Cd		0.003924	M	Ir	<	0.000510	M	Pt	<	0.000509	M	Ti	<	0.000509			
M	Ce	<	0.000509	O	K		0.001499	M	Rb	<	0.002038	M	Tl	<	0.009172			
M	Co	<	0.000509	M	La	<	0.000509	M	Re	<	0.000509	M	Tm	<	0.000509			
O	Cr		0.001549	O	Li	<	0.000457	M	Rh	<	0.000509	M	U	<	0.000509			
M	Cs	<	0.000509	M	Lu	<	0.000509	M	Ru	<	0.006129	M	V	<	0.000509			
O	Cu	<	0.010296	O	Mg		0.000349	O	S	<	0.034320	M	W	<	0.001019			
M	Dy	<	0.000509	M	Mn	<	0.000509	M	Sb	<	0.001019	M	Y	<	0.000509			
M	Er	<	0.000509	M	Mo	<	0.000509	M	Sc	<	0.000509	M	Yb	<	0.000509			

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 65.39 +2 4 Zn(OH)(aq)1+
Chemical Compatibility -Stable in HCl, HNO3, H2SO4 ,HF, H3PO4. Avoid basic media forming insoluble carbonate and hydroxide. Stable with most metals and inorganic anions in acidic media.
Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO3 / LDPE container.
Zn Containing Samples (Preparation and Solution) -Metal (soluble in HNO3); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO3); Organic based (dry ash at 4500C and dissolve ash in HCl) (sulfuric/peroxide acid digestion)
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 66 amu	7 ppt	N/A	50Ti16O,50Cr16O, 50V16O, 34S16O2, 32S16O18O, 32S17O2, 33S16O17O, 32S34S, 33S2
ICP-OES 202.548 nm	0.004/0.0002 µg/mL	1	Nb, Cu, Co, Hf
ICP-OES 206.200 nm	0.006/0.0006 µg/mL	1	Sb, Ta, Bi, Os
ICP-OES 213.856 nm	0.002/0.0004 µg/mL	1	Ni, Cu, V

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

December 05, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **December 05, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGU1
Lot Number:	P2-U683975
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	1 000 µg/mL ea: Uranium
Starting Material:	Uranyl Nitrate
Starting Material Lot#:	1948
Starting Material Purity:	99.9985%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 1001 ± 5 µg/mL

Density: 1.010 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **1001 ± 5 µg/mL**
ICP Assay NIST SRM 3164 Lot Number: 080521

Assay Method #2 **1002 ± 6 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Certified Abundance:

IV's Certified Abundance

Isotope	Atom %
Uranium 238U	99.8 ± 0.1
Uranium 235U	0.24 ± 0.05

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.000103	M	Eu	<	0.000103	M	Na		0.020618	M	Se	<	0.001246	M	Zn	<	0.003533
M	Al	<	0.003740	M	Fe		0.001029	M	Nb	<	0.000207	M	Si	<	0.035027	M	Zr	<	0.000103
M	As	<	0.001143	M	Ga	<	0.001350	M	Nd	<	0.000623	M	Sm	<	0.000311				
M	Au	<	0.000207	M	Gd	<	0.000311	M	Ni	<	0.008313	M	Sn	<	0.007273				
M	B	<	0.005819	M	Ge	<	0.001974	M	Os	<	0.000103	M	Sr	<	0.001039				
M	Ba	<	0.002286	M	Hf	<	0.000103	i	P	<		M	Ta	<	0.000103				
M	Be	<	0.001350	M	Hg	<	0.000415	M	Pb	<	0.000103	M	Tb	<	0.000103				
M	Bi	<	0.000103	M	Ho	<	0.000103	M	Pd	<	0.000207	M	Te	<	0.006234				
M	Ca	<	0.010391	M	In	<	0.000103	M	Pr	<	0.000103	M	Th		0.010535				
M	Cd	<	0.000103	M	Ir	<	0.000103	M	Pt	<	0.000103	M	Ti	<	0.000207				
M	Ce	<	0.000103	M	K	<	0.041565	M	Rb	<	0.000519	M	Tl	<	0.000103				
M	Co	<	0.000415	M	La	<	0.001662	M	Re	<	0.000103	M	Tm	<	0.000103				
M	Cr	<	0.001870	M	Li	<	0.001662	M	Rh	<	0.000103	s	U	<					
M	Cs		0.000175	M	Lu	<	0.000103	M	Ru	<	0.000519	M	V	<	0.000207				
M	Cu		0.000792	M	Mg	<	0.002493	i	S	<		M	W	<	0.000103				
M	Dy	<	0.000103	M	Mn	<	0.001454	M	Sb	<	0.000103	M	Y	<	0.000103				
M	Er	<	0.000103	M	Mo	<	0.000415	M	Sc	<	0.006234	M	Yb	<	0.000103				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 238.03 +6 8 UO_2^{2+}(uranyl)

Chemical Compatibility - Soluble in HCl and HNO_3. Avoid H_3PO_4. H_2SO_4 and HF matrices should not be a problem depending upon [U]. Although the UO_2^{2+} ion is distinctly basic, any U^{+4} will precipitate in basic media. UO_2^{2+}salts are generally soluble in water and UO_2^{2+} is stable with most metals and inorganic anions. The uranyl phosphate is insoluble in water. UF_4 and UF_6 are water soluble.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5% HNO_3 / LDPE container.

U Containing Samples (Preparation and Solution) -Metal (Dissolves rapidly in HCl and HNO_3); Oxide (Soluble in HNO_3); Ores (Digest for 1-2 hours with 1 gram of ore to 30 mL 1:1 HNO_3. Silica insolubles are removed by filtration after bringing the sample to fumes with conc. H_2SO_4.)

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 238 amu	2 ppt	N/A	206Pb16O2
ICP-OES 263.553 nm	0.3 / 0.01 µg/mL	1	Ce, Ir, Th, Rh, W, Zr, Ta, Ti, V, Hf, Fe, Re, Ru
ICP-OES 367.007 nm	0.3 / 0.02 µg/mL	1	Th, Ce
ICP-OES 385.958 nm	0.3 / 0.01 µg/mL	1	Th, Fe

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

September 28, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **September 28, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

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ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Multi Analyte Custom Grade Solution
Catalog Number:	AR-6020ICS-0A10
Lot Number:	R2-MEB692465
Matrix:	1.4% (v/v) HNO3
Value / Analyte(s):	1 000 µg/mL ea: Chloride,
	200 µg/mL ea: Carbon,
	100 µg/mL ea: Calcium, Aluminum, Iron, Potassium, Magnesium, Sodium, Phosphorus, Sulfur,
	2 µg/mL ea: Titanium, Molybdenum

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Aluminum, Al	100.0 ± 0.3 µg/mL	Calcium, Ca	100.0 ± 0.5 µg/mL
Carbon, C	200.1 ± 0.5 µg/mL	Chloride, Cl	1 000 ± 5 µg/mL
Iron, Fe	100.0 ± 0.5 µg/mL	Magnesium, Mg	100.0 ± 0.5 µg/mL
Molybdenum, Mo	2.001 ± 0.012 µg/mL	Phosphorus, P	100.1 ± 0.6 µg/mL
Potassium, K	100.0 ± 0.5 µg/mL	Sodium, Na	100.0 ± 0.5 µg/mL
Sulfur, S	100.0 ± 0.5 µg/mL	Titanium, Ti	2.001 ± 0.017 µg/mL

Density: 1.007 g/mL (measured at 20 ± 4 ºC)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Al	ICP Assay	3101a	140903
Al	EDTA	928	928
C	Acidimetric	84L	84L
Ca	ICP Assay	3109a	130213
Ca	EDTA	928	928
Fe	ICP Assay	3126a	140812
Fe	EDTA	928	928
K	ICP Assay	3141a	140813
K	Gravimetric		See Sec. 4.2
Mg	ICP Assay	3131a	140110
Mg	EDTA	928	928
Mo	ICP Assay	3134	130418
Na	ICP Assay	3152a	120715
Na	Gravimetric		See Sec. 4.2
P	ICP Assay	3139a	060717
P	Acidimetric	84L	84L
S	Acidimetric	84L	84L
S	ICP Assay	traceable to 3154	M2-S657208
Ti	ICP Assay	3162a	130925

The follow ing equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

$CRM/RM\ Expanded\ Uncertainty\ (\pm) = U_{CRM/RM} = k\ (u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{1/2}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\ (u_{char\ i})^2)]^{1/2}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\ (u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

$CRM/RM\ Expanded\ Uncertainty\ (\pm) = U_{CRM/RM} = k\ (u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{1/2}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

N/A

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

April 22, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **April 22, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

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ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGAG10
Lot Number:	P2-AG688237
Matrix:	7% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Silver
Starting Material:	Ag Shot
Starting Material Lot#:	2217
Starting Material Purity:	99.9993%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10004 ± 30 µg/mL

Density: 1.054 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9984 ± 32 µg/mL**
ICP Assay NIST SRM 3151 Lot Number: 160729

Assay Method #2 **10016 ± 26 µg/mL**
Volhard NIST SRM 999c Lot Number: 999c

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

s	Ag	<		M	Eu	<	0.000253	O	Na		0.005563	M	Se	<	0.018179	M	Zn		0.005800
O	Al		0.006296	O	Fe		0.002932	M	Nb	<	0.000253	M	Si		0.022487	M	Zr	<	0.005559
M	As	<	0.002403	M	Ga	<	0.000253	M	Nd	<	0.000253	M	Sm	<	0.000253				
M	Au		0.001635	M	Gd	<	0.000253	O	Ni	<	0.005472	M	Sn		0.001928				
O	B	<	0.009978	M	Ge	<	0.000754	M	Os	<	0.000254	O	Sr		0.000086				
M	Ba	<	0.000785	M	Hf	<	0.000253	M	P	<	0.053784	M	Ta	<	0.000253				
M	Be	<	0.002407	M	Hg	<	0.001332	M	Pb		0.003281	M	Tb	<	0.000253				
M	Bi		0.001671	M	Ho	<	0.000253	M	Pd	<	0.001382	M	Te	<	0.003715				
O	Ca		0.007116	M	In	<	0.003483	M	Pr	<	0.000253	M	Th	<	0.000253				
M	Cd	<	0.000253	M	Ir	<	0.000254	M	Pt	<	0.000253	M	Ti	<	0.002706				
M	Ce	<	0.000573	O	K		0.004010	M	Rb	<	0.000253	M	Tl	<	0.000253				
M	Co	<	0.000253	M	La	<	0.000253	M	Re	<	0.000253	M	Tm	<	0.000253				
O	Cr	<	0.005043	O	Li	<	0.000214	M	Rh	<	0.000253	M	U	<	0.000253				
M	Cs	<	0.002769	M	Lu	<	0.000253	M	Ru	<	0.000254	M	V	<	0.000822				
O	Cu		0.004614	O	Mg		0.001035	M	S	<	0.560935	M	W	<	0.002146				
M	Dy	<	0.000253	M	Mn	<	0.000253	M	Sb	<	0.006899	M	Y	<	0.000253				
M	Er	<	0.000253	M	Mo	<	0.000479	M	Sc	<	0.000733	M	Yb	<	0.000253				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 107.87 +1 6 $Ag(H_2O)_6^+$

Chemical Compatibility -Stable in HNO_3, and HF. Avoid basic media. Ag forms more insoluble salts than any other metal. It also is subject to photochemical reduction to the metal in HCl media although 10 µg/mL solutions in 10% HCl [$AgCl_{x1-x}$] are commonly used in the analytical laboratory. The most common solubility problems exist with arsenate, arsenite , bromide, chloride, iodide, carbonate , chromate, cyanide, iodate, oxalate, oxide, sulfate, sulfide, tartrate, and thiocyanate in aqueous media. The addition of nitric acid renders many of these salts soluble.

Stability - 2-100 ppb levels stable for 75+ days when mixed with equivalent levels of all other elements including the precious metals (where chloride is present) when in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Ag Containing Samples (Preparation and Solution) -Metal (Soluble in HNO_3); Oxides (Soluble in HNO_3); Ores (Digestion with conc. HNO_3).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 107 amu	1 ppt	N/A	91Zr16O
ICP-OES 243.779 nm	0.12/0.01 µg/mL	1	Mn, Th, Ni, Rh
ICP-OES 328.068 nm	0.007/0.0007 µg/mL	1	Ce, Rh, V
ICP-OES 338.289 nm	0.013/0.001 µg/mL	1	Ce, Cr, Th

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

January 29, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **January 29, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com
tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES !" #$$%&' !(&' () *+, - . / 01234 &5&%#67 &89!%&: &5(" ;) % (<& =) : >&(&5$&) ; 7 &;&%&5$& ? #(&%#6@)% 9$&%3#5' *+, A*B=- . / CD234 &5&%#6 7 &89!%&: &5(" ;) %<(& =) : >&(&5$&) ; E&"(!5F #5' =#6G%#(!) 5 H#G) %#() %&" 3I *5) %5#5!$ J&5(9%&" !" #6') #5 *+, K/ / - %&F!"(&%&' : #59;#$(9%&%LM+7 = &%(!$#(& N9: G&%LM+7 G/ / 01PI

2.0 PRODUCT DESCRIPTION

@)% 9$(=) ' &S	+!5F6& T5#6Q(& = 9" () : 4 %#' & +) 69(!) 5
= #(#6) F N9: G&%S	= 4 TH- /
H) (N9: G&%S	+COTH / / R10
? #(%LJS	. V LWAVPXN, 0
J#69& AT5#6Q(&L" PS	-/ / / / YFA H&#S T69: !59:
+(#%(5F ? #(&%#6S	T6LN, 0P0 ZKXC,
+(#%(5F ? #(&%#6H) ([S	@CC00/ C
+(#%(5F ? #(&%#6@9%(QS	KKIKK- 0V

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: -/ / -- \ 0- YFA H

Density: -I/ R FA HL: &#"9%&' #(C/ \ 1]=P

Assay Information:

Assay Method #1 **10015 ± 44 µg/mL**
= @T" "#QN+E +7 ? 0-/ -# H) (N9: G&%S- 1/ K/ 0

Assay Method #2 **10008 ± 25 µg/mL**
B^ ET N*+E +7 ? KCR H) (N9: G&%SKCR

Assay Method #3 **10014 ± 36 µg/mL**
=#6$96#&' N*+E +7 ? H) (N9: G&%S+ && + &$I 1IC

CE<& = #6$96#(&' J#69& !" # W#69& $#6$96#(&' ;%): (<& _ &!F<( ) ; # "(#%(5F : #(&%#6(<#(<#" G&&5 $&%(!&' ' !%&$(6QVWI # N#(!) 5#6*5" (!(9(&) ; +(#5' #%" #5' E&$<5) 6) FQLN*+EP+7 ? A7 ? I + && + &$ 1IC ;) %G#6#5$& (%$&#G16(Q

E<& ;) 66) !5F &89#(!) 5" #%& 9" &' !5 (<& $#6$96#!) 5) ; (<& $&%(;!&' W#69& #5' (<& 95$&%(#!5(Q 7 &>) %&' 95$&%(#!5(!&" %&>%&" &5(&U>#5' &' 95$&%(#!5(!&" &U>%&" " &' #(#>>%U: #(&&Q(<& KDV $) 5;!' &5$& 6&%&69" !5F # $) W&%#F& ;#$() %) ; ` a CI

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)\,(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

OE<!" >%' 9$(!" (%#$&#G6& () N*+E W# #5 95G%` &5 $<#!5 ) ; $) : >#%" ) 5" I E<& 95$&%#!5(!&" ;) %&#$< $&%!(!&' W#69& #%& %&>) %&' 2 #` !5F !5() #$$) 95((<& +7 ? A7 ? 95$&%#!5(Q&%)%#5' (<& : &#" 9%&: &5(2_ &!F<!5F #5' W)69: & ' !69(!) 5 &%)%%I *5 %#%& $#" &" _<&%& 5) N*+E +7 ? A7 ? #%& #W#!6#G6&2 (<& (&%: !b5G<) 9" & " (' Ib!" " >&$!;!&' I

4.1 Thermometer Calibration

OT66(<&%:) : &(&% #%& N*+E (%#$&#G6& (<%9F< (<&%:) : &(&% (<#(#%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %QI

4.2 Balance Calibration

OT66#5#6Q!$#6G#6#5$&" #%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q#5' >%$&' 9%&I E<& _&!F<(" 9" &' ;) %&" (!5F #%& #559#66Q$) : >#%&' () : #" (&%_&!F<(" #5' #%& (%#$&#G6& () N*+EI

4.3 Glassware Calibration

OT5 !5G<) 9" & >%$&' 9%& !" 9" &' () $#6G%#(& #66= 6#" " T F6#" " _#%& 9" &' !5 (<& : #59;#$(9%!5F #5' 89#6!(Q $) 5(%)6) ; =7 ? A7 ? " I

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

=7 ? A7 ? " #%& (&" (&' ;) % #%$& : &(#66$!: >9%!(!&" GQTU#6*=@O B+ #5' *=@O?+ I E<& %&" 96(;%: (<& :) " (" &5" !(!W& : &(<) ' ;) %&#$< &6&: &5(2!" %&>) %&' G&6) _I +) 69(!) 5" (&" (&' GQ*=@O?+ _&%& #5#6Q&' !5 #5 d H@T@ !6(&%&' =6&#5 7)) : I T5 d H@T@ !6(&%!" KKIKKRDV &;;!$!&5(;) %<& %&:) W#6) ; >#%!$6&" ') _5 () / I0 Y: I

?	TF	f	/ I/ / - D/ /	?	B9	f	/ I/ / / gR/	,	N#		/ ID- / C/ /	?	+&	f	/ I/ - 1/ / /	?	I 5		/ I/ / K- R0
"	T6	f		,	e&		/ I- - 1CR1	?	NG	f	/ I/ / / gR/	,	+!		/ I/ D0/ g/	,	I %		/ I/ / 0g. 0
?	T"	f	/ I/ / gR/ /	,	4 #		/ I- K- R0D	?	N'	f	/ I/ / / gR/	?	+:	f	/ I/ / / gR/				
?	T9	f	/ I/ / / gR/	?	4 '	f	/ I/ / 1- / /	,	N!		/ I/ / - - / C	?	+5	f	/ I/ / gR/ /				
,	h	f	/ I/ C- / / /	?	4 &	f	/ I/ / - 1/ /	?	, "	f	/ I/ / R. / /	,	+%		/ I/ / gD0/				
,	h#		/ I/ - CgDC	?	X;	f	/ I/ / C. / /	5	@	f		?	E#	f	/ I/ / / gR/				
,	h&	f	/ I/ / - 0/ /	?	XF	f	/ I/ / g- / /	?	@G		/ I/ / gD0/	?	EG	f	/ I/ / / gR/				
?	h!	f	/ I/ / R- / /	?	X)	f	/ I/ / / gR/	?	@'	f	/ I/ / / gR/	?	E&	f	/ I/ 0/ / / /				
,	=#		/ I/ . - 1CR	?	*5	f	/ I/ / / K/ /	?	@%	f	/ I/ / / gR/	?	E<	f	/ I/ / / gR/				
?	='	f	/ I/ / - 1/ /	?	*%	f	/ I/ / / gR/	?	@(	f	/ I/ / / gR/	,	E!		/ I/ / - - 1C				
?	=&	f	/ I/ / C. / /	,	i		/ I/ D0/ g/	?	7 G	f	/ I/ - 1/ / /	?	E6	f	/ I/ / / gR/				
,	=)		/ I/ / - K. K	?	H#	f	/ I/ / CK/ /	?	7 &	f	/ I/ / / gR/	?	E:	f	/ I/ / / gR/				
,	=%		/ I/ - 1CRD	,	H!		/ I/ / / - 1C	?	7 <	f	/ I/ / / gR/	?	d	f	/ I/ / - 1/ /				
?	="		/ I/ / D0/ g	?	H9	f	/ I/ / / gR/	?	7 9	f	/ I/ / / gR/	?	J	f	/ I/ / D1/ /				
,	=9		/ I/ / 01gK	,	? F		/ I/ gK0R.	!	+	f		?	j	f	/ I/ - C/ / /				
?	^ Q	f	/ I/ / D1/ /	,	? 5		/ I/ / - gD0	?	+G	f	/ I/ / 1C/ /	?	k	f	/ I/ / / gR/				
?	B%	f	/ I/ / / gR/	?	?)	f	/ I/ - C/ / /	?	+$	f	/ I/ / C- / /	?	k G	f	/ I/ / / gR/				

? O= <&$` &' GQ*= @O? + , O= <&$` &' GQ*= @O B+ ! O+ >&$(%#6*5(&%;&%&5$&
5 ON) (= <&$` &' e) % " O+) 69!) 5 +(#5' #% B6& &5(

6.0 INTENDED USE

Oe) %<(& $#6G%#(!) 5) ; #5#6Q!$#6!5" (%9: &5(" #5' W#6" #(!) 5) ; #5#6Q!$#6: &(<) ' " #" #>>%>%#(&I

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

O+() %& G&(_&&5 #>>%)U: #(&6Q1m O/ m =_<!6& !5 "&#6&' E= E G#FI

Oj <!6& "() %&' !5 (<& "&#6&' E= E G#F2(%#5">!%#(!) 5) ; (<!" =7 ? A? ? !" 5&F6F!G&I T;(&%) >&5!5F (<& "&#6&' E= E G#F (%#5">!%#(!) 5) ; (<& =7 ? A? ? _!6) $$9%2%&" 96!5F !5 # F%#' 9#6!5$%&#" & !5 (<& #5#6Q(& $) 5$&5(%#(!) 5L" PI *(!" (<& %&">) 5"!G!6(Q) ; (<& 9"&%)(#$$) 95(;) %<!" &;;&$(I j <&5 (<& G) ((6& !" _&!F<&' G) (< G&;) %& #5' #;(&%G&!5F >6#$&' !5 "() %#F&2 (<& : #"" ' !;;&%&5$&) G' &%%&' _!6G& # : &#"9%&) ; (%#5">!%#(!) 5 : #"" 6) ""I

OT;(&%) >&5!5F (<& "&#6&' E= E G#F2`&&> $#> (!F<(6Q" &#6&' _<&5 5) (!5 9"& #5' "() %& G&(_&&5 1m O1m = () : !5!: !c& (<& &;;&$(") ; (%#5">!%#(!) 5I d"& #(C/ m\ 1m = () : !5!: !c& W) 6: &(%!$' !6(!) 5 &%%)%%_<&5 9"!5F (<& %&>) %&(' ' &5"!(Q ^) 5) (>!>&((& ;%): (<& $) 5(#!5&%% ^) 5) (%&(9%5 %&:) W&' #6!9) (" () $) 5(#!5&%%

Oe) %) %& !5;) %:#(!) 52W!"!(**www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - CglKR n0 g T6LXC, Rgn0

Chemical Compatibility -+) 6G&& !5 X= 62XN, 02Xe #5' XC+, 1I TW)!' 5&9(%#6: &' !#I +) 6G&& !5 "(%)5F6Q G#"!$ N#, X ;) %:!5F (<& T6, XPILXC, RC- O">&$!&"I +(#G6& _!(< :)"(: &(#6" #5' !5) %F#5!$ #5!) 5"I E<& ><)"><#(& !" !5") 6G6& !5 _#(&%#5') 56Q" 6F<(6Q") 6G6& !5 #$!' I

Stability - OO// >>G6&W&6 "(#G6& ;) %) 5(<" !5 - V XN, 0 AH^@B $) 5(#!5&%% - O/ 2/ / >>: ") 6!9(!) 5" $<&: !$#6Q "(#G6& ;) %Q&#% !5 OODV XN, 0 AH^@B $) 5(#!5&%%

Al Containing Samples (Preparation and Solution) -? &(#6Lh &" (' !"") 6W&' !5 X= 6AXN, 0 P#OT6C, 0 LN#C=, (;9"!) 5 !5 @(Po

Atomic Spectroscopic Information (ICP-OES D.L.s are given as <u>radial/axial</u> view):

Technique/Line	Estimated D.L.	Order	Interferences L95' &%#5&' !5' !$#(&" "&W&%&P
*=@O/+ C. #: 9	0/ >>(	NAT	- C=- DN2- 0=- 1N2 - X- C=- 1N2 - - h- g, 2 D1=%O n2 D1e&On
*=@OB+ - g. I/ . R5:	/ I- A I/ / K YFA H	-	e&
*=@OB+ 0K1I1/ - 5:	/ I/ DA I/ / g YFA H	-	d2 =&
*=@OB+ 0KgI- DC5:	/ I/ 0A I/ / g YFA H	-	?) 2 I%2 &

8.0 HAZARDOUS INFORMATION

O@&&#" & %&;&%)((<& +#;&(Q^ #(# +<&&(;) %!5;) %:#(!) 5 %&F#%!5F (<!" =7 ? A? ? I

9.0 HOMOGENEITY

OE<!" ") 6!9(!) 5 _#" : !U&' #$$) %!5F () #5 !5G<) 9"& >%)$&' 9%& #5' !" F9#%#5(&&' () G& <) :) F&5&) 9"I X) :) F&5&!(Q' #(# !5' !$#(& (<#((<& &5' 9"&%"<) 96 (#`& # : !5!: 9: "#: >6& "!c&) ; / IC: H() #""9%& <) :) F&5&!(QI

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

OM+7 = &%!;!$#(& N9: G&%M+7 O/ 01

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

O= <&: !$#6E&"(!5F OT$$%&' !(&' A TCHT = &%!;!$#(& N9: G&%RR0I/ -

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

O7 &;&%&5$& ? #(&%!#6@)% 9$&%OT$$%&' !(&' A TCHT = &%!;!$#(& N9: G&%RR0I/ C

!" #$%!&() *! +# - .(/00 (1* ' 2!"3"$ 4(5#6* .(7 2#&-&%!8, #$.() %9;;0</ .(=>?@*3*A2"!* B(C00DDED<EE@;0 9FCF0/0 .(G%&F;0 9FCF0I: @&!"#$%!&6*! +# - 9 "J @&K L &!"#$%!&6*! +# - 9 "J

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

@#F& 0) ; 1

11.1 Certification Issue Date

p#59#%QC. 2C/ C-

OE<& $&%!(!$#(!) 5 !" W#6' _!(<!5 (<& : &#" 9%&: &5(95$&%#(!5(Q" >&$!;!&' >%)W' &' (<& =7 ? A7 ? !" " () %&' #5' <#5' 6&' !5 #$$) %#5$& _!(< !5" (%)$(!) 5" F!W&5 !5 + &$. I- I E<!" $&%!(!$#(!) 5 !" 596&;!&' !; !5" (%)$(!) 5" !5 + &$. I- #%& 5) (;) 6) _ &') %!; (<& =7 ? A7 ? !" ' #: #F&' 2$) 5(#: !5#(&' 2) %) (<&%_!" & :) ' !;!&' I

11.2 Lot Expiration Date

OJanuary 27, 2025

OE<& ' #(& #;(&%_ <!$< (<!" =7 ? A7 ? " <) 96 5) (G& 9" &' I

OE<& 6) (&U>!%#(!) 5 ' #(& %&;6&$(" (<& >&%) ') ; (!: & (<#((<& " (#G6(Q) ; # =7 ? A7 ? $#5 G& " 9>>) %&' GQ6) 5F (&%: " (#G6(Q" (9' !&" $) 5' 9$(&') 5 >%)>&%&Q" () %&' #5' <#5' 6&' =7 ? A7 ? " I H) (&U>!%#(!) 5 !" 6: !(&' >% #%&Q.GQ (%#5" >!%#(!) 5 L6) " ") ; _#(&%)% (<& ") 6) (!) 5P#5' !5;%&89&5(6Q.GQ.$<&: !$#6" (#G6(Q

11.3 Period of Validity

O+ &#6&' E= E h#F , >&5 ^ #(&Sqqqqqqqqqqqqqqqqqqqqqqqqqq

OE<!" =7 ? A7 ? " <) 96 5) (G& 9" &' 6) 5F&%<(#5) 5& Q&#%L) %" !U:) 5(<" !5 (<& $#" &) ; # 0/ : HG) ((&P ;)% (<& ' #(&) ;) >&5!5F (<& #6) : !5!c&' G#F) %#;(&%<(& ' #(& F!W&5 !5 + &$I - - IC2_ <!$<&W&%$) : &" ;!%(I E<!" !" $) 5(!5F&5(9>) 5 (<& =7 ? A7 ? G&!5F " () %&' #5' <#5' 6&' !5 #$$) %#5$& _!(< (<& !5" (%)$(!) 5" F!W&5 !5 + &$I . I- I

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

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^! %&$() %2M9#6(Q=) 5(%6

Michael 2 Booth

Certifying Officer:

@#964 #!5&"
= <#!%:#5 A+ &5!) %E&$<5!$#6^ !%&$() %

Paul R Gaines

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com
tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

CERTIFICATE OF ANALYSIS

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGAS10
Lot Number:	R2-AS691113
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Arsenic
Starting Material:	As Pieces
Starting Material Lot#:	2208
Starting Material Purity:	99.9980%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9981 ± 55 µg/mL

Density: 1.028 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9981 ± 55 µg/mL**
ICP Assay NIST SRM 3103a Lot Number: 100818

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The follow ing equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.001578	M	Eu	<	0.000526	O	Na		0.036136	M	Se	<	0.014204	O	Zn	<	0.003390
O	Al		0.006694	M	Fe		0.002633	O	Nb	<	0.011526	O	Si		0.139479	M	Zr	<	0.003156
s	As	<		M	Ga	<	0.000526	M	Nd	<	0.000526	M	Sm	<	0.000526				
M	Au	<	0.000526	M	Gd	<	0.000526	O	Ni	<	0.005537	M	Sn	<	0.001052				
M	B		0.017011	M	Ge	<	0.000526	M	Os	<	0.000526	M	Sr	<	0.000526				
M	Ba	<	0.000526	M	Hf	<	0.000526	O	P	<	0.056500	M	Ta	<	0.000526				
O	Be	<	0.001130	M	Hg	<	0.002104	M	Pb	<	0.000526	M	Tb	<	0.000526				
M	Bi	<	0.002104	M	Ho	<	0.000526	M	Pd	<	0.000526	M	Te	<	0.003682				
O	Ca		0.005657	M	In	<	0.000526	M	Pr	<	0.002630	M	Th	<	0.000526				
M	Cd	<	0.000526	M	Ir	<	0.000526	M	Pt	<	0.000526	O	Ti	<	0.001017				
M	Ce	<	0.000526	O	K		0.003865	M	Rb	<	0.002104	M	Tl	<	0.000526				
M	Co	<	0.003156	M	La	<	0.000526	M	Re	<	0.000526	M	Tm	<	0.000526				
M	Cr		0.000877	M	Li	<	0.000526	M	Rh	<	0.000526	M	U	<	0.000526				
M	Cs	<	0.002104	M	Lu	<	0.000526	M	Ru	<	0.000526	M	V	<	0.001578				
M	Cu	<	0.003156	O	Mg		0.000235	O	S	<	0.056500	M	W	<	0.000526				
M	Dy	<	0.000526	M	Mn	<	0.001052	M	Sb	<	0.000526	M	Y	<	0.000526				
M	Er	<	0.000526	M	Mo	<	0.000526	M	Sc	<	0.002104	M	Yb	<	0.000526				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 74.92 ; mix of +3 and +5 ; 6 ; H_3AsO_4 and $HAsO_2$

Chemical Compatibility - Arsenic has no cationic chemistry. It is soluble in HCl, HNO_3,H_3PO_4, H_2SO_4 and HF aqueous matrices water and NH_4OH . It is stable with most inorganic anions (forms arsenate when boiled with chromate) but many cationic metals form the insoluble arsenates under pH neutral conditions. When fluorinated and / or under acidic conditions arsenate formation is typically not a problem at moderate to low concentrations.

Stability - 2-100 ppb levels stable for months alone or mixed with other elements at equivalent levels in 1% HNO_3 / LDPE container.

As Containing Samples (Preparation and Solution) - Metal (soluble in 1:1 H_2O / HNO_3); Oxides (the oxide exists in crystalline and amorphous forms where the amorphic form is more water soluble. The oxides typically dissolve in dilute acidic solutions when boiled); Minerals (one gram of powered sample is fused in a Ni crucible with 10 grams of a 1:1 mix of K_2CO_3 and KNO_3 and the melt extracted with hot water); Organic Matrices (0.2 to 0.5 grams of sample are fused with 15 grams of a 1:1 Na_2CO_3 / Na_2O_2 mix in a Ni crucible. The fuseate is extracted with water and acidified with HNO_3).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 75 amu	20 ppt	N/A	40Ar35Cl, 59Co16O, 36Ar38Ar1H,8Ar37Cl,Ar39K, 150Nd2+,150Sm2+
ICP-OES 189.042 nm	0.05/0.005 µg/mL	1	Cr
ICP-OES 193.696 nm	0.1/0.01 µg/mL	1	V, Ge
ICP-OES 228.812 nm	0.1/0.01 µg/mL	1	Cd, Pt, Ir, Co

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

March 25, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **March 25, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGBA10
Lot Number:	P2-BA682107
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Barium
Starting Material:	Ba(NO3)2
Starting Material Lot#:	Mixed Lots
Starting Material Purity:	99.9995%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10072 ± 32 µg/mL

Density: 1.024 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10054 ± 80 µg/mL**
ICP Assay NIST SRM 3104a Lot Number: 140909

Assay Method #2 **10075 ± 30 µg/mL**
Gravimetric NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.001538	O	Eu	<	0.028728	O	Na		0.006767	M	Se	<	0.007964	O	Zn		0.004335
M	Al		0.005194	M	Fe		0.016554	M	Nb	<	0.000200	O	Si	<	0.020780	M	Zr	<	0.000271
M	As	<	0.000519	M	Ga	<	0.000200	M	Nd	<	0.000200	M	Sm	<	0.082480				
M	Au	<	0.003452	M	Gd	<	0.000200	M	Ni	<	0.001290	M	Sn	<	0.000200				
M	B	<	0.002519	M	Ge	<	0.000430	M	Os	<	0.000752	O	Sr		0.027070				
s	Ba	<		M	Hf	<	0.002746	O	P	<	0.044677	M	Ta	<	0.001008				
M	Be	<	0.000430	M	Hg	<	0.001063	M	Pb	<	0.002257	M	Tb	<	0.000200				
M	Bi	<	0.002971	M	Ho	<	0.000200	M	Pd	<	0.000286	M	Te	<	0.001470				
O	Ca		0.026224	M	In	<	0.000200	M	Pr	<	0.000200	M	Th	<	0.000200				
M	Cd	<	0.000200	M	Ir	<	0.000446	M	Pt	<	0.000200	M	Ti	<	0.000324				
M	Ce	<	0.004362	O	K		0.011526	M	Rb		0.001487	M	Tl	<	0.000200				
M	Co	<	0.000200	O	La	<	0.091587	M	Re	<	0.000200	M	Tm	<	0.000954				
M	Cr	<	0.002191	O	Li	<	0.002181	M	Rh	<	0.000200	M	U	<	0.000200				
M	Cs	<	0.001640	M	Lu	<	0.002934	M	Ru	<	0.000200	M	V	<	0.000229				
M	Cu	<	0.003646	O	Mg		0.002379	O	S	<	0.073041	M	W	<	0.001627				
M	Dy	<	0.000200	M	Mn	<	0.000902	M	Sb	<	0.000514	O	Y	<	0.019637				
M	Er	<	0.000556	M	Mo	<	0.000455	M	Sc	<	0.000478	M	Yb	<	0.001991				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 137.33 +2 6 Ba(H2O)6+2
Chemical Compatibility - Soluble in HCl, and HNO3. Avoid H2SO4, HF and neutral to basic media. Stable with most metals and inorganic anions forming insoluble silicate, carbonate, hydroxide, oxide, fluoride, sulfate, oxalate, chromate, arsenate, iodate, molybdate, sulfite and tungstate in neutral aqueous media.
Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1 -10,000 ppm solutions chemically stable for years in 1-3.5% HNO3 / LDPE container.
Ba Containing Samples (Preparation and Solution) -Metal(is best dissolved in diluted HNO3); Ores(Carbonate fusion in Pt0 followed by HCl dissolution. If sulfate is present dissolve the fuseate using HCl / tartaric acid to prevent BaSO4 precipitate); Organic Matrices (dry ash and dissolve in dilute HCl.)
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 138 amu	1 ppt	N/A	122Sn16O, 122Te16O
ICP-OES 230.424 nm	0.004/0.0005 µg/mL	1	Mo, Ir, Co
ICP-OES 233.527 nm	0.004/0.0003 µg/mL	1	
ICP-OES 455.403 nm	0.002/0.0001 µg/mL	1	Zr, U

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

September 13, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **September 13, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com
tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES !" #$$%&' !(&' () *+, - . / 01234 &5&%#67 &89!%&: &5(" ;) % (<& =) : >&(&5$&) ; 7 &;&%&5$& ? #(&%#6@)% 9$&%3#5' *+, A*B=- . / CD234 &5&%#6 7 &89!%&: &5(" ;) %<(& =) : >&(&5$&) ; E&" (!5F #5' =#6G%#(!) 5 H#G) %#() %&" 3I *5) %5!$ J&5(9%&" !" #6) #5 *+, K/ / - %&F!" (&%&' : #59;#$(9%&%LM+7 = &%{!$#(& N9: G&%M+7 G/ 01PI

2.0 PRODUCT DESCRIPTION

@)% 9$(=) ' &S	+!5F6& T5#6Q(& = 9" () : 4 %#' & +) 69(!) 5
= #(#6) F N9: G&%S	= 4 UB- /
H) (N9: G&%S	@QCOUBV. RRVD
? #(%#S	VX LYAYPZN , 0
J#69& AT5#6Q(&L" PS	-/ / / / [FA H&#S U&%Q6B9:
+(#%{5F ? #(&%#6S	U&%Q6B9: ' !#$&(#(&
+(#%{5F ? #(&%#6H) (\ S	CCC-
+(#%{5F ? #(&%#6@9%(QS	KKIKKKRX

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: -/ / 0V] 0D [FA H

Density: - I- 1/ FA HL: &#" 9%&' #(C/] 1 ^= P

Assay Information:

Assay Method #1 **10051 ± 42 µg/mL**
= @T" "#QN+ E + 7 ? 0- / D# H) (N9: G&%S/ K/ D- 1

Assay Method #2 **10008 ± 59 µg/mL**
= #6$96#&' N*+ E + 7 ? H) (N9: G&%S+ && + &$I 1IC

CE<& = #6$96#(&' J#69& !" # Y#69& $#6$96#(&' ;%: (<& _ &!F<( ) ; # " (#%{5F : #(&%#6(<#(<#" G&&5 $&%{!&' ' !%&$(6QY" I # N#(!) 5#6*5" (!(9(&) ; +(#5' #%" #5' E&$<5) 6) FQLN*+EP+7 ? A7 ? I + && + &$ 1IC ;) %G#6#5$& (%#$&#G96(Q

E<& ;) 66) !5F &89#(!) 5" #%& 9" &' !5 (<& $#6$96#(!) 5) ; (<& $&%(;!&' Y#69& #5' (<& 95$&%(#!5(Q 7 &>) %(&' 95$&%(#!5(!&" %&>%&" &5(&W¥#5' &' 95$&%(#!5(!&" &W¥%&" " &' #(#>>%)W #(&6Q(<& KDX $) 5;!' &5$& 6&Y&69" !5F # $) Y&%#F& ;#$() %) ; ` a C

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

OE<!" >%þ' 9$(!" (%‰$&#G8& () N*+E Y!# #5 95G%þ` &5 $<#!5 ) ; $) : >#%" ) 5"I E<& 95$&%‰#(!5(!&" ;) %&#$< $&%‰(!&' Y#69& #%& %&>) %&(' 2 #` !5F !5() #$$) 95((<& +7 ? A7 ? 95$&%‰#(!5(Q&%)%%#5' (<& : &#" 9%&: &5(2_ &!F<!5F #5' Y) 69: & ' !69(!) 5 &%)%%I *5 %‰%& $#" &" _<&%& 5) N*+E +7 ? A7 ? #%& #Y#!6#G8&2 (<& (&%: !5G<) 9" & " (' Ib!" " >&$!;!&' I

4.1 Thermometer Calibration

OT66(<&%:) : &(&% #%& N*+E (%‰$&#G8& (<%þ9F< (<&%:) : &(&% (<#(#%& $#6G%‰(&' GQ#5 #$$%&' !(&' $#6G%‰(!) 5 6#G) %‰() %Q

4.2 Balance Calibration

OT6#5#6Q!$#6G#6#5$&" #%& $#6G%‰(&' GQ#5 #$$%&' !(&' $#6G%‰(!) 5 6#G) %‰() %Q#5' >%þ$&' 9%&I E<& _ &!F<(" 9" &' ;) %&(" (!5F #%& #559#6Q$) : >#%&' () : #" (&%_ &!F<(" #5' #%& (%‰$&#G8& () N*+EI

4.3 Glassware Calibration

OT5 !5G<) 9" & >%þ$&' 9%& !" 9" &' () $#6G%‰(& #66=6#" " T F6#" " _#%& 9" &' !5 (<& : #59;#$(9%5F #5' 89#66(Q $) 5(%6) ; =7 ? A7 ? " I

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

=7 ? A7 ? " #%& (&" (&' ;) % (#%& : &(#66$!: >9%(!&" GQTW#6*=@0 B+ #5' *=@0?+I E<& %&" 96(;%: (<& :) " (" &5" !(!Y& : &(<) ' ;) %&#$< &&: &5(2!" %&>) %&(' G&0 _I +) 69(!) 5" (&" (&' GQ*=@0?+ _&%& #5#6Qc&' !5 #5 dH@TGe!6(&%&' =6&#5 7)) : I T5 dH@TGe!6(&%(" KKIKKRDX &;;!$!&5(;) %<(& %&:) Y#6) ; >#%!$6&' ') _5 () / I0 [: I

?	TF	/ I/ 1D1- 1	?	B9	f	/ I/ / / CD1	,	N#	/ I/ - D/ / K	?	+& f
/ I/ - DCD.	,	k5	/ I/ / 1/ DK	,	T6	/ I/ / R/ DR	,	e&	/ I/ -- . 1K	?	NG f
/ I/ / / CD1	,	+!	/ I/ V0. K0	,	k% f	/ I/ / . / V1	?	T" f	/ I/ / V1. 0	?	4 # f
/ I/ / / CD1	?	N' f	/ I/ / / CD1	?	+: f	/ I/ / / CD1	?	T9 f	/ I/ / / C1R	?	4 ' f
/ I/ / / CD1	?	N! f	/ I/ / / CD1	?	+5 f	/ I/ / CD1C	,	U f	/ I/ C- VV-	?	4 & f
/ I/ / / C1R	?	, " f	/ I/ / / CD1	?	+% f	/ I/ / / CD1	?	U#	/ I/ / - . V/	?	Z; f
/ I/ / / CD1	,	@ f	/ IVVVD/ /	?	E# f	/ I/ / / CD1	"	U& f	?	ZF f	/ I/ / - C11
?	@G f	/ I/ / - C. -	?	EG f	/ I/ / / CD1	?	U! f	/ I/ / / CD1	?	Z) f	/ I/ / / CD1
?	@ f	/ I/ / / CD1	?	E& f	/ I/ / - . R/	,	=#	/ I/ - DCDV	?	*5 f	/ I/ / / CD1
?	@% f	/ I/ / / CD1	?	E< f	/ I/ / / CD1	?	=' f	/ I/ / / CD1	?	*% f	/ I/ / / C1R
?	@(f	/ I/ / / CD1	,	E! f	/ I/ / CCVV	?	=& f	/ I/ / / CD1	,	h	/ I/ 0-- C.
?	7G f	/ I/ / / D/ R	?	E6 f	/ I/ / / CD1	?	=) f	/ I/ / 1/ VR	?	H# f	/ I/ / / CD1
?	7& f	/ I/ / / CD1	?	E: f	/ I/ / / CD1	?	=% f	/ I/ / - DCD	,	H! f	/ I/ / / VVV
?	7< f	/ I/ / / CD1	?	d f	/ I/ / / CD1	?	="	/ I/ / - V1C	?	H9 f	/ I/ / / CD1
?	79 f	/ I/ / / C1R	?	J f	/ I/ / / D/ R	?	=9 f	/ I/ / D/ RD	,	? F	/ I/ / - K/ .
!	+ f	?	i f	/ I/ / 1/ VR	?	gQ f	/ I/ / / CD1	,	? 5 f	/ I/ / - 000	?
+G f	/ I/ / / CD1	?	j f	/ I/ / / CD1	?	B% f	/ I/ / / CD1	?	?) f	/ I/ / / . VC	,
+$ f	/ I/ / - 000	?	j G f	/ I/ / / CD1							

? O=<&$`&' GQ*=@0? + , O=<&$`&' GQ*=@0 B+ ! O+>&$(%‰6*5(&%&%&5$&
5 ON) (=<&$`&' e) % " O+) 69(!) 5 +(#5' #% B6& &5(

6.0 INTENDED USE

Oe) %<(& $#6G%‰(!) 5) ; #5#6Q!$#6!5" (%þ: &5(" #5' Y#6' #(!) 5) ; #5#6Q!$#6: &(<) ' " #" #>>%þ>%‰(&I

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

O+() %& G&(_&&5 #>>%;W! #(&6Q1l O0/ l = _<!6& !5 " &#6&' E= E G#Fl

Oi <!6& " () %&' !5 (<& " &#6&' E= E G#F2(%#5" >!%#(!) 5) ; (<!" =7 ? A7 ? !" 5&F6F!G&l T;(&%) >&5!5F (<& " &#6&' E= E G#F (%#5" >!%#(!) 5) ; (<& =7 ? A7 ? _!6) $$9%2&%&" 96!5F !5 # F%#' 9#6!5$%&#" & !5 (<& #5#6Q(& $) 5$&5(%#(!) 5L" Pl *(!" (<& %&" >) 5" !G!6(Q) ; (<& 9" &%)(#$$) 95(;) % <!" &;;&$(l i <&5 (<& G) ((6& !" _&!F<&' G) (< G&;) %& #5' #;(&%G&!5F >6#$&' !5 " () %#F&2 (<& : #"" ' !;;&%&5$&) G' &%%&' _!6G& # : &#" 9%&) ; (%#5" >!%#(!) 5 : #"" 6) ""l

OT;(&%) >&5!5F (<& " &#6&' E= E G#F2`&&> $#> (!F<(6Q" &#6&' _<&5 5) (!5 9" & #5' " () %& G&(_&&5 1l OC1l = ( ) : !5!: !c& (<& &;;&$(") ; (%#5" >!%#(!) 5l d" & #(C/ l] 1l = ( ) : !5!: !c& Y) 6: &(%#$ ' !6) (!) 5 &%%) %%_<&5 9" !5F (<& %&>) %(&' ' &5" !(Q g) 5) (>!>&((& ;%): (<& $) 5(#!5&% g) 5) (%&(9%5 %&:) Y&' #6!89) (" () $) 5(#!5&%

Oe) %) %& !5;) %:#(!) 52Y!" !(**www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - Kl/ - mC 1 U&LZC, Pl mC

Chemical Compatibility -+) 6G6& !5 Z= 62ZN, 02 ZC+, 1 #5' Ze #89&) 9" : #(%!$&" l +(#G6& _!(< #66: &(#6" #5' !5) %F#5!$ #5!) 5" l

Stability - CO/ / >>G6&Y&6" "(#G6& ;) %) 5(<" !5 - X ZN, 0 AHg@B $) 5(#!5&% - O/ 2/ / >>: ") 6(!) 5" $<&: !$#66Q" (#G6& ;) %Q&#% !5 DO/ X ZN, 0 AHg@B $) 5(#!5&%

Be Containing Samples (Preparation and Solution) - ? &(# 6L!" G&" (' !"") 6Y&' !5 ' !6(&' ZC+, 1 PnU&, LG) !6!5F 5!(%!$2<Q %$<6) %!$2) %' 969%!$ #$!") % hZ+, 1 ;9" !) 5Pn, %&" LZC+, 1AZe ' !F&" (!) 5) %$#%G) 5#(& ;9" !) 5 !5 @(Pn , %F#5!$? #(%!$&" L" 969%!$A>&%) W &' !F&" (!) 5) %5!(%!$A 969%!$A>&%$<6) %!$ #$!' ' &$) : >) " !(!) 52) % %Q#" < #5' ' !"") 6(!) 5 #$$) %!5F () (<& U&, >%)$&' 9%& #G) Y&Pl

Atomic Spectroscopic Information (ICP-OES D.L.s are given as <u>radial/axial</u> view):

Technique/Line	Estimated D.L.	Order	Interferences L95' &%65&' !5' !$#(&" "&Y&%&P
*=@O/+ K#: 9	1 >>(	NAT	
*=@OB+ C01lRV- 5:	/ l/ / / 0A l/ / / - V [FA H	-	e&2E#2?)
*=@OB+ 0- 0l/ 1C 5:	/ l/ / / 0A l/ / / / K [FA H	-	J2 =&2 d
*=@OB+ 0- 0l- / . 5:	/ l/ / / . A l/ / / D [FA H	-	= &2E<2E:

8.0 HAZARDOUS INFORMATION

O@6&#" & %&;&%)((<& +#;&(Qg #(# +<&&(;) %5;) %:#(!) 5 %&F#%!5F (<!" =7 ? A7 ? l

9.0 HOMOGENEITY

OE<!" ") 6(!) 5 _#" : !W&' #$$) %!5F () #5 !5G<) 9" & >%) $&' 9%& #5' !" F9#%#5(&&' () G& <) :) F&5&) 9" l Z) :) F&5&!(Q' #(# !5' !$#(& (<#((<& &5' 9" &%" <) 96' (#`& # : !5!: 9: "#: >6& " !c&) ; / lC: H() #"" 9%& <) :) F&5&!(Q

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

OM+7 = &%(!;!$#(& N9: G&%M+7 O/ 01

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

O= <&: !$#6E&" (!5F OT$$%&' !(&' A TCHT = &%(!;!$#(& N9: G&%RR0l/ -

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

O7 &;&%&5$& ? #(&%!#6@%) 9$&%OT$$%&' !(&' A TCHT = &%(!;!$#(& N9: G&%RR0l/ C

!" #$%!&() *! +#-./00 (1* ' 2!"3"$ 4(5#6* .(7 2#&-&%!8, #$.() %(;:0</ .(=>?@*3*A2"!* B(C009DDED<EE@;0 9FCF90/0 .(G%#F;0 9FCF90l: @&!"#$%!&6*! +#-9 "J @&!KL &!"#$%!&6*! +#-9 "J

11.0 CERTIFICATION, LOT EXPIRATION, PERIOD OF VALIDITY AND REVISION HISTORY

@#F& 0) ; 1

11.1 Certification Issue Date

T>%6CC2C/ - K

OE<& $&%!($#(!) 5 !" Y#6" _!(<!5 (<& : &#"9%& &5(95$&%#(!5(Q">&$!;!&' >%)Y!' &' (<& =7 ? A7 ? !" "() %&' #5' <#5' 6&' !5 #$$) %#5$& _!(< !5" (%a$(!) 5" F!Y&5 !5 +&$. I- I E<!" $&%!($#(!) 5 !" 5966;!&' !; !5" (%a$(!) 5" !5 +&$. I- #%& 5) (;) 66) _&') %!; (<& =7 ? A7 ? !" ' #: #F&' 2$) 5(#: !5#(&' 2) %) (<&%_!" & :) ' !;!&' I

11.2 Lot Expiration Date

OApril 22, 2023

OE<& ' #(& #;(&%_<!$< (<!" =7 ? A7 ? "<) 96 5) (G& 9" &' I

OE<& 6) (&V¥!%#(!) 5 ' #(& %&;6&$(" (<& >&%) ') ; (!: & (<#((<& "(#G66(Q) ; # =7 ? A7 ? $#5 G& "9>>) %&' GQ6) 5F (&%: "(#G66(Q"(9' !&" $) 5' 9$(&') 5 >%)>&%&Q"() %&' #5' <#5' 6&' =7 ? A7 ? "I H) (&V¥!%#(!) 5 !" 6: !(&' >% #%&QGQ (%#5" >!%#(!) 5 L6) "") ; _#(&%)% (<& ") 69(!) 5P#5' !5;%&89&5(6QGQ$<&: !$#6"(#G66(Q

11.3 Period of Validity

O+&#6&' E= E U#F , >&5 g#(&Soooooooooooooooooooooooooo

OE<!" =7 ? A7 ? "<) 96 5) (G& 9" &' 6) 5F&%<(#5) 5& Q&#%L) %"!W:) 5(<" !5 (<& $#" &) ; # 0/ : HG) ((&P ;)% (<& ' #(&) ;) >&5!5F (<& #69: !5!c&' G#F) %#;(&%<(& ' #(& F!Y&5 !5 +&$I -- IC2_<!$<&Y&%$) : &" ;!%(I E<!" !" $) 5(!5F&5(9>) 5 (<& =7 ? A7 ? G&!5F "() %&' #5' <#5' 6&' !5 #$$) %#5$& _!(< (<& !5" (%a$(!) 5" F!Y&5 !5 +&$I . I- I

11.4 Revision Status

O7 &Y!" !) 5 - O7 &Y!" &') 5 E<9%' #Q2p#5 - 12C/ C- GQ9(%a) 5FI 7 &Y!" !) 5 _#" : #' & ;) %<(& ;) 66) _!5F %&#") 5S ?) ' !;!&' +&$(!) 5 . =<&: !$#6e) %: !5 +) 69(!) 5I

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

? !$<#&6U)) (<
g!%&$() %2M9#6(Q=) 5(%6

Certifying Officer:

@#964 #!5&"
=<#!%:#5 A+&5!) %E&$<5!$#6g!%&$() %

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCA10
Lot Number:	R2-CA697921
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Calcium
Starting Material:	Calcium Oxide
Starting Material Lot#:	P2-CA677788
Starting Material Purity:	99.9995%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9985 ± 30 µg/mL

Density: 1.039 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9976 ± 43 µg/mL**
ICP Assay NIST SRM 3109a Lot Number: 130213

Assay Method #2 **9965 ± 25 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **10008 ± 26 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.002500	M	Eu	<	0.001300	M	Na		0.008214	O	Se	<	0.022000	O	Zn		0.001158
O	Al	<	0.030000	O	Fe		0.002316	M	Nb	<	0.001300	O	Si	<	0.022000	M	Zr	<	0.006200
O	As	<	0.025000	M	Ga	<	0.002500	M	Nd	<	0.001300	M	Sm	<	0.001300				
M	Au	<	0.013000	M	Gd	<	0.001300	O	Ni	<	0.005300	O	Sn	<	0.013000				
O	B	<	0.006900	O	Ge	<	0.018000	M	Os	<	0.002500	M	Sr		0.115847				
M	Ba		0.000905	M	Hf	<	0.002500	O	P	<	0.027000	M	Ta	<	0.008600				
O	Be	<	0.000270	M	Hg	<	0.001300	M	Pb		0.001685	M	Tb	<	0.001300				
M	Bi	<	0.002500	M	Ho	<	0.001300	M	Pd	<	0.006200	O	Te	<	0.045000				
s	Ca	<		M	In	<	0.001300	M	Pr	<	0.001300	M	Th	<	0.001300				
O	Cd	<	0.000540	M	Ir	<	0.001300	M	Pt	<	0.001300	O	Ti	<	0.004200				
M	Ce	<	0.001300	O	K		0.015797	M	Rb	<	0.014000	M	Tl	<	0.001300				
O	Co		0.000558	M	La	<	0.001300	M	Re	<	0.001300	M	Tm	<	0.001300				
O	Cr	<	0.006000	O	Li	<	0.006900	M	Rh	<	0.002500	M	U	<	0.001300				
M	Cs	<	0.001300	M	Lu	<	0.001300	M	Ru	<	0.003800	O	V	<	0.002200				
M	Cu	<	0.002500	O	Mg		0.002843	n	S	<		M	W	<	0.012000				
M	Dy	<	0.001300	O	Mn		0.000115	M	Sb	<	0.007400	M	Y	<	0.001300				
M	Er	<	0.001300	M	Mo		0.002527	O	Sc	<	0.006100	M	Yb	<	0.001300				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 40.08 +2 6 $Ca(H_2O)_6^{+2}$

Chemical Compatibility - Soluble in HCl and HNO_3. Avoid H_2SO_4, HF, H_3PO_4 and neutral to basic media. Stable with most metals and inorganic anions forming insoluble silicate, carbonate, hydroxide, oxide, fluoride, sulfate, oxalate, chromate, arsenate, and tungstate in neutral aqueous media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-10% HNO_3 / LDPE container.

Ca Containing Samples (Preparation and Solution) -Metal (best dissolved in diluted HNO_3); Ores (Carbonate fusion in Pt0 followed by HCl dissolution); Organic Matrices (dry ash and dissolution in dilute HCl. Do not heat when dissolving to avoid precipitation of SiO_2). The oxide, hydroxide, carbonate, phosphate, and fluoride of calcium are soluble in % levels of HCl or HNO_3. The sulfates (gypsum, anhydrite, etc.), certain silicates, and complex compounds require fusion with Na_2CO_3 followed by HCl / water dissolution. Note that contamination is a very real problem when analyzing for trace levels.

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 44 amu	1200 ppt	n/a	16O212C, 28Si16O, 88Sr
ICP-OES 393.366 nm	0.0002 / 0.00004 µg/mL	1	U, Ce
ICP-OES 396.847 nm	0.0005 / 0.00006 µg/mL	1	Th
ICP-OES 422.673 nm	0.01 / 0.001 µg/mL	1	Ge

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

November 09, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **November 09, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Director, Quality Control

Certifying Officer:

Paul Gaines
Chairman / Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCD10
Lot Number:	P2-CD685077
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Cadmium
Starting Material:	Cd Shot
Starting Material Lot#:	1954
Starting Material Purity:	99.9996%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9954 ± 30 µg/mL

Density: 1.029 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9956 ± 54 µg/mL**
ICP Assay NIST SRM 3108 Lot Number: 130116

Assay Method #2 **9953 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

O	Ag	<	0.006348	M	Eu	<	0.010622	O	Na		0.004020	M	Se	<	0.008116	O	Zn	<	0.002152
O	Al		0.011566	M	Fe		0.003011	M	Nb	<	0.000405	O	Si		0.005480	M	Zr	<	0.000405
M	As	<	0.001623	M	Ga	<	0.000405	M	Nd	<	0.000405	M	Sm	<	0.000405				
M	Au	<	0.000405	M	Gd	<	0.000405	M	Ni	<	0.002840	M	Sn	<	0.001217				
M	B	<	0.004463	M	Ge	<	0.000405	M	Os	<	0.000405	M	Sr	<	0.000405				
O	Ba	<	0.000968	M	Hf	<	0.000405	O	P	<	0.045730	M	Ta	<	0.000405				
M	Be	<	0.000405	O	Hg	<	0.002152	M	Pb	<	0.002434	M	Tb	<	0.000405				
M	Bi	<	0.000405	M	Ho	<	0.000405	M	Pd	<	0.000405	M	Te	<	0.016636				
O	Ca		0.002946	O	In	<	0.021520	M	Pr	<	0.000405	M	Th	<	0.000405				
s	Cd	<		M	Ir	<	0.000405	M	Pt	<	0.000405	M	Ti	<	0.001217				
M	Ce	<	0.000405	O	K		0.008179	M	Rb	<	0.000405	M	Tl	<	0.004495				
M	Co	<	0.000405	M	La	<	0.000405	M	Re	<	0.000405	M	Tm	<	0.000405				
M	Cr		0.002907	M	Li	<	0.000405	M	Rh	<	0.000405	M	U	<	0.000405				
M	Cs	<	0.002374	M	Lu	<	0.000405	M	Ru	<	0.000405	M	V	<	0.003179				
M	Cu	<	0.002434	O	Mg		0.000137	O	S	<	0.037660	M	W	<	0.000405				
M	Dy	<	0.000405	M	Mn	<	0.001623	M	Sb	<	0.004057	M	Y	<	0.000405				
M	Er	<	0.000405	M	Mo	<	0.000811	M	Sc	<	0.001623	M	Yb	<	0.000811				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 112.41 +2 4 Cd2(OH) (aq)3+ and Cd(OH)(aq)

Chemical Compatibility -Stable in HCl, HNO3, H2SO4 , and HF. Avoid basic media forming insoluble carbonate and hydroxide.

Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5 % HNO3 / LDPE container.

Cd Containing Samples (Preparation and Solution) -Metal (soluble in HNO3); Oxides (soluble in HCl or HNO3); Ores (dissolve in HCl /HNO3 then take to fumes with H2SO4. The silica and lead sulfate are filtered off after the addition of water); Organic based (dry ash at 450°C and dissolve ash in HCl), (sulfuric / peroxide acid digestion).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 111 amu	11 ppt	n/a	95Mo16O
ICP-OES 214.438 nm	0.003 / 0.0003 µg/mL	1	Pt, Ir
ICP-OES 226.502 nm	0.003 / 0.0003 µg/mL	1	Ir
ICP-OES 228.802 nm	0.003 / 0.0003 µg/mL	1	Co, Ir, As, Pt

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

November 08, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **November 08, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCO10
Lot Number:	N2-CO671028
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Cobalt
Starting Material:	COBALT
Starting Material Lot#:	1749
Starting Material Purity:	99.9978%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9988 ± 34 µg/mL

Density: 1.057 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9973 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #2 **10024 ± 50 µg/mL**
ICP Assay NIST SRM traceable to 3113 Lot Number: M2-CO661665

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

O	Ag		0.022956	M	Eu	<	0.000422	O	Na		0.008125	M	Se	<	0.009290	M	Zn		0.007197
O	Al		0.013621	O	Fe		0.048700	M	Nb	<	0.000422	O	Si		0.017539	M	Zr	<	0.014357
i	As	<		M	Ga	<	0.000844	M	Nd	<	0.017735	M	Sm	<	0.001689				
M	Au	<	0.000583	M	Gd		0.003247	O	Ni	<	0.043642	M	Sn	<	0.005067				
M	B	<	0.013512	M	Ge	<	0.004645	M	Os	<	0.000583	O	Sr		0.000841				
O	Ba		0.071210	M	Hf	<	0.000422	n	P	<		M	Ta	<	0.000422				
O	Be	<	0.001771	M	Hg	<	0.002334	M	Pb		0.010094	M	Tb	<	0.001689				
M	Bi		0.000614	M	Ho	<	0.000422	M	Pd	<	0.000422	M	Te	<	0.008445				
O	Ca		0.025034	M	In	<	0.003378	M	Pr	<	0.006756	M	Th	<	0.000422				
M	Cd	<	0.000844	M	Ir	<	0.000583	M	Pt	<	0.000422	M	Ti	<	0.002533				
M	Ce		0.002721	O	K		0.005785	M	Rb	<	0.001689	M	Tl	<	0.000422				
s	Co	<		M	La		0.000877	M	Re		0.016853	M	Tm	<	0.000422				
M	Cr	<	0.020269	O	Li		0.000262	M	Rh	<	0.000422	M	U	<	0.000422				
M	Cs		0.000877	M	Lu	<	0.000422	M	Ru	<	0.000583	M	V	<	0.001689				
M	Cu		0.007197	O	Mg		0.003444	n	S	<		M	W	<	0.000844				
M	Dy	<	0.000422	O	Mn	<	0.006072	M	Sb	<	0.005911	M	Y		0.001228				
M	Er	<	0.000422	M	Mo	<	0.005911	M	Sc	<	0.001689	M	Yb	<	0.003378				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 58.93 +2 6 $Co(H_2O)_6^{2+}$
Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4 ,HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.
Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.
Co Containing Samples (Preparation and Solution) - Metal (soluble in HNO_3); Oxides (Soluble in HCl); Ores (dissolve in HCl / HNO_3).
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 59 amu	2 ppt	n/a	42Ca16O1H , 40Ar18O1H , 36Ar23Na, 43Ca16O, 24Mg35Cl
ICP-OES 228.616 nm	0.01/0.001 µg/mL	1	
ICP-OES 237.862 nm	0.01/0.002 µg/mL	1	W, Re, Al, Ta
ICP-OES 238.892 nm	0.01/0.002 µg/mL	1	Fe, W, Ta

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

January 15, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **January 15, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Supervisor, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCR(3)10
Lot Number:	R2-CR691013
Matrix:	10% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Chromium
Starting Material:	Cr METAL
Starting Material Lot#:	2077
Starting Material Purity:	99.9942%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10044 ± 40 µg/mL

Density: 1.082 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10057 ± 58 µg/mL**
ICP Assay NIST SRM 3112a Lot Number: 170630

Assay Method #2 **10035 ± 50 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The follow ing equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.000540	M	Eu	<	0.003200	O	Na		0.130091	M	Se	<	0.012000	O	Zn	<	0.002700
O	Al		0.016634	O	Fe		0.202602	M	Nb	<	0.022000	n	Si	<		M	Zr	<	0.020000
M	As		0.003838	O	Ga	<	0.031000	M	Nd	<	0.000540	M	Sm	<	0.035000				
M	Au	<	0.000540	M	Gd	<	0.000540	O	Ni		0.009170	M	Sn		0.004051				
M	B	<	0.049000	M	Ge	<	0.005400	M	Os	<	0.088000	O	Sr	<	0.000250				
O	Ba	<	0.002000	M	Hf	<	0.000540	i	P	<		M	Ta	<	0.000540				
O	Be	<	0.000250	M	Hg	<	0.001600	M	Pb		0.002559	M	Tb	<	0.000540				
M	Bi		0.008956	M	Ho	<	0.000540	M	Pd	<	0.001100	M	Te	<	0.004800				
O	Ca		0.074642	M	In	<	0.001100	M	Pr	<	0.000540	M	Th	<	0.000540				
M	Cd	<	0.000540	M	Ir	<	0.000540	M	Pt	<	0.000540	O	Ti		0.013435				
M	Ce	<	0.000540	O	K		0.034122	i	Rb	<		M	Tl	<	0.001100				
O	Co	<	0.002900	M	La	<	0.001100	M	Re	<	0.002700	O	Tm	<	0.001800				
s	Cr	<		O	Li	<	0.000130	M	Rh	<	0.032000	M	U	<	0.001100				
M	Cs	<	0.019000	M	Lu	<	0.000540	M	Ru	<	0.094000	O	V		0.159949				
O	Cu		0.010023	O	Mg		0.001450	i	S	<		M	W	<	0.028000				
M	Dy	<	0.000540	O	Mn	<	0.014000	M	Sb	<	0.008600	M	Y	<	0.001100				
M	Er	<	0.016000	O	Mo	<	0.013000	O	Sc	<	0.001400	M	Yb	<	0.000540				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 52.00 +3 6 $Cr(H_2O)_6^{3+}$

Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4, HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Cr3 Containing Samples (Preparation and Solution) -Metal (soluble in HCl); Oxides/Ores (Chrome ore/oxides are very difficult to dissolve. The following procedures [A-D] are commonly used: A. Fusion with $KHSO_4$ and extraction with hot KCl. The residue fused with Na_2CO_3 and $KClO_3$, 3:1. B. Fusion with $NaKSO_4$ and NaF 2:1, C. Fusion with magnesia or lime and sodium or potassium carbonates, 4:1. D. Fusion with Na_2O_2 or NaOH and KNO_3 or NaOH and Na_2O_2. Nickel, iron, copper, or silver crucibles should be used for D. Platinum may be used for A, B, C); Organic Matrices (ash at 4500C followed by one of the fusion methods above or sulfuric/hydrogen peroxide acid digestions may be applicable to non oxide containing samples).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 52 amu	40 ppt	N/A	36S16O, 36Ar16O - The 50Cr, 53Cr, 54Cr lines suffer from many more potential interferences from sulfur, chlorine and argon compounds of oxygen, nitrogen and carbon.
ICP-OES 205.552 nm	0.006/0.0008 µg/mL	1	Os
ICP-OES 276.654 nm	0.01/0.001 µg/mL	1	Cu, Ta, V
ICP-OES 284.325 nm	0.008/0.0007 µg/mL	1	

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

March 25, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **March 25, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

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ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGCU10
Lot Number:	R2-CU693370
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Copper
Starting Material:	Cu Metal
Starting Material Lot#:	2095
Starting Material Purity:	99.9996%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10016 ± 30 µg/mL

Density: 1.033 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10010 ± 55 µg/mL**
ICP Assay NIST SRM 3114 Lot Number: 121207

Assay Method #2 **10017 ± 26 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **10015 ± 25 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\ (u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\ (u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.007542	M	Eu	<	0.000942	O	Na		0.001434	M	Se	<	0.016971	M	Zn	<	0.005657
O	Al	<	0.000609	O	Fe		0.008698	M	Nb	<	0.000942	O	Si		0.003052	M	Zr	<	0.000942
M	As	<	0.010371	M	Ga	<	0.000942	M	Nd	<	0.000942	M	Sm	<	0.000942				
M	Au	<	0.001885	M	Gd	<	0.000942	M	Ni		0.003780	M	Sn	<	0.005657				
O	B		0.003662	M	Ge	<	0.005657	M	Os	<	0.000942	M	Sr	<	0.000942				
M	Ba		0.004252	M	Hf	<	0.000942	O	P	<	0.031668	M	Ta	<	0.000942				
M	Be	<	0.000942	O	Hg	<	0.007064	M	Pb		0.005788	M	Tb	<	0.000942				
M	Bi	<	0.000942	M	Ho	<	0.000942	M	Pd	<	0.000942	M	Te	<	0.004714				
O	Ca		0.002304	M	In	<	0.000942	M	Pr	<	0.000942	M	Th	<	0.000942				
M	Cd	<	0.000942	M	Ir	<	0.000942	M	Pt	<	0.000942	O	Ti	<	0.002801				
M	Ce	<	0.000942	O	K		0.000762	M	Rb	<	0.000942	M	Tl	<	0.000942				
M	Co		0.001890	M	La	<	0.000942	M	Re	<	0.000942	M	Tm	<	0.000942				
M	Cr	<	0.005657	O	Li	<	0.000243	i	Rh	<		M	U	<	0.000942				
M	Cs	<	0.000942	M	Lu	<	0.000942	M	Ru	<	0.039588	M	V	<	0.003771				
s	Cu	<		O	Mg		0.000320	O	S		0.007172	M	W	<	0.005657				
M	Dy	<	0.000942	O	Mn		0.000793	M	Sb	<	0.001885	M	Y	<	0.000942				
M	Er	<	0.000942	M	Mo	<	0.005657	M	Sc	<	0.000942	M	Yb	<	0.000942				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 63.55 +2 6 $Cu(H_2O)_6^{2+}$

Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4, HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Cu Containing Samples (Preparation and Solution) -Metal (soluble in HNO_3); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO_3).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 63 amu	10 ppt	n/a	40Ar23Na 47Ti16O, 14N12C37Cl, 16O12C35Cl, 23Na40Ca
ICP-OES 219.958 nm	0.01/.002 µg/mL	1	Th, Ta, Nb, U, Hf
ICP-OES 224.700 nm	0.01/.001 µg/mL	1	Pb, Ir, Ni, W
ICP-OES 324.754 nm	0.06/.001 µg/mL		Nb, U, Th, Mo, Hf

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

June 05, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- June 05, 2024

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES™
Refine your results. Redefine your industry.

300 Technology Drive
Christiansburg, VA 24073 USA
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P: 800-669-6799/540-585-3030
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Certificate of Analysis

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES !" #$$%&' !(&' () *+, - . / 01234 &5&%#67 &89!%&: &5(" ;) % (<& =) : >&(&5$&) ; 7 &;&%&5$& ? #(&%#6@)% 9$&%3#5' *+, A*B=- . / CD234 &5&%#6 7 &89!%&: &5(" ;) %<(& =) : >&(&5$&) ; E&"(!5F #5' =#6G%#(!) 5 H#G) %#() %&" 3I *5) %5#5!$ J&5(9%&" !" #6') #5 *+, K/ / - %&F!"(&%&' : #59;#$(9%&%LM+7 = &%(!$#(& N9: G&%M+7 O-/ 01PI

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2.0 PRODUCT DESCRIPTION

@)% 9$(=) ' &S	? 96(! T5#6Q(& = 9" () : 4 %#' & +) 69(!) 5
= #(#6) F N9: G&%S	T7*O
H) (N9: G&%S	+ CO?BU. / 1CR1
? #(%WS	DW LXAXPYN, 0
J#69& AT5#6Q(&L" PS	-/ /// ZFA. H&#S
	*%5

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Iron, Fe	**10 000.0 ± 40.0 µg/mL**		

Density: - I/ 00 FA. HL: &#"9%&' #(C/ [1 \= P

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
^ &	*= @T" "#Q	0- C] #	- 1/ R- C
^ &	B_ET	KCR	KCR

E<& ;) 66) !5F &89#(!) 5" #%& 9" &' !5 (<& $#6$96#(!) 5) ; (<& $&%(;!&' X#69& #5' (<& 95$&%(#!5(Q 7 &>) %(&' 95$&%(#!5(!&" %&>%&" &5(&V>#5' &' 95$&%(#!5(!&" &V>%&" " &' #(#>>%)V: #(&&Q(<& KDW $) 5;!' &5$& 6&&69" !5F # $) X&%F& ;#$() %) ; a b O

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2 (u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

OE<!" >%)' 9$(!" (%#$&#G&() N*+E X!# #5 95G%)a&5 $<#!5) ; $) : >#%') 5" I E<& 95$&%#(!5(!&" ;) %&#$< $&%(!&' X#69& #%& %&>) %&' 2 #a!5F !5() #$$) 95((<& +7 ? A7 ? 95$&%#(!5(Q&%)%#5' (<& : &#" 9%&: &5(2` &!F<!5F #5' X) 69: & ' !6G(!) 5 &%)%%I *5 %#%& $#" &" ` <&%& 5) N*+E +7 ? A7 ? #%& #X#!6#G&2 (<& (&%: d5G<) 9" & " (' Ic!" " >&$!;!&' I

4.1 Thermometer Calibration

OT66(<&%:) : &(&% #"%& N*+E (%#$$&#G6& (<%9F< (<&%:) : &(&% (<#(#"%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q

4.2 Balance Calibration

OT66#5#6Q!$#6G#6#5$&" #"%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q#5' >%$$&' 9%&I E<&` &!F<(" 9"&' ;) %&(" (!5F #"%& #559#66Q$) : >#"%&' () : #"(&% &!F<(" #5' #"%& (%#$$&#G6& () N*+EI

4.3 Glassware Calibration

OT5 !5G<) 9"& >%$$&' 9%& !" 9"&' () $#6G%#(& #66=6#"" T F6#"" ` #"%& 9"&' !5 (<&: #59;#$(9%5F #5' 89#6Q $) 5(%6) ; =7 ? A7 ? "I

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

NAT

6.0 INTENDED USE

O^) %<(& $#6G%#(!) 5) ; #5#6Q!$#6!5"(%9: &5(" #5' X#6' #(!) 5) ; #5#6Q!$#6: &(<) ' " #" #>>%>%#(&I

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

O+() %& G&(` &&5 #>>%V!: #(&6Q 1d O0/ d = ` <!6& !5 "&#6&' E= E G#FI

Oe <!6& "() %&' !5 (<& "&#6&' E= E G#F2(%#5">!%#(!) 5) ; (<!" =7 ? A7 ? !" 5&F6!G6&I T;(&%) >&5!5F (<& "&#6&' E= E G#F (%#5">!%#(!) 5) ; (<& =7 ? A7 ? ` !66) $$9%2%&" 96(!5F !5 # F%#' 9#6!5$%&#"& !5 (<& #5#6Q(& $) 5$&5(%#(!) 5L" PI *(!" (<& %&">) 5"!G6(Q) ; (<& 9"&%)( #$$) 95( ;) %<(!" &;;&$(I e <&5 (<& G) ((6& !" ` &!F<&' G) (< G&;) %& #5' #;(&%G&!5F >6#$&' !5 "() %#F&2 (<& : #"" ' !;;&%&5$&) G'&%%&' ` !66G& # : &#"9%&) ; (%#5">!%#(!) 5 : #"" 6) ""I

OT;(&%) >&5!5F (<& "&#6&' E= E G#F2a&&> $#> (!F<(6Q "&#6&' ` <&5) ( !5 9"& #5' "() %& G&(` &&5 1d OC1d = () : !5!: !f & (<& &;;&$(") ; (%#5">!%#(!) 5I g"& #(C/ d[1d = () : !5!: !f & X) 69: &(%!$ ' !6(!) 5 &%%%% <&5 9"!5F (<& %&>) %(&' ' &5"!(Q _) 5) (>!>&((& ;%: (<& $) 5(#!5&% _) 5) (%&(9%5 %&:) X&' #6!89) (" () $) 5(#!5&%

O^) %) %& !5;) %:#(!) 52X!"!(www.inorganicventures.com/TCT

8.0 HAZARDOUS INFORMATION

O@6&#"& %&;&%)((<& +#;&(Q _#(# +<&&(;) % !5;) %:#(!) 5 %&F#%!5F (<!" =7 ? A7 ? I

9.0 HOMOGENEITY

OE<!" ") 69(!) 5 ` #" : !V&' #$$) %!5F () #5 !5G<) 9"& >%$$&' 9%& #5' !" F9#%#5(&&' () G& <) :) F&5&) 9"I Y) :) F&5&!(Q' #(# !5' !$#(& (<#((<& &5' 9"&%%<) 96' (#a& # : !5!: 9: "#: >6& "!f &) ; / IC: H() #" "9%& <) :) F&5&!(Q

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

OM+7 = &%(!$#(& N9: G&%M+7 G/ 01

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

O=<&: !$#6E&"(!5F OT$$%&' !(&' A TCHT = &%(!$#(& N9: G&%RR0I/ -

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

O7 &;&%&5$& ? #(&%#6@%) 9$&%OT$$%&' !(&' A TCHT = &%(!$#(& N9: G&%RR0I/ C

!" #$%!&() *! +# - ./00 (1*' 2!"3"$ 4(5#6" .(7 2#&-&%!8, #$.() %(;:0</ .(=>?@*3*A2"!* B(C00DDED<EE@;0 FCF0/0 .(G%#F;0 FCF0I: @&!"#$%!&6*! +# - 9 "J @&KL &!"#$%!&6*! +# - 9 "J

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

@#F& C) ; 0

11.1 Certification Issue Date

T>%6C/ 2C/ C-

OE<& $&%!(!$#(!) 5 !" X#6' ` !(<!5 (<& : &#" 9%&: &5( 95$&%#(!5(Q" >&$!;!&' >%)X' &' (<& =7 ? A7 ? !" " () %&' #5' <#5' 6&' !5 #$$) %#5$& ` !(< !5" (%)$(!) 5" F!X&5 !5 + &$. I- I E<!" $&%!(!$#(!) 5 !" 5966;!&' !; !5" (%)$(!) 5" !5 + &$. I- #%& 5) (;) 66) ` &') %!; (<& =7 ? A7 ? !" ' #: #F&' 2$) 5(#: !5#(&' 2) %) (<&% !" & :) ' !;!&' I

11.2 Lot Expiration Date

O**April 20, 2025**

OE<& ' #(& #;(&% <!$< (<!" =7 ? A7 ? " <) 96 5) (G& 9" &' I

OE<& 6) (&\>!%#(!) 5 ' #(& %&;6&$(" (<& >&%) ') ; (!: & (<#((<& " (#G6(Q) ; # =7 ? A7 ? $#5 G& " 9>>) %&' GQ6) 5F (&%: " (#G6(Q" (9' !&" $) 5' 9$(&') 5 >%)>&%&Q" () %&' #5' <#5' 6&' =7 ? A7 ? " I H) (&\>!%#(!) 5 !" 6: !(&' >% #%&QGQ (%#5" >!%#(!) 5 L6) " ") ; ` #(&% ;)% (<& ") 6) (!) 5P#5' !5;%&89&5(6QGQ$<&: !$#6" (#G6(Q

11.3 Period of Validity

O+ &#6&' E= E U#F , >&5 _ #(&Shhhhhhhhhhhhhhhhhhhhhhhhhhhh

OE<!" =7 ? A7 ? " <) 96 5) (G& 9" &' 6) 5F&%<(#5) 5& Q&#%L) %" !V :) 5(<" !5 (<& $#" &) ; # 0/ : HG) ((&P ;)% (<& ' #(&) ;) >&5!5F (<& #6) : !5!f &' G#F) %#;(&%<(& ' #(& F!X&5 !5 + &$I - - IC2` <!$<&X&%$) : &" ;!%(I E<!" !" $) 5(!5F&5( 9>) 5 (<& =7 ? A7 ? G&!5F " () %&' #5' <#5' 6&' !5 #$$) %#5$& ` !(< (<& !5" (%)$(!) 5" F!X&5 !5 + &$I . I- I

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

? !$<#&6U)) (<
_! %&$() %2M9#6(Q=) 5(%6

Michael 2 Booth

Certifying Officer:

@#964 #!5&"
= <#!%:#5 A+ &5!) %E&$<5!$#6_ !%&$() %

Paul R Gaines

300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com
tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES !" #$$%&' !(&' () *+, - . / 01234 &5&%#67 &89!%&: &5(" ;) % (<& =) : >&(&5$&) ; 7 &;&%&5$& ? #(&%#6@)% 9$&%3#5' *+, A*B=- . / CD234 &5&%#6 7 &89!%&: &5(" ;) %<(& =) : >&(&5$&) ; E&" (!5F #5' =#6G%#(!) 5 H#G) %#() %&" 3I *5) %5#5!$ J &5(9%&" !" #6) #5 *+, K/ / - %&F!" (&%&' : #59;#$(9%&%LM+7 = &%(!$#(& N9: G&%LM+7 G / 01PI

2.0 PRODUCT DESCRIPTION

@)% 9$(=) ' &S	+!5F6& T5#6Q(& = 9" () : 4 %#' & +) 69(!) 5
= #(#6) F N9: G&%S	= 4 U- /
H) (N9: G&%S	+COU / / K. R
? #(%LVS	CW LXAXPYN, 0
J#69& AT5#6Q(&L" PS	- / / / / ZFA. H&#S @) (#" " !9:
+(#%L5F ? #(&%#6S	UN, 0
+(#%L5F ? #(&%#6H) ([S	C0- 0
+(#%L5F ? #(&%#6@9%(QS	KKIKK. - W

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: - / / - \ ] 0/ ZFA. H

Density: - I/ CD FA. HL: &#" 9%&' #(C/] 1 ^= P

Assay Information:

Assay Method #1 **10018 ± 54 µg/mL**
= @T" "#QN+E +7 ? 0- 1- # H) (N9: G&%S- 1/ R- 0

Assay Method #2 **10016 ± 24 µg/mL**
4 %#X!: &(%$ N*+E +7 ? H) (N9: G&%S+ && + &$I 1IC

Assay Method #3 **10014 ± 45 µg/mL**
= #6$96#&' N*+E +7 ? H) (N9: G&%S+ && + &$I 1IC

CE<& = #6$96#(&' J#69& !" # X#69& $#6$96#(&' ;%): (<& _ &!F<( ) ; # " (#%L5F : #(&%#6(<#(<#" G&&5 $&%L(!&' ' !%&$(6QX" I # N#(!) 5#6*5" (!(9(&) ; +(#5' #%" #5' E&$<5) 6) FQLN*+EP+7 ? A7 ? I + && + &$ 1IC ;) %G#6#5$& (%$&#G16(Q

E<& ;) 66) !5F &89#(!) 5" #%& 9" &' !5 (<& $#6$96#!) 5) ; (<& $&%(;!&' X#69& #5' (<& 95$&%(#!5(QI 7 &>) %&' 95$&%(#!5(!&" %&>%&" &5(&V>#5' &' 95$&%(#!5(!&" &V>%&" " &' #(#>>%V!: #(&6Q(<& KDW $) 5;!' &5$& 6&&69" !5F # $) X&%F& ;#$() %) ; ` a CI

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

OE<!" >%þ' 9$(!" (%#$&#G8& () N*+E X!# #5 95G%þ` &5 $<#!5 ) ; $) : >#%!') 5"I E<& 95$&%#(!5(!&" ;) %&#$< $&%!(!&' X#6!9& #%& %&>) %&(' 2 #` !5F !5() #$$) 95((<& +7 ? A7 ? 95$&%#(!5(Q&%)%%#5' (<& : &#" 9%&: &5(2_ &!F<!5F #5' X) 6!9: & ' !6!9(!) 5 &%)%%I *5 %#%& $#" &" _<&%& 5) N*+E +7 ? A7 ? #%& #X#!6#G8&2 (<& (&%: !5G<) 9" & " (' Ib!" " >&$!;!&' I

4.1 Thermometer Calibration

OT6(<&%:) : &(&% #%& N*+E (%#$&#G8& (<%þ9F< (<&%:) : &(&% (<#(#%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q!

4.2 Balance Calibration

OT6#5#6Q!$#6G#6#5$&" #%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q!#5' >%þ$&' 9%&I E<& _&!F<(" 9" &' ;) %&(" (!5F #%& #559#6Q$) : >#%&' () : #" (&%_&!F<(" #5' #%& (%#$&#G8& () N*+EI

4.3 Glassware Calibration

OT5 !5G<) 9" & >%þ$&' 9%&!" 9" &' () $#6G%#(& #6= 6#" " T F6#" " _#%& 9" &' !5 (<& : #59;#$(9%5F #5' 89#6(Q $) 5(%6) ; =7 ? A7 ? " I

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

=7 ? A7 ? " #%& (&" (&' ;) % (#%& : &(#6!$!: >9%(!&" GQTV!#6*=@D ?+ B+ #5' *=@D ?+I E<& %&" 96(;%: (<& :) " (" &5" !(!X& : &(<) ' ;) %&#$< &8&: &5(2!" %&>) %&(' G&0 _I +) 6!9(!) 5" (&" (&' GQ*=@D ?+ _&%& #5#6Qc&' !5 #5 d H@T Ge!6&%&' =6&#5 7)) : I T5 d H@T Ge!6&%&"d" KKIKKRDW &;;!$!&5(;) %<(& %&:) X#6) ; >#%!$6&" ') _5 () / I0 Z: I

?	TF	f	/ I/ / - 1/ /	?	B9	f	/ I/ / / \ \ /	,	N#		/ IC1/ / / /	?	+&	f	/ I/ / . K/ /	,	k5		/ I/ - . / / /
,	T6		/ I/ / - \ / /	,	e&		/ I/ / DR/ /	?	NG	f	/ I/ / / \ \ /	,	+!		/ I/ - C/ / /	,	k%	f	/ I/ / - \ / /
?	T"	f	/ I/ / D0/ /	?	4 #	f	/ I/ / / \ \ /	?	N'	f	/ I/ / / \ \ /	?	+:	f	/ I/ / / \ \ /				
?	T9	f	/ I/ / C/ / /	?	4 '	f	/ I/ / / \ \ /	,	N!	f	/ I/ / 1K/ /	?	+5	f	/ I/ / / \ \ /				
,	g	f	/ I/ / D\ / /	?	4 &	f	/ I/ / C/ / /	?	, "	f	/ I/ / 00/ /	,	+%		/ I/ / / / DD				
,	g#	f	/ I/ / / R\ /	?	Y;	f	/ I/ / / \ \ /	,	@	f	/ I/ 0C/ / /	?	E#	f	/ I/ / / \ \ /				
,	g&	f	/ I/ / / / RC	?	YF	f	/ I/ / C/ / /	?	@G	f	/ I/ / C0/ /	?	EG	f	/ I/ / / \ \ /				
?	g!	f	/ I/ / \ \ / /	?	Y)	f	/ I/ / / \ \ /	?	@	f	/ I/ / / \ \ /	?	E&	f	/ I/ - . / / /				
,	=#		/ I/ 0- / / /	?	*5	f	/ I/ / / \ \ /	?	@%	f	/ I/ / / \ \ /	?	E<	f	/ I/ / / \ \ /				
,	='	f	/ I/ / / 1D/	?	*%	f	/ I/ / / \ \ /	?	@(	f	/ I/ / C. / /	?	E!	f	/ I/ / / \ \ /				
?	=&	f	/ I/ / / \ \ /	"	U	f		?	7G		/ I1R/ / / /	?	E6	f	/ I/ / / \ \ /				
,	=)	f	/ I/ / / . R/	?	H#	f	/ I/ / / \ \ /	?	7&	f	/ I/ / / \ \ /	?	E:	f	/ I/ / / \ \ /				
,	=%		/ I/ / / D0/	,	H!	f	/ I/ / / / R1	?	7<	f	/ I/ / / \ \ /	?	d	f	/ I/ / / \ \ /				
?	="	f	/ I/ / / \ \ /	?	H9	f	/ I/ / / \ \ /	?	79	f	/ I/ / / \ \ /	,	J	f	/ I/ / - - / /				
?	=9	f	/ I/ / C. / /	,	? F		/ I/ / \ 0/ /	,	+		/ I/ CR/ / /	?	i	f	/ I/ / / \ \ /				
?	hQ	f	/ I/ / / \ \ /	,	? 5		/ I/ / / 1R/	?	+G	f	/ I/ / / \ \ /	?	j	f	/ I/ / / \ \ /				
?	B%	f	/ I/ / / \ \ /	?	?)	f	/ I/ / / \ \ /	,	+$	f	/ I/ / / 01/	,	j G	f	/ I/ / / C. /				

? O=<&$` &' GQ*=@D ? + , O=<&$` &' GQ*=@D B+ ! O+>&$(%#6*5(&%&%&5$&
5 ON) (=<&$` &' e) % " O+) 69!) 5 +(#5' #% B6& &5(

6.0 INTENDED USE

Oe) %<(& $#6G%#(!) 5) ; #5#6Q!$#6!5" (%: &5(" #5' X#6' #(!) 5) ; #5#6Q!$#6: &(<) ' " #" #>>%þ>%#(&I

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

O+() %& G&(_&&5 #>>%) V!: #(&&Q1I O0/ I = _<!6& !5 "&#6&' E= E G#FI

Oi <!6& "() %&' !5 (<& "&#6&' E= E G#F2(%#5">!%#(!) 5) ; (<!" =7 ? A7 ? !" 5&F6F!G6&I T;(&%) >&5!5F (<& "&#6&' E= E G#F (%#5">!%#(!) 5) ; (<& =7 ? A7 ? _!6) $$9%2%&" 96!5F !5 # F%#' 9#6!5$%&#" & !5 (<& #5#6Q(& $) 5$&5(%#(!) 5L" PI *(!" (<& %&">) 5"!G!6!(Q) ; (<& 9"&%)(#$$) 95(;) %<!" &;;&$(I i <&5 (<& G) ((6& !" _&!F<&' G) (< G&;) %& #5' #;(&%G&!5F >6#$&' !5 "() %#F&2 (<& : #"" ' !;;&%&5$&) G' &%%&' _!6G& # : &#" 9%&) ; (%#5">!%#(!) 5 : #"" 6) ""I

OT;(&%) >&5!5F (<& "&#6&' E= E G#F2`&&> $#> (!F<(6Q"&#6&' _<&5 5) (!5 9"& #5' "() %& G&(_&&5 1I OC1I = ( ) : !5!: !c& (<& &;;&$(") ; (%#5">!%#(!) 5I d"& #(C/ I] 1I = ( ) : !5!: !c& X) 6) : &(%!$ ' !6) (!) 5 &%%) %%_<&5 9"!5F (<& %&>) %(&' &5"!(Q h) 5) (>!>&((& ;%): (<& $) 5(#!5&%% h) 5) (%&(9%5 %&:) X&' #6!89) (" () $) 5(#!5&%%

Oe) %) %& !5;) %:#(!) 52X!"!(**www.inorganicventures.com/TCT**
Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 0KI-/ m+ L\ P Un1#8P
Chemical Compatibility -+) 6)G6& !5 Y= 62YN, 02 YC+, 1 #5' Ye #89&) 9" : #(%!$&" I TX) !' 9"&) ; Y= 6, 1 ' 9& () !5") 6)G!6!(Q) ; (<& >&%$<6) %#(&I +(#G6&_!(< #66: &(#6" #5' !5) %F#5!$ #5!) 5" &V$&>(=6, 1OI
Stability - OG/ / >>G6&X&6 "(#G6& ;) %) 5(<" !5 - W YN, 0 AHh@B$) 5(#!5&%% - G/ 2/ / >>: ") 6)(!) 5" $<&: !$#66Q"(#G6& ;) %Q&#%" !5 - ODW YN, 0 AHh@B$) 5(#!5&%%
K Containing Samples (Preparation and Solution) - ? &(#6Lh!"") 6X&" X&%Q%#>!' 6Q!5 _#(&%Pn, %&" L+) ' !9: $#%G) 5#(&;9"!) 5 !5 @(;) 6) _&' GQY= 6' !"") 6)(!) 5OG6#5` 6&X&6) ; U !5 ") ' !9: $#%G) 5#(& $%!$#6Pn, %F#5!$? #(%!$&" L+ 969%$A+&%) V!' &' !F&"(!) 5 P
Atomic Spectroscopic Information (ICP-OES D.L.s are given as <u>radial/axial</u> view):

Technique/Line	Estimated D.L.	Order	Interferences L95' &%65&' !5' !$#(&" "&X&%&P
*=@O+ 0K#: 9	-/ >>(	5A#	0RT%Y2 0N#-\ , 2 . R+&
*=@OB+ 1/ 1I. C- 5:	-I- A/ I/ DZFA H	-	d2 =&
*=@OB+ .\\ I1K/ 5:	/I1 A/ I/ /- ZFA H	-	C5') %&%#%!#(!) 5 ;%): 7 IBI") 5 ") : &) >(!$#6' &"!F5"
*=@OB+ ..-ID0- 5:	-I/ A/ I/ 0 ZFA H	-	C5') %&%#%!#(!) 5 ;%): 7 IBI") 5 ") : &) >(!$#6' &"!F5"

8.0 HAZARDOUS INFORMATION

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9.0 HOMOGENEITY

OE<!" ") 6)(!) 5 _#" : !V&' #$$) %!5F () #5 !5G<) 9"& >%)$&' 9%& #5' !" F9#%#5(&&' () G& <) :) F&5&) 9"I Y) :) F&5&!(Q' #(# !5' !$#(& (<#((<& &5' 9"&%' <) 96' (#` & # : !5!: 9: "#: >6& "!c&) ; /IC: H() #""9%& <) :) F&5&!(QI

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

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10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

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10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

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!" #$%!&() *! +#-.(/00 (1*' 2!"3"$ 4(5#6* .(7 2#-&%!8, #$.() %(;:0</ .(=>?@*3*A2"!* B(C00DDED<EE@;0 9FCF90/0 .(G%H;0 9FCF90I: @&!"#$%!&6*! +#-9"J @&!KL &!"#$%!&6*! +#-9"J

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

e&G%#%Q/ \ 2C/ C-

OE<& $&%{!$#(!) 5 !" X#6' _!(<!5 (<& : &#" 9%&: &5(95$&%#(!5(Q" >&$!;!&' >%)X' &' (<& =7 ? A7 ? !" "() %&' #5' <#5' 6&' !5 #$$) %#5$& _!(< !5" (%$(!) 5" F!X&5 !5 +&$. I- I E<!" $&%{!$#(!) 5 !" 596;!&' !; !5" (%$(!) 5" !5 +&$. I- #%& 5) (;) 66) _&') %{; (<& =7 ? A7 ? !" ' #: #F&' 2$) 5(#: !5#(&' 2) %) (<&%_!" & :) ' !;!&' I

11.2 Lot Expiration Date

O**February 06, 2025**

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OE<& 6) (&\>!%#(!) 5 ' #(& %&;6&$(" (<& >&%) ') ; (!: & (<#((<& "(#G16(Q) ; # =7 ? A7 ? $#5 G& "9>>) %&' GQ6) 5F (&%: "(#G16(Q" (9' !&" $) 5' 9$(&') 5 >%)>&%&Q" () %&' #5' <#5' 6&' =7 ? A7 ? "I H) (&\>!%#(!) 5 !" 6: !(&' >% #%&QGQ (%&5" >!%#(!) 5 L6) "") ; _#(&% ;)% (<& ") 6) (!) 5P#5' !5;%&89&5(6QGQ$<&: !$#6"(#G16(Q

11.3 Period of Validity

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OE<!" =7 ? A7 ? "<) 96 5) (G& 9" &' 6) 5F&%<(#5) 5& Q&#%L) %" !V:) 5(<" !5 (<& $#" &) ; # 0/ : HG) ((&P ;)% (<& ' #(&) ;) >&5!5F (<& #69: !5!c&' G#F) %#;(&%<(& ' #(& F!X&5 !5 +&$I -- IC2_<!$<&X&%$) : &" ;!%(I E<!" !" $) 5(!5F&5(9>) 5 (<& =7 ? A7 ? G&!5F "() %&' #5' <#5' 6&' !5 #$$) %#5$& _!(< (<& !5" (%$(!) 5" F!X&5 !5 +&$I . I- I

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

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h!%&$() %2M9#6(Q=) 5(%6

Certifying Officer:

@#964 #!5&"
= <#!%:#5 A+&5!) %E&$<5!$#6h!%&$() %

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGMG10
Lot Number:	R2-MG695748
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Magnesium
Starting Material:	Magnesium Metal
Starting Material Lot#:	2168
Starting Material Purity:	99.9984%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10044 ± 30 µg/mL

Density: 1.053 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10055 ± 26 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #2 **10042 ± 57 µg/mL**
ICP Assay NIST SRM 3131a Lot Number: 140110

Assay Method #3 **10033 ± 26 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

O	Ag	0.002104	M	Eu	<	0.000910	O	Na	0.071011	O	Se	<	0.048000	O	Zn	0.003296	
M	Al	0.003550	M	Fe	0.002536	M	Nb	<	0.000460	O	Si	<	0.032000	O	Zr	<	0.002700
M	As	< 0.001400	M	Ga	<	0.000460	M	Nd	<	0.000910	M	Sm	<	0.000460			
M	Au	< 0.001400	M	Gd	<	0.000460	O	Ni	<	0.001600	M	Sn	<	0.002300			
O	B	0.006847	M	Ge	<	0.001400	M	Os	<	0.000460	O	Sr		0.000278			
O	Ba	0.000963	M	Hf	<	0.000460	O	P	0.015216	M	Ta	<	0.000460				
O	Be	< 0.000120	M	Hg	<	0.000460	M	Pb	<	0.000460	M	Tb	<	0.000460			
M	Bi	< 0.000460	M	Ho	<	0.000460	M	Pd	<	0.003200	M	Te	<	0.007300			
O	Ca	0.053258	M	In	<	0.000460	M	Pr	<	0.000460	M	Th	<	0.000460			
O	Cd	< 0.000360	M	Ir	<	0.000460	M	Pt	<	0.001900	O	Ti	<	0.001700			
M	Ce	< 0.002300	M	K	0.048186	M	Rb	0.002409	M	Tl	0.003043						
M	Co	< 0.000910	M	La	<	0.002800	M	Re	<	0.000460	M	Tm	<	0.000460			
M	Cr	< 0.002300	O	Li	0.027897	M	Rh	<	0.000460	M	U	<	0.000460				
M	Cs	0.001039	M	Lu	<	0.000460	M	Ru	<	0.000460	M	V	<	0.000460			
O	Cu	< 0.003000	s	Mg	<		O	S	<	0.190000	M	W	<	0.000460			
M	Dy	< 0.000460	O	Mn	0.015216	M	Sb	0.020796	O	Y	<	0.000720					
M	Er	< 0.000460	M	Mo	<	0.000910	O	Sc	<	0.000480	M	Yb	<	0.000460			

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 24.31 +2 6 $Mg(H_2O)_6^{+2}$

Chemical Compatibility -Soluble in HCl, HNO_3, and H_2SO_4 avoid HF, H_3PO_4 and neutral to basic media. Stable with most metals and inorganic anions forming insoluble silicates, carbonates, hydroxides, oxides, and tungstates in neutral and slightly acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-10% HNO_3 / LDPE container.

Mg Containing Samples (Preparation and Solution) -Metal (Best dissolved in diluted HNO_3); Oxide (Readily soluble in above compatible aqueous acidic solutions); Ores (Carbonate fusion in Pt0 followed by HCl dissolution); Organic Matrices (Sulfuric / peroxide digestion or nitric / sulfuric / perchloric acid decomposition, or dry ash and dissolution in dilute HCl).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 24 amu	42 ppt	n/a	7Li17O, 48Ti+2 , 48Ca+2
ICP-OES 279.553 nm	0.0002 / 0.00003 µg/mL	1	Th
ICP-OES 280.270 nm	0.0003 / 0.00005 µg/mL	1	U, V
ICP-OES 285.213 nm	0.002 / 0.00003 µg/mL	1	U, Hf, Cr, Zr

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

September 01, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **September 01, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Director, Quality Control

Certifying Officer:

Paul Gaines
Chairman / Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGMN10
Lot Number:	P2-MN687536
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Manganese
Starting Material:	Mn Metal
Starting Material Lot#:	2275
Starting Material Purity:	99.9909%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10046 ± 30 µg/mL

Density: 1.035 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10045 ± 25 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #2 **10083 ± 68 µg/mL**
ICP Assay NIST SRM 3132 Lot Number: 050429

Assay Method #3 **10031 ± 47 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.001500	M	Eu	<	0.000730	O	Na		0.176713	M	Se	<	0.006600	M	Zn		0.009960
O	Al		0.004337	M	Fe	<	0.650000	M	Nb	<	0.000730	O	Si		0.097995	M	Zr	<	0.000730
M	As	<	0.008000	M	Ga		0.004337	M	Nd	<	0.001500	M	Sm	<	0.000730				
M	Au	<	0.000730	M	Gd	<	0.000730	M	Ni		0.024097	M	Sn	<	0.002200				
M	B		0.069078	M	Ge	<	0.004400	M	Os	<	0.000730	O	Sr		0.000931				
M	Ba	<	0.001500	M	Hf	<	0.000730	i	P	<		M	Ta	<	0.000730				
M	Be	<	0.000730	M	Hg	<	0.002200	M	Pb		0.007389	M	Tb	<	0.000730				
M	Bi	<	0.003000	M	Ho	<	0.000730	M	Pd	<	0.000730	M	Te	<	0.019000				
O	Ca		0.062652	M	In	<	0.003000	M	Pr	<	0.000730	M	Th	<	0.000730				
M	Cd	<	0.001500	M	Ir	<	0.000730	M	Pt	<	0.000730	O	Ti	<	0.006500				
M	Ce	<	0.007300	O	K		0.006425	M	Rb	<	0.006600	M	Tl	<	0.000730				
O	Co		0.014779	M	La	<	0.003000	M	Re	<	0.000730	M	Tm	<	0.000730				
O	Cr		0.273102	O	Li		0.000417	M	Rh	<	0.003000	M	U	<	0.001500				
M	Cs	<	0.000730	M	Lu	<	0.000730	M	Ru	<	0.004400	M	V	<	0.000730				
O	Cu		0.007711	O	Mg		0.321297	i	S	<		M	W	<	0.004400				
M	Dy	<	0.001500	s	Mn	<		M	Sb	<	0.021000	O	Y		0.001365				
M	Er	<	0.001500	M	Mo		0.010281	O	Sc	<	0.004100	M	Yb	<	0.000730				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 54.94 +2 6 $Mn(H_2O)_6^{2+}$

Chemical Compatibility -Stable in HCl, HNO_3, H_2SO_4 ,HF, H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5 % HNO_3/LDPE container.

Mn Containing Samples (Preparation and Solution) -Metal (Soluble in dilute acids); Oxides (Soluble in dilute acids); Ores (Dissolve with HCl. If silica is present add HF and then fume off silica by adding H_2SO_4 and heat to SO_3 fumes - dense white fumes).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 55 amu	10 ppt	n/a	40Ar14N1H,39K16O,37Cl18O,40Ar15N,38Ar17O,36Ar18O1H ,38Ar16O1H,37Cl17O1H,23Na32S
ICP-OES 257.610 nm	0.0014 / 0.00002 µg/mL	1	Ce, W, Re
ICP-OES 259.373 nm	0.0016 / 0.00002 µg/mL	1	U, Ta, Mo, Fe, Nb
ICP-OES 260.569 nm	0.0021 / 0.00002 µg/mL	1	Co

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

January 05, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **January 05, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

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300 Technology Drive
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGMO10
Lot Number:	R2-MO693167
Matrix:	tr. NH4OH H2O
Value / Analyte(s):	10 000 µg/mL ea: Molybdenum
Starting Material:	Ammonium Molybdate
Starting Material Lot#:	2257
Starting Material Purity:	99.9914%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10013 ± 35 µg/mL

Density: 1.011 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10035 ± 67 µg/mL**
ICP Assay NIST SRM 3134 Lot Number: 130418

Assay Method #2 **10005 ± 40 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The follow ing equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.001826	M	Eu	<	0.000300	M	Na		0.008750	M	Se	<	0.007480	M	Zn	0.002553
M	Al		0.004455	M	Fe		0.002093	M	Nb	<	0.015030	i	Si	<		M	Zr	< 0.005393
M	As	<	0.003006	M	Ga	<	0.000300	i	Nd	<		M	Sm	<	0.000300			
M	Au	<	0.006012	M	Gd	<	0.000300	M	Ni	<	0.004828	M	Sn		0.001004			
M	B	<	0.035184	M	Ge	<	0.000903	M	Os	<	0.003006	M	Sr		0.001903			
O	Ba		0.015613	M	Hf	<	0.000896	i	P	<		M	Ta	<	0.000300			
M	Be	<	0.003006	M	Hg	<	0.003006	M	Pb	<	0.000409	M	Tb	<	0.000300			
M	Bi	<	0.000401	M	Ho	<	0.000300	M	Pd	<	0.001114	M	Te	<	0.060122			
O	Ca		0.032589	M	In	<	0.015030	M	Pr	<	0.090184	M	Th	<	0.000786			
O	Cd	<	0.051800	M	Ir	<	0.007483	M	Pt	<	0.000388	O	Ti	<	0.093240			
M	Ce	<	0.015030	M	K		1.114508	M	Rb		0.040641	M	Tl		0.013140			
M	Co		0.004032	M	La	<	0.000300	M	Re	<	0.000300	M	Tm	<	0.000300			
M	Cr		0.005931	O	Li		0.000215	M	Rh	<	0.000300	M	U		0.000937			
M	Cs		0.002812	M	Lu	<	0.000300	M	Ru	<	0.003006	M	V	<	0.000759			
M	Cu		0.005172	M	Mg		0.005212	i	S	<		M	W		0.592427			
M	Dy	<	0.000300	M	Mn		0.000952	M	Sb		0.003147	M	Y	<	0.000300			
M	Er	<	0.000300	s	Mo	<		M	Sc	<	0.009019	M	Yb	<	0.000300			

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 95.94 +6 6,7,8,9 [MoO4] -2(chemical form as received)

Chemical Compatibility -Mo is received in a NH4OH matrix giving the operator the option of using HCl or HF to stabilize acidic solutions. The [MoO4]-2 is soluble in concentrated HCl [MoOCl5]-2, dilute HF / HNO3 [MoOF5] -2 and basic media [MoO4]-2. Stable at ppm levels with some metals provided it is fluorinated. Do not mix with Alkaline or Rare Earths when HF is present. Stable with most inorganic anions provided it is in the [MoO4]-2 chemical form.

Stability - 2-100 ppb levels stable (alone or mixed with all other metals that are at comparable levels) as the [MoOF5]-2 for months in 1% HNO3 / LDPE container. 1-10,000 ppm single element solutions as the [MoO4] -2 chemically stable for years in 1% NH4OH in a LDPE container.

Mo Containing Samples (Preparation and Solution) -Metal (Soluble in HF / HNO3 or hot dilute HCl); Oxide (soluble in HF or NH4OH) ; Organic Matrices (Dry ash at 450EC in Pt0 and dissolve oxide with HF or HCl).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 95 amu	3 ppt	n/a	40Ar39K16O,79Br16O,190Os2+,190Pt2+
ICP-OES 202.030 nm	0.008 / 0.0002 µg/mL	1	Os, Hf
ICP-OES 203.844 nm	0.012 / 0.002 µg/mL	1	
ICP-OES 204.598 nm	0.012 / 0.001 µg/mL	1	Ir, Ta

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

May 28, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **May 28, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES !" #$$%&' !(&' () *+, - . / 01234 &5&%#67 &89!%&: &5(" ;) % (<& =) : >&(&5$&) ; 7 &;&%&5$& ? #(&%#6@)% 9$&%3#5' *+, A*B=- . / CD234 &5&%#6 7 &89!%&: &5(" ;) %<(& =) : >&(&5$&) ; E&" (!5F #5' =#6G%#(!) 5 H#G) %#() %&" 3I *5) %5#5!$ J &5(9%&" !" #6') #5 *+, K/ / - %&F!" (&%&' : #59;#$(9%&%LM+7 = &%(!$#(& N9: G&%M+7 G- / 01PI

2.0 PRODUCT DESCRIPTION

@)% 9$(=) ' &S	+!5F6& T5#6Q(& = 9" () : 4 %#' & +) 69(!) 5
= #(#6) F N9: G&%S	= 4 NT - /
H) (N9: G&%S	+CONT / / R1C
? #(%US	CV LWWPXN, 0
J#69& AT5#6Q(&L" PS	- / / / / YFA H&#S +) ' !9:
+(#%!5F ? #(&%#6S	N#C=, 0
+(#%!5F ? #(&%#6H) (ZS	CC. 1
+(#%!5F ? #(&%#6@9%(QS	KKIKKDRV

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: - / / D0 [0/ YFA H

Density: - I/ 0\ FA HL: &#" 9%&' #(C/ [1] = P

Assay Information:

Assay Method #1 **10070 ± 26 µg/mL**
4 %#W! &(%$ N*+ E + 7 ? H) (N9: G&%S+ && + &$I 1IC

Assay Method #2 **10012 ± 31 µg/mL**
= @T" "#QN+ E + 7 ? 0- DC# H) (N9: G&%S- C/ . - D

Assay Method #3 **10059 ± 20 µg/mL**
= #$96#&' N*+ E + 7 ? H) (N9: G&%S+ && + &$I 1IC

CE<& = #6$96#(&' J#69& !" # W#69& $#6$96#(&' ;%): (<& ^ &!F<( ) ; # " (#%!5F : #(&%#6(<#(<#" G&&5 $&%!(!&' ' !%&$(6QWI # N#(!) 5#6*5" (!(9(&) ; +(#5' #%" #5' E&$<5) 6) FQLN*+EP+7 ? A7 ? I + && + &$ 1IC ;) %G#6#5$& (%$&#G16(Q

E<& ;) 66') !5F &89#(!) 5" #%& 9" &' !5 (<& $#6$96#!) 5) ; (<& $&%(;!&' W#69& #5' (<& 95$&%(#!5(Q 7 &>) %&' 95$&%(#!5(!&" %&>%&" &5(&U>#5' &' 95$&%(#!5(!&" &U>%&" " &' #(#>>%U: #(&&Q(<& KDV $) 5;!' &5$& 6&%&69" !5F # $) W&%#F& ;#$() %) ; _ ` CI

Characterization of CRM/RM by Two or More Methods	Characterization of CRM/RM by One Method
Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:	**Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:**
$X_{CRM/RM} = \Sigma(w_i)(X_i)$	$X_{CRM/RM} = (X_a)(u_{char\ a})$
X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$	X_a = mean of Assay Method A with
w_i = the weighting factors for each method calculated using the inverse square of the variance:	$u_{char\ a}$ = the standard uncertainty of characterization Method A
$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$	
CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$	CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$
k = coverage factor = 2	k = coverage factor = 2
$u_{char} = [\Sigma((w_i)^2 (u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method	$u_{char\ a}$ = the errors from characterization
u_{bb} = bottle to bottle homogeneity standard uncertainty	u_{bb} = bottle to bottle homogeneity standard uncertainty
u_{lts} = long term stability standard uncertainty (storage)	u_{lts} = long term stability standard uncertainty (storage)
u_{ts} = transport stability standard uncertainty	u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

OE<!" >%' 9$(!" (%$$&#G& () N*+E W# #5 95G%_&5 $<#!5) ; $) : >#%") 5" I E<& 95$&%#!5(!&" ;) %&#$< $&%!(!&' W#6)& #%& %&>) %&' 2 #_!5F !5() #$$) 95((<& +7 ? A7 ? 95$&%#!5(Q&%)%#5' (<& : &#" 9%& &5(2^ &!F<!5F #5' W)6: & ' !6(!) 5 &%)%%I *5 %#%& $#" &" ^ <&%& 5) N*+E +7 ? A7 ? #%& #W#!6#G&2 (<& (&%: #5G<) 9" & "(' I a!" ">&$!;!&' I

4.1 Thermometer Calibration

OT6(<&%:) : &(&% #%& N*+E (%$$&#G& (<%9F< (<&%:) : &(&% (<#(#%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %QI

4.2 Balance Calibration

OT6#5#6Q!$#6G#6#5$&" #%& $#6G%#(&' GQ#5 #$$%&' !(&' $#6G%#(!) 5 6#G) %#() %Q#5' >%$&' 9%&I E<& ^ &!F<(" 9" &' ;) %&(" (!5F #%& #559#6Q$) : >#%&' () : #" (&%^ &!F<(" #5' #%& (%$$&#G& () N*+EI

4.3 Glassware Calibration

OT5 !5G<) 9" & >%$&' 9%& !" 9" &' () $#6G%#(& #66=6#" " T F6#" " ^ #%& 9" &' !5 (<& : #59;#$(9%5F #5' 89#6(Q $) 5(%6) ; =7 ? A7 ? " I

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

=7 ? A7 ? " #%& (&" (&' ;) % #$& : &(#6$!: >9%!&" GQTU#6*=@O B+ #5' *=@O ?+ I E<& %&" 96(;%: (<& :) "("&5" !(!W& : &(<) ' ;) %&#$< &6&: &5(2!" %&>) %&' G&6 ^ I +) 6(!) 5" (&" (&' GQ*=@O ?+ ^ &%& #5#6Q&' !5 #5 c H@T O!6(&%&' =6&#5 7)) : I T5 c H@T O!6(&%!" KKIKKRDV &;;!$!&5(;) %<& %&:) W#6) ; >#%!$6&" ') ^ 5 () / I0 Y: I

,	TF	e	/I///CD/	?	B9	e	/I///R1/	"	N#	e		,	+&	e	/I//1.//	,	k5	/I///CC\
,	T6		/I//0\RR	,	d&		/I//-D\/	,	NG	e	/I//-0//	,	+!		/I/1K\1R	,	k%	/I///\R/
,	T"	e	/I//\K//	?	4#	e	/I///R1/	?	N'	e	/I///R1/	?	+:	e	/I///R1/			
?	T9	e	/I///R1/	?	4'	e	/I///R1/	,	N!	e	/I///CD/	?	+5	e	/I//-.//			
,	f		/I///K0\	?	4&	e	/I//01//	?	,"	e	/I///R1/	,	+%		/I///CDD			
,	f#		/I//CC\K	?	X;	e	/I///R1/	,	@		/I//\DCD	?	E#	e	/I//1C//			
,	f&	e	/I///-0/	?	XF	e	/I//-.//	?	@G	e	/I///R1/	?	EG	e	/I///R1/			
,	f!	e	/I//R-//	?	X)	e	/I///R1/	?	@	e	/I///R1/	,	E&	e	/I//1R//			
,	=#		/I/RD--C	?	*5	e	/I///R1/	?	@%	e	/I///R1/	?	E<	e	/I//CD//			
,	='	e	/I///CD/	?	*%	e	/I///R1/	?	@(	e	/I///R1/	,	E!		/I///DD0			
?	=&	e	/I//-.//	,	h		-I/1K.-R	?	7G	e	/I//01//	?	E6	e	/I///R1/			
,	=)	e	/I///0./	?	H#	e	/I///R1/	?	7&	e	/I///R1/	?	E:	e	/I///R1/			
,	=%	e	/I//-1//	,	H!		/I////\K	?	7<	e	/I///R1/	?	c	e	/I///R1/			
?	="	e	/I//01//	?	H9	e	/I///R1/	?	79	e	/I//-.//	,	J	e	/I//-\//			
,	=9	e	/I//-1//	,	?F		/I/CR0./	,	+		/I/1RC0/	,	i	e	/I//D///			
?	gQ	e	/I///R1/	,	?5		/I///-0K	?	+G	e	/I//-.//	,	j	e	/I///.0/			
?	B%	e	/I///R1/	,	?)	e	/I//1R//	,	+$	e	/I///0./	,	jG	e	/I///-0/			

? O=<&$_&' GQ*=@O?+ , O=<&$_&' GQ*=@O B+ ! O+>&$(%#6*5(&%&%&5$&
5 ON) (=<&$_&' d) % " O+) 69!) 5 +(#5' #% B6& &5(

6.0 INTENDED USE

Od) %<& $#6G%#(!) 5) ; #5#6Q!$#6!5" (%: &5(" #5' W#6' #(!) 5) ; #5#6Q!$#6: &(<) ' " #" #>>%>%#(&I

@#F& C) ; 1

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

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Oi <!6& " () %&' !5 (<& " &#6&' E= E G#F2(%#5" >!%#(!) 5) ; (<!" =7 ? A7 ? !" 5&F6F!G6&I T;(&%) >&5!5F (<& " &#6&' E= E G#F (%#5" >!%#(!) 5) ; (<& =7 ? A7 ? ^ !6) $$9%2%&" 96(!5F !5 # F%#' 9#6!5$%&#" & !5 (<& #5#6Q(& $) 5$&5(%#(!) 5L" PI *(!" (<& %&" >) 5" !G16(Q) ; (<& 9" &%)(#$$) 95(;) %<!" &;;&$(I i <&5 (<& G) ((6& !" ^ &!F<&' G) (< G&;) %& #5' #;(&%G&!5F >6#$&' !5 " () %#F&2 (<& : #" " ' !;;&%&5$&) G' &%%&' ^ !6G& # : &#" 9%&) ; (%#5" >!%#(!) 5 : #" " 6) " " I

OT;(&%) >&5!5F (<& " &#6&' E= E G#F2_&&> $#> (!F<(6Q" &#6&' ^ <&5 5) (!5 9" & #5' " () %& G&(^ &&5 1I OC1I = ( ) : !5!: !b& (<& &;;&$(") ; (%#5" >!%#(!) 5I c " & #(C/ I [1I = ( ) : !5!: !b& W)6): &(%$ ' !6)(!) 5 &%)%%^ <&5 9" !5F (<& %&>) %&(' &5" !(QI g) 5) (>!>&((& ;%): (<& $) 5(#!5&% g) 5) (%&(9%5 %&:) W&' #6)89) (" () $) 5(#!5&%

Od) %) %& !5;) %:#(!) 52W" !(**www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - CCIKK m+ L\ PN#m1#8P6#%6&6Q !) 5!$!5 5#(9%&

Chemical Compatibility -+) 6)G6& !5 X= 62XN, 02 XC+, 1 #5' Xd #89&) 9" : #(%$&" I +(#G6& ^ !(< #6): &(#6' #5' !5) %6#5!$ #5!) 5" I

Stability - CO/ / >>G6&W&6' "(#G6& ;) %) 5(<" !5 - V XN, 0 AHg@B $) 5(#!5&% - O/ 2/ / >>: ") 6)(!) 5" $<&: !$#6&Q" (#G6& ;) %&#% !5 - OV XN, 0 AHg@B $) 5(#!5&%

Na Containing Samples (Preparation and Solution) - ? &(#6Lg!" ") 6W&" W&%Q%>!' 6Q!5 ^ #(&%Pn %&" LH!(<!9: $#%6) 5#(& ;9" !) 5 !5 F%#><!(& $%%$!G6& ;) 6) ^ &' GQX= 6' !" ") 6)(!) 5 OG6#5_ 6&W&6') ; N# !5 6(<!9: $#%6) 5#(& $%%!$#6Pn %6#5!$? #(%$&" L+ 969%%$ A>&%)U' & ' !F&" (!) 5) %5!(%$A'969%%$A>&%$<6) %%$ #$!' ' &$) : >) " !(!) 5PI

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	Estimated D.L.	Order	Interferences L95' &%%5&' !5' !$#(&" " &W&%&P
*=@%+ C0 #: 9	0-/ >>(	5##	1\ E!mC 21\ = #mC
*=@,OB+ 00/ IC0. 5:	CI/ A/ I/ K YFA H	-	@ 2 k5
*=@,OB+ DRRIKKD 5:	/ I/ 0 A/ I/ / \ YFA H	-	C5') %&%#%!#(!) 5 ;%): 7 IBI") 5 ") : &) >(!$#6' &" !F5"
*=@,OB+ DRKIDKD 5:	/ I/ . A/ I/ / / / K YFA H	-	C5') %&%#%!#(!) 5 ;%): 7 IBI") 5 ") : &) >(!$#6' &" !F5"

8.0 HAZARDOUS INFORMATION

OG6&#" & %&;&%)((<& +#;&(Qg #(# +<&&(;) %5;) %:#(!) 5 %&F#%!5F (<!" =7 ? A7 ? I

9.0 HOMOGENEITY

OE<!" ") 6)(!) 5 ^ #" : !U&' #$$) %!5F () #5 !5G<) 9" & >%)$&' 9%& #5' !" F9#%#5(&&' () G& <) :) F&5&) 9" I X) :) F&5&!(Q' #(# !5' !$#(& (<#((<& &5' 9" &%' <) 96 (#_& # : !5!: 9: "#: >6&" !b&) ; / IC : H() #" " 9%& <) :) F&5&!(QI

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

OM+7 = &%{!$#(& N9: G&%M+7 O/ 01

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

O= <&: !$#6E&" (!5F OT $$%&' !(&' A TCHT = &%{!$#(& N9: G&%RR0I/ -

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

O7 &;&%&5$& ? #(&%#6@)% 9$&%OT $$%&' !(&' A TCHT = &%{!$#(& N9: G&%RR0I/ C

!" #$%!&() *! + # - .(/00 (1* ' 2!"3"$ 4(5 #&* .(7 2#& +&%!8, #$.() %4:;0</ .(=>?@*3*A2"!* B(C00DDE0<E@F;0 9FCF90/0 .(G%&F;0 9FCF90I: @&!"#$%!&6*! + # - 9 "J @&!"K L &!"#$%!&6*! + # - 9 "J

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

o#59#%QCD2C/ C-

OE<& $&%{!$#(!) 5 !" W#6' ^ !(<!5 (<& : &#" 9%&: &5(95$&%#(!5(Q" >&$!;!&' >%)W &' (<& =7 ? A7 ? !" "() %&' #5' <#5' 6&' !5 #$$) %#5$& ^ !(< !5" (%)$(!) 5" F!W&5 !5 +&$. I- I E<!" $&%{!$#(!) 5 !" 596&;!&' !; !5" (%)$(!) 5" !5 +&$. I- #%& 5) (;) 6) ^ &') %{; (<& =7 ? A7 ? !" ' #: #F&' 2$) 5(#: !5#(&' 2) %) (<&% !" & :) ' !;!&' I

11.2 Lot Expiration Date

OJanuary 25, 2025

OE<& ' #(& #;(&%^ <!$< (<!" =7 ? A7 ? "<) 96 5) (G& 9" &' I

OE<& 6) (&U>!%#(!) 5 ' #(& %&;6&$(" (<& >&%) ') ; (!: & (<#((<& " (#G16(Q) ; # =7 ? A7 ? $#5 G& " 9>>) %&' GQ6) 5F (&%: " (#G16(Q" (9' !&" $) 5' 9$(&') 5 >%)>&%&Q" () %&' #5' <#5' 6&' =7 ? A7 ? " I H) (&U>!%#(!) 5 !" 6: !(&' >% #%6&QGQ (%&5" >!%#(!) 5 L6) "") ; ^ #(&% ;)% (<& ") 6) (!) 5P#5' !5;%&89&5(6&QGQ$<&: !$#6" (#G16(Q

11.3 Period of Validity

O+ &#6&' E= E f #F , >&5 g #(&Spppppppppppppppppppppppppppp

OE<!" =7 ? A7 ? "<) 96 5) (G& 9" &' 6) 5F&%<(#5) 5& Q&#%L) %" !U:) 5(<" !5 (<& $#" &) ; # 0/ : HG) ((&P ;)% (<& ' #(&) ;) >&5!5F (<& #69: !5!b&' G#F) %#;(&%<(& ' #(& F!W&5 !5 +&$I -- IC2^ <!$<&W&%$) : &" ;!%(I E<!" !" $) 5(!5F&5(9>) 5 (<& =7 ? A7 ? G&!5F " () %&' #5' <#5' 6&' !5 #$$) %#5$& ^ !(< (<& !5" (%)$(!) 5" F!W&5 !5 +&$I . I- I

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

? !$<#&6f)) (<
g! %&$() %2M9#6(Q=) 5(%6

Michael 2 Booth

Certifying Officer:

@#964 #!5&"
= <#!%:#5 A+ &5!) %E&$<5!$#6g !%&$() %

Paul R Zaino

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGNI10
Lot Number:	P2-NI686384
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Nickel
Starting Material:	Ni Metal
Starting Material Lot#:	2277 and 2282
Starting Material Purity:	99.9992%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9979 ± 30 µg/mL

Density: 1.038 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9971 ± 54 µg/mL**
ICP Assay NIST SRM 3136 Lot Number: 120619

Assay Method #2 **9970 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **9993 ± 33 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag		0.002606	M	Eu	<	0.001100	O	Na		0.004965	O	Se	<	0.067000	M	Zn		0.006578
M	Al	<	0.013000	O	Fe		0.018618	M	Nb	<	0.001100	O	Si		0.010923	M	Zr	<	0.001100
O	As	<	0.067000	M	Ga	<	0.001100	M	Nd	<	0.001100	M	Sm	<	0.001100				
M	Au	<	0.002100	M	Gd	<	0.001100	s	Ni	<		M	Sn	<	0.016000				
M	B	<	0.017000	M	Ge	<	0.004200	M	Os		0.002110	O	Sr	<	0.000940				
M	Ba	<	0.001100	M	Hf	<	0.001100	i	P	<		M	Ta	<	0.001100				
O	Be	<	0.000410	M	Hg		0.014895	M	Pb		0.006578	M	Tb	<	0.001100				
M	Bi	<	0.004200	M	Ho	<	0.001100	M	Pd	<	0.001100	M	Te	<	0.015000				
O	Ca		0.003351	M	In	<	0.001100	M	Pr	<	0.001100	M	Th	<	0.001100				
M	Cd		0.001365	M	Ir		0.004716	M	Pt	<	0.001100	M	Ti	<	0.004200				
M	Ce	<	0.001100	O	K		0.004716	M	Rb	<	0.001100	M	Tl	<	0.001100				
O	Co		0.017377	M	La	<	0.001100	M	Re		0.001737	M	Tm	<	0.001100				
O	Cr	<	0.006700	O	Li	<	0.000140	M	Rh	<	0.006300	M	U	<	0.001100				
M	Cs	<	0.007300	M	Lu	<	0.001100	M	Ru	<	0.019000	M	V	<	0.002100				
M	Cu		0.004096	O	Mg		0.000372	i	S	<		M	W	<	0.006300				
M	Dy	<	0.001100	O	Mn	<	0.001900	M	Sb		0.005833	O	Y	<	0.000540				
M	Er	<	0.001100	M	Mo	<	0.008400	M	Sc	<	0.002100	M	Yb	<	0.001100				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 58.69 +2 6 Ni(H2O)62+
Chemical Compatibility -Stable in HCl, HNO3, H2SO4 ,HF, H3PO4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.
Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO3 / LDPE container.
Ni Containing Samples (Preparation and Solution) -Metal (Soluble in HNO3); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO3).
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 60 amu	100 ppt	n/a	43Ca16O1H , 44Ca16O, 23Na37Cl
ICP-OES 221.647 nm	0.01 / 0.0009 µg/mL	1	Si
ICP-OES 231.604 nm	0.02 / 0.002 µg/mL	1	Sb, Ta, Co
ICP-OES 232.003 nm	0.02 / 0.006 µg/mL	1	Cr, Re, Os, Nb, Ag, Pt, Fe

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

December 02, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **December 02, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

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fax: 540.585.3012
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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGPB10
Lot Number:	P2-PB686383
Matrix:	0.5% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Lead
Starting Material:	Lead Nitrate
Starting Material Lot#:	2299
Starting Material Purity:	99.9974%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10031 ± 30 µg/mL

Density: 1.015 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10060 ± 63 µg/mL**
ICP Assay NIST SRM 3128 Lot Number: 101026

Assay Method #2 **10048 ± 32 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **10007 ± 32 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag		0.000850	M	Eu	<	0.000310	O	Na		0.005780	M	Se	<	0.004600	M	Zn		0.005440
O	Al		0.234602	O	Fe		0.023460	M	Nb	<	0.000310	O	Si		0.047600	M	Zr	<	0.000610
M	As	<	0.001900	M	Ga	<	0.000310	M	Nd	<	0.000310	M	Sm	<	0.000310				
M	Au	<	0.002200	M	Gd	<	0.004300	M	Ni	<	0.001600	M	Sn	<	0.000610				
O	B	<	0.005200	M	Ge	<	0.000610	M	Os	<	0.000310	O	Sr		0.000442				
O	Ba		0.001530	M	Hf	<	0.000310	O	P	<	0.052000	M	Ta	<	0.000310				
O	Be	<	0.000630	M	Hg	<	0.001600	s	Pb	<		M	Tb	<	0.000310				
O	Bi		0.021080	M	Ho	<	0.000610	M	Pd	<	0.000310	M	Te	<	0.004300				
O	Ca		0.037400	M	In	<	0.000310	M	Pr	<	0.000310	M	Th	<	0.000310				
M	Cd	<	0.000610	M	Ir	<	0.000310	M	Pt	<	0.000310	M	Ti		0.002992				
M	Ce	<	0.000910	O	K		0.008840	M	Rb	<	0.000610	M	Tl		0.037400				
M	Co	<	0.000610	M	La	<	0.000610	M	Re	<	0.000310	M	Tm	<	0.000610				
M	Cr	<	0.003400	O	Li		0.000108	O	Rh	<	0.006300	M	U	<	0.000310				
M	Cs		0.002686	M	Lu	<	0.000310	M	Ru	<	0.000310	M	V	<	0.000310				
M	Cu	<	0.002500	O	Mg		0.004760	O	S	<	0.052000	M	W	<	0.002200				
M	Dy	<	0.000310	M	Mn	<	0.000310	M	Sb	<	0.001300	M	Y	<	0.000310				
M	Er	<	0.000310	O	Mo	<	0.005400	M	Sc	<	0.000310	M	Yb	<	0.000310				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 207.20 +2 6 $Pb(H_2O)_{6}^{+2}$

Chemical Compatibility - Soluble in HCl, HF and HNO_3. Avoid H_2SO_4. Stable with most metals and inorganic anions forming insoluble carbonate, borate, sulfate, sulfite, sulfide, phosphate, oxalate, chromate, tannate, iodate, and cyanide in neutral aqueous media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5% HNO_3 / LDPE container.

Pb Containing Samples (Preparation and Solution) -Metal (Best dissolved in 1:1 H_2O / HNO_3); Oxides (The many different Pb oxides are soluble in HNO_3 with the exception of PbO_2 which is soluble in HCl or HF); Ores and Alloys (Best attacked using 1:1 H_2O / HNO_3); Organic Matrices (Dry ash and dissolve in dilute HCl).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 208 amu	5 ppt	n/a	192Pt16O, 192Os16O
ICP-OES 168.215 nm	0.03 / 0.003 µg/mL	1	Co
ICP-OES 217.000 nm	0.09 / 0.03 µg/mL	1	W, Ir, Hf, Sb, Th
ICP-OES 220.353 nm	0.04 / 0.006 µg/mL	1	Bi, Nb

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

December 02, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **December 02, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGSB10
Lot Number:	R2-SB688559
Matrix:	3% (v/v) HNO3 3% (w/v) tartaric acid
Value / Analyte(s):	10 000 µg/mL ea: Antimony
Starting Material:	Antimony Metal
Starting Material Lot#:	1857
Starting Material Purity:	99.9894%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10003 ± 47 µg/mL

Density: 1.061 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10003 ± 41 µg/mL**
ICP Assay NIST SRM 3102a Lot Number: 140911

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

$CRM/RM\ Expanded\ Uncertainty\ (\pm) = U_{CRM/RM} = k\ (u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\ (u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\ (u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

$CRM/RM\ Expanded\ Uncertainty\ (\pm) = U_{CRM/RM} = k\ (u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.000200	M	Eu	<	0.000300	O	Na		0.140000	M	Se	<	0.007300	O	Zn		0.005000
M	Al		0.003200	O	Fe		0.060000	M	Nb	<	0.000100	O	Si		0.150000	O	Zr	<	0.006300
M	As	<	0.004400	M	Ga	<	0.000400	M	Nd	<	0.000100	M	Sm	<	0.000100				
M	Au	<	0.000210	M	Gd	<	0.000100	O	Ni		0.004800	M	Sn	<	0.001800				
M	B	<	0.011000	M	Ge	<	0.000600	M	Os	<	0.000110	O	Sr		0.000750				
O	Ba	<	0.004900	M	Hf	<	0.000100	O	P		0.540000	M	Ta		0.003300				
M	Be	<	0.000400	M	Hg	<	0.000110	M	Pb	<	0.000400	M	Tb	<	0.000100				
M	Bi	<	0.000200	M	Ho	<	0.000100	M	Pd	<	0.000210	M	Te	<	0.000600				
O	Ca		0.110000	M	In	<	0.000100	M	Pr	<	0.001600	M	Th	<	0.000100				
M	Cd	<	0.000200	M	Ir	<	0.000110	M	Pt	<	0.000600	M	Ti	<	0.002800				
M	Ce		0.006500	O	K		0.020000	M	Rb	<	0.001000	M	Tl	<	0.000100				
M	Co	<	0.000200	O	La	<	0.016000	M	Re	<	0.000100	M	Tm	<	0.000100				
M	Cr		0.006900	O	Li	<	0.000430	M	Rh	<	0.000300	M	U	<	0.000100				
M	Cs	<	0.000200	M	Lu	<	0.000100	M	Ru	<	0.000310	M	V	<	0.000800				
M	Cu	<	0.000600	O	Mg		0.021000	n	S	<		M	W	<	0.000200				
M	Dy	<	0.000100	O	Mn		0.001900	s	Sb	<		M	Y	<	0.000100				
M	Er	<	0.000100	M	Mo	<	0.000500	O	Sc	<	0.002300	M	Yb	<	0.000100				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 121.75 +3 6 Sb(O)C4H4O6-1

Chemical Compatibility -Stable in conc. HCl, dilute or conc. HF. Stable in dilute HNO3 as the fluoride or tartrate complex. Avoid basic media. Stable with most metals and inorganic anions in acidic media as the tartrate provided the acidity is not too high or the acid is oxidizing causing loss of the stabilizing tartrate ion. The fluoride complex of antimony is stable in strong acid but you should only mix with other metals that are fluorinated.

Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-2% HNO3 / LDPE container.

Sb Containing Samples (Preparation and Solution) -Metal and alloys (Soluble in H2O / HF / HNO3 mixture); Oxides (Soluble in HCl and tartaric acid or H2O / HF / HNO3 mixtures); Ores (fusion with Na2CO3 in Pt0 followed by dissolving the fuseate in a H2O / HF / HNO3 mixture); Organic based (sulfuric acid / hydrogen peroxide digestion)

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 121 amu	5 ppt	N/A	105Pd16O, 89Y16O2
ICP-OES 206.833 nm	0.03/0.003 µg/mL	1	Ta, Cr, Ge, Hf
ICP-OES 217.581 nm	0.05/0.005 µg/mL	1	Nb, W, Re, Fe
ICP-OES 231.147 nm	0.06/0.006 µg/mL	1	Ni, Co, Pt

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

April 30, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- April 30, 2024

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED
Testing Laboratory
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ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGSE10
Lot Number:	P2-SE684206
Matrix:	3% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Selenium
Starting Material:	Se Metal
Starting Material Lot#:	1962
Starting Material Purity:	99.9991%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9992 ± 61 µg/mL

Density: 1.035 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9993 ± 67 µg/mL**
ICP Assay NIST SRM 3149 Lot Number: 100901

Assay Method #2 **9992 ± 73 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.002242	M	Eu	<	0.000373	O	Na		0.013700	s	Se	<		O	Zn		0.002382
M	Al		0.004465	M	Fe		0.008506	O	Nb	<	0.002975	O	Si		0.006270	M	Zr	<	0.001868
O	As	<	0.022040	M	Ga	<	0.000373	M	Nd	<	0.000373	M	Sm	<	0.000373				
M	Au	<	0.000373	M	Gd	<	0.000373	O	Ni		0.001849	M	Sn		0.000850				
O	B	<	0.007714	M	Ge	<	0.002616	M	Os	<	0.000373	M	Sr	<	0.001121				
M	Ba	<	0.001495	M	Hf	<	0.000373	O	P	<	0.022040	M	Ta	<	0.000373				
M	Be	<	0.001495	M	Hg	<	0.002240	M	Pb		0.006379	M	Tb	<	0.006353				
M	Bi	<	0.000373	M	Ho	<	0.000373	M	Pd	<	0.000373	M	Te	<	0.012707				
O	Ca		0.006552	M	In	<	0.000373	M	Pr	<	0.001495	M	Th	<	0.002990				
M	Cd		0.001169	M	Ir	<	0.000373	M	Pt	<	0.000373	M	Ti	<	0.003363				
M	Ce	<	0.000373	O	K		0.002006	M	Rb	<	0.001868	M	Tl		0.008613				
M	Co	<	0.000373	M	La	<	0.001121	M	Re	<	0.000373	M	Tm	<	0.000373				
M	Cr		0.002870	O	Li		0.000062	M	Rh	<	0.000373	M	U	<	0.000373				
M	Cs	<	0.001121	M	Lu	<	0.000373	M	Ru	<	0.001493	M	V	<	0.000747				
M	Cu	<	0.000747	O	Mg		0.001159	O	S		0.024674	M	W	<	0.002242				
M	Dy	<	0.000373	M	Mn	<	0.000373	M	Sb	<	0.002242	M	Y	<	0.000373				
M	Er	<	0.000373	O	Mo	<	0.003195	M	Sc	<	0.001121	M	Yb	<	0.000373				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 78.96 +4 6 H_2SeO_3

Chemical Compatibility -Soluble in HCl, HNO_3,H_3PO_4, H_2SO_4 and HF aqueous matrices and water. It is stable with most inorganic anions but many cationic metals form the insoluble selenites under pH neutral conditions. When fluorinated and/or under acidic conditions precipitation is typically not a problem at moderate to low concentrations.

Stability - 2-100 ppb levels stable for months alone or mixed with other elements at equivalent levels in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Se Containing Samples (Preparation and Solution) -Metal (soluble in HNO_3); Oxides (readily soluble in water); Minerals and alloys (acid digestion with HNO_3or HNO_3 / HF); Organic Matrices (acid digestion with hot concentrated H_2SO_4 accompanied by the careful dropwise addition of H_2O_2 until clear).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 82 amu	200 ppt	N/A	12C35Cl2
ICP-OES 196.026 nm	0.08/0.006 µg/mL	1	Fe
ICP-OES 203.985 nm	0.2/0.05 µg/mL	1	Sb, Ir, Cr, Ta
ICP-OES 206.279 nm	0.3/0.16 µg/mL	1	Cr, Pt

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

September 13, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **September 13, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

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CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGTL10
Lot Number:	R2-TL691937
Matrix:	5% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Thallium
Starting Material:	TlNO3
Starting Material Lot#:	2118
Starting Material Purity:	99.9998%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 9987 ± 49 µg/mL

Density: 1.035 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **9968 ± 68 µg/mL**
ICP Assay NIST SRM 3158 Lot Number: 151215

Assay Method #2 **10001 ± 58 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The follow ing equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.000200	M	Eu	<	0.000200	O	Na		0.002479	M	Se	<	0.011019	O	Zn	0.002288
O	Al	<	0.004184	O	Fe	<	0.002824	M	Nb	<	0.000200	O	Si		0.003744	M	Zr	< 0.000200
M	As	<	0.002003	M	Ga	<	0.000200	M	Nd	<	0.000200	M	Sm	<	0.000200			
O	Au	<	0.002824	M	Gd	<	0.000200	M	Ni		0.001717	M	Sn	<	0.000601			
O	B	<	0.004184	M	Ge	<	0.000801	M	Os	<	0.000198	O	Sr	<	0.000313			
M	Ba	<	0.000400	M	Hf	<	0.000200	O	P	<	0.010460	M	Ta	<	0.000200			
O	Be	<	0.000104	M	Hg	<	0.000794	M	Pb		0.000807	M	Tb	<	0.000200			
M	Bi	<	0.005209	M	Ho	<	0.000200	M	Pd	<	0.000400	M	Te	<	0.005008			
O	Ca		0.002426	M	In	<	0.000200	M	Pr	<	0.000200	M	Th	<	0.000200			
M	Cd		0.001312	M	Ir	<	0.000198	M	Pt	<	0.000801	O	Ti	<	0.001255			
M	Ce	<	0.000200	O	K		0.006150	M	Rb	<	0.000200	s	Tl	<				
M	Co	<	0.000601	M	La	<	0.000200	M	Re	<	0.000200	M	Tm	<	0.000200			
M	Cr	<	0.000801	O	Li	<	0.000177	M	Rh	<	0.000200	M	U	<	0.000200			
M	Cs	<	0.003606	M	Lu	<	0.000200	M	Ru	<	0.000397	M	V	<	0.002203			
M	Cu	<	0.001001	O	Mg		0.000527	O	S	<	0.015690	M	W	<	0.000601			
M	Dy	<	0.000200	M	Mn	<	0.000801	M	Sb	<	0.000400	M	Y	<	0.000200			
M	Er	<	0.000200	M	Mo	<	0.001202	O	Sc	<	0.000711	M	Yb	<	0.000200			

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 204.38 +1 6 Tl(H2O)61+

Chemical Compatibility - Soluble in HCl, HNO3, and H2SO4. Stable with most metals and inorganic anions. The sulfite, thiocyanate and oxalate are moderately soluble; the phosphate and arsenite are slightly soluble and the sulfide is insoluble.

Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5% HNO3 / LDPE container.

Tl Containing Samples (Preparation and Solution) -Metal (Best dissolved in HNO3 which forms chiefly the Tl1+ ion.); Oxide (The thallous oxide is readily soluble in water. The thallic oxide requires high levels of acid); Ores (Carbonate fusion in Pt0 followed by HCl dissolution); Organic Matrices (Sulfuric/peroxide digestion or dry ash and dissolution in HCl).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 205 amu	2 ppt	N/A	189Os16O
ICP-OES 190.864 nm	0.04 / 0.004 µg/mL	1	V, Ti
ICP-OES 276.787 nm	0.1 / 0.01 µg/mL	1	Ta, V, Fe, Cr
ICP-OES 351.924 nm	0.2 / 0.02 µg/mL	1	Th, Ce, Zr

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

April 08, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- April 08, 2024

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO 17034, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGV10
Lot Number:	R2-V688296
Matrix:	7% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Vanadium
Starting Material:	Vanadium pentoxide
Starting Material Lot#:	1782
Starting Material Purity:	99.9907%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10026 ± 30 µg/mL

Density: 1.105 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10025 ± 56 µg/mL**
ICP Assay NIST SRM 3165 Lot Number: 160906

Assay Method #2 **10027 ± 30 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.000510	M	Eu	<	0.000110	M	Na		0.095000	M	Se	<	0.002300	M	Zn		0.008900
O	Al		0.051000	O	Fe		0.350000	M	Nb	<	0.000710	O	Si		0.260000	M	Zr	<	0.002500
M	As	<	0.000410	M	Ga	<	0.007100	M	Nd	<	0.000210	M	Sm	<	0.000110				
M	Au	<	0.000410	M	Gd	<	0.000110	M	Ni		0.011000	M	Sn	<	0.003300				
M	B	<	0.006000	M	Ge	<	0.000110	M	Os	<	0.000410	M	Sr		0.001400				
M	Ba		0.001800	M	Hf	<	0.000110	O	P	<	0.120000	M	Ta	<	0.000110				
M	Be	<	0.000110	M	Hg	<	0.000310	M	Pb	<	0.002300	M	Tb	<	0.000110				
M	Bi	<	0.000610	M	Ho	<	0.000110	M	Pd	<	0.000610	M	Te	<	0.000610				
M	Ca		0.180000	M	In	<	0.000110	M	Pr	<	0.000110	M	Th	<	0.000210				
M	Cd	<	0.000410	M	Ir	<	0.000110	M	Pt	<	0.000410	M	Ti	<	0.021000				
M	Ce	<	0.000310	M	K		0.400000	M	Rb	<	0.000410	M	Tl	<	0.000110				
M	Co	<	0.001100	M	La	<	0.000110	M	Re	<	0.000110	M	Tm	<	0.000110				
O	Cr		0.190000	M	Li	<	0.001400	M	Rh	<	0.000110	M	U	<	0.000310				
M	Cs		0.005700	M	Lu	<	0.000110	M	Ru	<	0.000410	s	V	<					
M	Cu	<	0.001800	M	Mg		0.009200	n	S	<		M	W	<	0.003100				
M	Dy	<	0.000110	M	Mn		0.008700	M	Sb		0.076000	M	Y	<	0.000110				
M	Er	<	0.000110	M	Mo		0.086000	M	Sc	<	0.000310	M	Yb	<	0.000110				

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 50.94 +5 6 H2V10O284-

Chemical Compatibility -Soluble in HCl, HNO3, H2SO4, HF, H3PO4 and strong basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO3 / LDPE container.

V Containing Samples (Preparation and Solution) -Metal (Fusion with NaOH or KOH in Ni0 or Na2CO3 / KNO3); Oxides (V2O3 - use HCl, V2O4 - use HCl or HNO3, V2O5 - use concentrated acids); Ores (Na2CO3 / KNO3 in Pt0 caution - nitrates attack Pto followed by water extraction of fuseate); Organic Matrices (Ash at 450 EC followed by dissolving according to V2O5 above) .

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 51 amu	4 ppt	N/A	34S16O1H, 35Cl16O, 38Ar13C, 36Ar15N, 36Ar14N1H, 37Cl14N,36S15N, 33S18O, 34S17O, 102Ru+2,02Pd+2
ICP-OES 290.882 nm	0.008 / 0.0008 µg/mL	1	Hf, Nb
ICP-OES 292.402 nm	0.006 / 0.001 µg/mL	1	Th
ICP-OES 309.311 nm	0.005 / 0.001 µg/mL	1	Mg, U, Th

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

March 01, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **March 01, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

INORGANIC VENTURES
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

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1.0 ACCREDITATION / REGISTRATION

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ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

2.0 PRODUCT DESCRIPTION

Product Code:	Single Analyte Custom Grade Solution
Catalog Number:	CGZN10
Lot Number:	P2-ZN686137
Matrix:	2% (v/v) HNO3
Value / Analyte(s):	10 000 µg/mL ea: Zinc
Starting Material:	Zn Shot
Starting Material Lot#:	2201
Starting Material Purity:	99.9993%

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 10040 ± 30 µg/mL

Density: 1.033 g/mL (measured at 20 ± 4 ºC)

Assay Information:

Assay Method #1 **10009 ± 54 µg/mL**
ICP Assay NIST SRM 3168a Lot Number: 120629

Assay Method #2 **10049 ± 33 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

Assay Method #3 **10041 ± 28 µg/mL**
Calculated NIST SRM Lot Number: See Sec. 4.2

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two or More Methods

Certified Value, $X_{CRM/RM}$, where two or more methods of characterization are used is the weighted mean of the results:

$X_{CRM/RM} = \Sigma(w_i)(X_i)$

X_i = mean of Assay Method i with standard uncertainty $u_{char\ i}$

w_i = the weighting factors for each method calculated using the inverse square of the variance:

$w_i = (1/u_{char\ i})^2 / (\Sigma(1/(u_{char\ i})^2)$

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char} = [\Sigma((w_i)^2\,(u_{char\ i})^2)]^{½}$ where $u_{char\ i}$ are the errors from each characterization method

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$X_{CRM/RM} = (X_a)\,(u_{char\ a})$

X_a = mean of Assay Method A with

$u_{char\ a}$ = the standard uncertainty of characterization Method A

CRM/RM Expanded Uncertainty (±) = $U_{CRM/RM} = k\,(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{ts})^{½}$

k = coverage factor = 2

$u_{char\ a}$ = the errors from characterization

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	<	0.003057	M	Eu	<	0.000509	O	Na		0.001874	M	Se	<	0.023441	s	Zn	<
O	Al	<	0.005720	O	Fe		0.006348	M	Nb	<	0.000509	O	Si	<	0.057200	M	Zr	< 0.000509
M	As	<	0.003057	M	Ga	<	0.007134	M	Nd	<	0.000509	M	Sm	<	0.000509			
M	Au	<	0.000510	M	Gd	<	0.000509	M	Ni	<	0.000509	M	Sn	<	0.000509			
O	B	<	0.017160	M	Ge	<	0.003057	M	Os	<	0.000510	M	Sr	<	0.000509			
M	Ba	<	0.000509	M	Hf	<	0.000509	O	P	<	0.057200	M	Ta	<	0.000509			
M	Be	<	0.000509	M	Hg	<	0.001021	O	Pb		0.023870	M	Tb	<	0.000509			
M	Bi	<	0.005095	M	Ho	<	0.000509	M	Pd	<	0.002038	M	Te	<	0.023441			
O	Ca		0.033793	M	In	<	0.000509	M	Pr	<	0.000509	M	Th	<	0.000509			
O	Cd		0.003924	M	Ir	<	0.000510	M	Pt	<	0.000509	M	Ti	<	0.000509			
M	Ce	<	0.000509	O	K		0.001499	M	Rb	<	0.002038	M	Tl	<	0.009172			
M	Co	<	0.000509	M	La	<	0.000509	M	Re	<	0.000509	M	Tm	<	0.000509			
O	Cr		0.001549	O	Li	<	0.000457	M	Rh	<	0.000509	M	U	<	0.000509			
M	Cs	<	0.000509	M	Lu	<	0.000509	M	Ru	<	0.006129	M	V	<	0.000509			
O	Cu	<	0.010296	O	Mg		0.000349	O	S	<	0.034320	M	W	<	0.001019			
M	Dy	<	0.000509	M	Mn	<	0.000509	M	Sb	<	0.001019	M	Y	<	0.000509			
M	Er	<	0.000509	M	Mo	<	0.000509	M	Sc	<	0.000509	M	Yb	<	0.000509			

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit **www.inorganicventures.com/TCT**

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 65.39 +2 4 Zn(OH)(aq)1+
Chemical Compatibility -Stable in HCl, HNO3, H2SO4 ,HF, H3PO4. Avoid basic media forming insoluble carbonate and hydroxide. Stable with most metals and inorganic anions in acidic media.
Stability - 2-100 ppb levels stable for months in 1% HNO3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO3 / LDPE container.
Zn Containing Samples (Preparation and Solution) -Metal (soluble in HNO3); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO3); Organic based (dry ash at 4500C and dissolve ash in HCl) (sulfuric/peroxide acid digestion)
Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	**Estimated D.L.**	**Order**	**Interferences** (underlined indicates severe)
ICP-MS 66 amu	7 ppt	N/A	50Ti16O,50Cr16O, 50V16O, 34S16O2, 32S16O18O, 32S17O2, 33S16O17O, 32S34S, 33S2
ICP-OES 202.548 nm	0.004/0.0002 µg/mL	1	Nb, Cu, Co, Hf
ICP-OES 206.200 nm	0.006/0.0006 µg/mL	1	Sb, Ta, Bi, Os
ICP-OES 213.856 nm	0.002/0.0004 µg/mL	1	Ni, Cu, V

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO 17034 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

December 05, 2019

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **December 05, 2023**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Manager, Quality Control

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9014

HSA-59-9-10.5

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-01RE1 B	SDG:	21I0042
Sampled:	08/30/21 11:55	Prepared:	09/09/21 16:11	File ID:	091021 CN CKI2b-026
% Solids:	38.24	Preparation:	EPA 9013/9010	Analyzed:	09/10/21 18:36
Batch:	BJI0275	Sequence:	SJI0172	Initial/Final:	2.572 g Wet / 52.572 mL
Instrument:	UV1800-2			Calibration:	UNASSIGNED

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	MDL	MRL	Q
57-12-5	Cyanide, Total after Distillation	0.588	1	0.265	0.265	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9014

HSA-60-9-10.5

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-02 B	SDG:	21I0042
Sampled:	08/30/21 14:20	Prepared:	09/09/21 16:11	File ID:	091021 CN CKI2b-011
% Solids:	27.05	Preparation:	EPA 9013/9010	Analyzed:	09/10/21 18:05
Batch:	BJI0275	Sequence:	SJI0172	Initial/Final:	2.693 g Wet / 52.693 mL
Instrument:	UV1800-2			Calibration:	UNASSIGNED

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	MDL	MRL	Q
57-12-5	Cyanide, Total after Distillation	<0.358	1	0.358	0.358	U

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9014

HSA-62-13-14

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-03 B	SDG:	21I0042
Sampled:	08/31/21 11:00	Prepared:	09/09/21 16:11	File ID:	091021 CN CKI2b-012
% Solids:	73.67	Preparation:	EPA 9013/9010	Analyzed:	09/10/21 18:06
Batch:	BJI0275	Sequence:	SJI0172	Initial/Final:	2.574 g Wet / 52.574 mL
Instrument:	UV1800-2			Calibration:	UNASSIGNED

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	MDL	MRL	Q
57-12-5	Cyanide, Total after Distillation	15.7	5	0.686	0.686	D

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9014

DUP-1-083121

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-04 B	SDG:	21I0042
Sampled:	08/31/21 11:30	Prepared:	09/09/21 16:11	File ID:	091021 CN CKI2b-015
% Solids:	69.07	Preparation:	EPA 9013/9010	Analyzed:	09/10/21 18:08
Batch:	BJI0275	Sequence:	SJI0172	Initial/Final:	3.042 g Wet / 53.042 mL
Instrument:	UV1800-2			Calibration:	UNASSIGNED

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	MDL	MRL	Q
57-12-5	Cyanide, Total after Distillation	11.4	5	0.625	0.625	D

PREPARATION BATCH SUMMARY

EPA 9014

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Batch: BJI0275 Batch Matrix: Solid Preparation: EPA 9013/9010

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
HSA-59-9-10.5	21I0042-01RE1	091021 CN CKI2b-026	09/09/21 16:11	Added 9/10/2021 by CKI
HSA-60-9-10.5	21I0042-02	091021 CN CKI2b-011	09/09/21 16:11	
HSA-62-13-14	21I0042-03	091021 CN CKI2b-012	09/09/21 16:11	
DUP-1-083121	21I0042-04	091021 CN CKI2b-015	09/09/21 16:11	
Blank	BJI0275-BLK1	091021 CN CKI2b-004	09/09/21 16:11	
LCS	BJI0275-BS1	091021 CN CKI2b-005	09/09/21 16:11	
HSA-59-9-10.5	BJI0275-DUP2	091021 CN CKI2b-027	09/09/21 16:11	Added 9/10/2021 by CKI
MRL Check	BJI0275-MRL1	091021 CN CKI2b-003	09/09/21 16:11	
HSA-59-9-10.5	BJI0275-MS2	091021 CN CKI2b-028	09/09/21 16:11	Added 9/10/2021 by CKI
HSA-59-9-10.5	BJI0275-MSD2	091021 CN CKI2b-029	09/09/21 16:11	Added 9/10/2021 by CKI
Reference	BJI0275-SRM1	091021 CN CKI2b-010	09/09/21 16:11	

Form I

METHOD BLANK DATA SHEET

EPA 9014

TotalAnalytes

Blank

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Batch: BJI0275
Laboratory ID: BJI0275-BLK1
Prepared: 09/09/21 16:11
Matrix: Solid
Preparation: EPA 9013/9010
Analyzed: 09/10/21 17:59
Sequence: SJI0172
Calibration: N/A
Instrument: UV1800-2

CAS NO.	Analyte	Concentration (mg/kg wet)	Dilution Factor	MDL	MRL	Q
57-12-5	Cyanide, Total after Distillation	ND	1	0.100	0.100	U

LCS / LCS DUPLICATE RECOVERY

EPA 9014

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/10/21 18:00
Batch:	BJI0275	Laboratory ID:	BJI0275-BS1
Preparation:	EPA 9013/9010	Sequence Name:	LCS
Initial/Final:	7.5 g / 151.5 mL		

COMPOUND	SPIKE ADDED (mg/kg wet)	LCS CONCENTRATION (mg/kg wet)	Q	LCS % REC. #	QC LIMITS REC.
Cyanide, Total after Distillation	8.14	7.43	D	91.4	75 - 125

* Indicates values outside of QC limits

DUPLICATES

EPA 9014

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Solid
Laboratory ID: BJI0275-DUP2
Batch: BJI0275
Lab Source ID: 21I0042-01RE1
Preparation: EPA 9013/9010
Initial/Final: 2.59 g / 52.59 mL
Source Sample Name: HSA-59-9-10.5
% Solids: 38.24

ANALYTE	CONTROL LIMIT	SAMPLE CONCENTRATION (mg/kg dry)	C	DUPLICATE CONCENTRATION (mg/kg dry)	C	RPD %	Q
Cyanide, Total after Distillation	20	0.588		0.266	*	75.6	*

*: Values outside of QC limits
L: Analyte concentration is <=5 times the reporting limit and the replicate control limit defaults to Dup = +/- RL instead of 20% RPD

MS / MS DUPLICATE RECOVERY
EPA 9014

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/10/21 18:44
Batch:	BJI0275	Laboratory ID:	BJI0275-MS2
Preparation:	EPA 9013/9010	Sequence Name:	Matrix Spike
Initial/Final:	2.508 g / 52.508 mL	Source Sample:	HSA-59-9-10.5

COMPOUND	SPIKE ADDED (mg/kg dry)	SAMPLE CONCENTRATION (mg/kg dry)	Q	MS CONCENTRATION (mg/kg dry)	Q	MS % REC. #		QC LIMITS REC.
Cyanide, Total after Distillation	7.92	0.588		4.87	*	54.1	*	75 - 125

* Values outside of QC limits

MS / MS DUPLICATE RECOVERY
EPA 9014

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/10/21 18:45
Batch:	BJI0275	Laboratory ID:	BJI0275-MSD2
Preparation:	EPA 9013/9010	Sequence Name:	Matrix Spike Dup
Initial/Final:	2.581 g / 52.581 mL	Source Sample:	HSA-59-9-10.5

COMPOUND	SPIKE ADDED (mg/kg dry)	MSD CONCENTRATION (mg/kg dry)	Q	MSD % REC. #		% RPD #	QC LIMITS RPD	QC LIMITS REC.
Cyanide, Total after Distillation	7.70	4.64	*	52.6	*	5.00	200	75 - 125

* Values outside of QC limits

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 9014

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0172
Instrument: UV1800-2
Calibration: UNASSIGNED

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Cal Standard	SJI0172-CAL1	091021 CN CKI1b-001	NA	09/10/21 17:50
Cal Standard	SJI0172-CAL2	091021 CN CKI1b-002	NA	09/10/21 17:51
Cal Standard	SJI0172-CAL3	091021 CN CKI1b-003	NA	09/10/21 17:52
Cal Standard	SJI0172-CAL4	091021 CN CKI1b-004	NA	09/10/21 17:53
Cal Standard	SJI0172-CAL5	091021 CN CKI1b-005	NA	09/10/21 17:54
Cal Standard	SJI0172-CAL6	091021 CN CKI1b-006	NA	09/10/21 17:54
Cal Standard	SJI0172-CAL7	091021 CN CKI1b-007	NA	09/10/21 17:55
Initial Cal Blank	SJI0172-ICB1	091021 CN CKI2b-001	NA	09/10/21 17:56
Initial Cal Check	SJI0172-ICV1	091021 CN CKI2b-002	NA	09/10/21 17:57
MRL Check	BJI0275-MRL1	091021 CN CKI2b-003	Solid	09/10/21 17:58
Blank	BJI0275-BLK1	091021 CN CKI2b-004	Solid	09/10/21 17:59
LCS	BJI0275-BS1	091021 CN CKI2b-005	Solid	09/10/21 18:00
Reference	BJI0275-SRM1	091021 CN CKI2b-010	Solid	09/10/21 18:04
HSA-60-9-10.5	21I0042-02	091021 CN CKI2b-011	Solid	09/10/21 18:05
HSA-62-13-14	21I0042-03	091021 CN CKI2b-012	Solid	09/10/21 18:06
Calibration Blank	SJI0172-CCB1	091021 CN CKI2b-013	NA	09/10/21 18:07
Calibration Check	SJI0172-CCV1	091021 CN CKI2b-014	NA	09/10/21 18:07
DUP-1-083121	21I0042-04	091021 CN CKI2b-015	Solid	09/10/21 18:08
Calibration Blank	SJI0172-CCB2	091021 CN CKI2b-024	NA	09/10/21 18:16
Calibration Check	SJI0172-CCV2	091021 CN CKI2b-025	NA	09/10/21 18:16
HSA-59-9-10.5	21I0042-01RE1	091021 CN CKI2b-026	Solid	09/10/21 18:36
HSA-59-9-10.5	BJI0275-DUP2	091021 CN CKI2b-027	Solid	09/10/21 18:43
HSA-59-9-10.5	BJI0275-MS2	091021 CN CKI2b-028	Solid	09/10/21 18:44
HSA-59-9-10.5	BJI0275-MSD2	091021 CN CKI2b-029	Solid	09/10/21 18:45
Calibration Blank	SJI0172-CCB3	091021 CN CKI2b-030	NA	09/10/21 18:46
Calibration Check	SJI0172-CCV3	091021 CN CKI2b-031	NA	09/10/21 18:46

INSTRUMENT BLANKS
EPA 9014

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: UV1800-2
Calibration: UNASSIGNED
Sequence: SJI0172
Date Analyzed: 09/10/21 17:56

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SJI0172-ICB1	Cyanide, Total after Distillation	0.00	0.005	0.005	mg/L	
SJI0172-CCB1	Cyanide, Total after Distillation	0.00	0.005	0.005	mg/L	
SJI0172-CCB2	Cyanide, Total after Distillation	-0.001	0.005	0.005	mg/L	
SJI0172-CCB3	Cyanide, Total after Distillation	0.00	0.005	0.005	mg/L	

INITIAL AND CONTINUING CALIBRATION CHECK

EPA 9014

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: UV1800-2
Calibration: UNASSIGNED
Control Limt: +/- 10.00%
Sequence: SJI0172

Lab Sample ID	Analyte	True	Found	%R	Units	Method
SJI0172-ICV1	Cyanide, Total after Distillation	0.10352	0.099	95.6	mg/L	EPA 9014
SJI0172-CCV1	Cyanide, Total after Distillation	0.10352	0.098	94.7	mg/L	EPA 9014
SJI0172-CCV2	Cyanide, Total after Distillation	0.10352	0.097	93.7	mg/L	EPA 9014
SJI0172-CCV3	Cyanide, Total after Distillation	0.10352	0.100	96.6	mg/L	EPA 9014

* Values outside of QC limits

STANDARD REFERENCE MATERIAL RECOVERY

EPA 9014

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Solid
Laboratory ID: BJI0275-SRM1
Batch: BJI0275
Initial/Final: 1.078 g / 151.5 mL
Preparation: EPA 9013/9010
Analyzed: 09/10/2021 18:04
Standard ID: J002685
Expires: 09/08/2021
Standard Lot#: D098-541
Description: Cyanide in Soil SRM

ANALYTE	TRUE (mg/kg wet)	FOUND (mg/kg wet)	MDL	MRL	Q	SRM % REC.	QC LIMITS REC.
Cyanide, Total after Distillation	35.600	43.3	1.39	1.39	D	122	31.46 - 168.54

* Values outside of QC limits

HOLDING TIME SUMMARY

Analysis: EPA 9014

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
HSA-59-9-10.5 21I0042-01RE1	08/30/21 11:55	09/02/21 10:52	09/09/21 16:11	10	14	09/10/21 18:36	1	4	
HSA-60-9-10.5 21I0042-02	08/30/21 14:20	09/02/21 10:52	09/09/21 16:11	10	14	09/10/21 18:05	1	4	
HSA-62-13-14 21I0042-03	08/31/21 11:00	09/02/21 10:52	09/09/21 16:11	9	14	09/10/21 18:06	1	4	
DUP-1-083121 21I0042-04	08/31/21 11:30	09/02/21 10:52	09/09/21 16:11	9	14	09/10/21 18:08	1	4	
Duplicate BJI0275-DUP2	08/30/21 11:55	09/02/21 10:52	09/09/21 16:11	10	14	09/10/21 18:43	1	4	
Matrix Spike BJI0275-MS2	08/30/21 11:55	09/02/21 10:52	09/09/21 16:11	10	14	09/10/21 18:44	1	4	
Matrix Spike Dup BJI0275-MSD2	08/30/21 11:55	09/02/21 10:52	09/09/21 16:11	10	14	09/10/21 18:45	1	4	

* Indicates hold time exceedance.

METHOD DETECTION AND REPORTING LIMITS

EPA 9014

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Matrix: Solid Instrument: UV1800-2

Analyte	MDL	RL	Units
Cyanide, Total after Distillation	0.100	0.100	mg/kg

Cyanide Titration

Analyst: CKI

Buret used for titrations: **CN**

Date & Time: 8/9/2021 10:37

Standardization of Cyanide Stock

Cyanide Stock ID: **I011195**

Silver Nitrate ID: **I008487**

grams to 1000 mL

Normality = **0.0141**

	Blank	Blank	Blank	
mL AgNO3 =	0.04	0.04	0.04	
mL CN Stock =	1.00	1.00	1.00	
mL AgNO3 =	1.20	1.22	1.21	*mg/L CN*
mg/L CN Stock =				
mL required for for 10 mg/L CN Intermediate in 50 mL				0.5925

J002685

ERA

A Waters Company

Certified Reference Material

▪ Certificate of Analysis ▪

Product: Cyanide in Soil
Catalog Number: 541
Lot No: D108-541
Certificate Issue Date: December 26, 2019
Expiration Date: July 11, 2023
Revision Number: Original

Product use instructions are included as part of the certification packet and are paginated separately from this Certificate of Analysis. Please reference the product use instructions for catalog #541 revision 090119.

CERTIFICATION

Parameter	Certified Value[1]	Reference Value[7]	Uncertainty[2]	QC Performance Acceptance Limits[3]	PT Performance Acceptance Limits[4]
	mg/Kg	mg/Kg	%	mg/Kg	mg/Kg
Cyanide, Total	48.8	35.6	20.8	11.2 - 59.9	11.2 - 60.0
Amenable Cyanide	< 25.0	< 25.0	20.8	-	0.00 - 25.0

ANALYTICAL VERIFICATION

Parameter	Certified Value[1]	Proficiency Testing Study			NIST Traceability	
		Mean	Recovery[5]	n	SRM Number[6]	Recovery
	mg/Kg	mg/Kg	%			%
Cyanide, Total	48.8	35.6	72.9	55	-	-
Amenable Cyanide	< 25.0	-	-	9	-	-

1. The **Certified Values** are the actual gravimetric/volumetric "made-to" concentrations confirmed by ERA analytical verification. The certified values are monitored and the purchasers will be notified of any significant changes resulting in recertification or withdrawal of this certified reference material during the period of validity of this certificate.

2. The **Uncertainty** represents an expanded uncertainty and approximates a 95% confidence interval. The uncertainty is based on the characterization, homogeneity and stability characteristics of the product, multiplied by a coverage factor (k=2). The uncertainty applies to the product as supplied and does not take into account any required or optional dilution and/or preparations the laboratory may perform while using this product. The formula used to calculate the expanded uncertainty is:
$U_{expanded} = k * SQRT((U_{char}^2) + (U_{homogen}^2) + (U_{LTS}^2) + (U_{STS}^2) + (U_{RSS}^2))$

Where:

Uexpanded = Expanded uncertainty.
k = Coverage factor.
Uchar = Combined standard uncertainty of the manufacturing and/or analytical verification assessment.
Uhomogen = Standard uncertainty of the homogeneity assessment.
ULTS = Standard uncertainty associated with long-term stability.
USTS = Standard uncertainty associated with short-term (transport) stability.
URSS = Standard uncertainty associated with repeated sampling of the product (where permitted by product use instructions).

3. The **QC Performance Acceptance Limits (QC PALs™)** are based on actual historical data collected in ERA's Proficiency Testing program. The QC PALs™ reflect any inherent biases in the methods used to establish the limits and closely approximate a 95% confidence interval of the performance that experienced laboratories should achieve using accepted environmental methods. Use the QC PALs™ to realistically evaluate your performance against your peers.

4. The **PT Performance Acceptance Limits (PT PALs™)** are calculated using the regression equations and fixed acceptance criteria specified in the NELAC proficiency testing requirements. Use the PT PALs™ when analyzing this QC standard alongside USEPA and NELAC compliant PT standards. Please note that many PT study acceptance limits are concentration dependent (some non-linearly) and, therefore, the acceptance limits of this QC standard and any PT standard may differ relative to their difference in concentrations.

5. The **PT Performance Data** include the mean value, percent recovery and number of data points reported by laboratories in our Proficiency Testing study compared to the Certified Values. In the event this lot was not used in a proficiency testing scheme, the data displayed was generated by ERA.

6. Where NIST Standard Reference Materials (SRMs) are available, each analyte has been analytically traced to the NIST SRM listed. **Analytical Traceability Recovery (%)** = [(% recovery ERA certified reference material)/(% recovery NIST SRM)]*100
The traceability data shown were compiled by analyzing this ERA certified reference material and/or it's associated stock solution(s) against the applicable NIST SRMs.

7. The **Reference Values** are equal to the mean recoveries for the parameters as determined in an interlaboratory round robin study. The **Reference Values** represent the expected performance for the analytes in this standard. ERA recommends using the **Reference Values** when assessing or evaluating your results.

8. **Metrological Traceability**. This certified reference material is metrologically traceable to NIST mass reference materials through an unbroken chain of comparisons.

9. For additional information on this product such as intended use, storage information, instructions for use, minimum sample size, and safety information, please refer to the Product Use Instructions provided.

If you have any questions or need technical assistance, please call ERA technical assistance at 1-800-372-0122 or send an email to info@eraqc.com.

Certifying Officer	Quality Officer
Brian Miller	Matthew Seebeck

ISO 17034:2016 ACCREDITED Reference Material Producer CERT #1539.03

ISO/IEC 17025:2017 ACCREDITED Chemical Testing Laboratory CERT #1539.02

ERA

A Waters Company

Instructions for Catalog # 541
Cyanide in Soil

Revision 090119

Description:

- This standard is packaged in a 2-ounce glass jar containing approximately 40 grams of soil.
- This standard is not preserved.
- The standard can be stored at room temperature.
- This product is intended to be used as a quality control check of the entire analytical process for the analytes/matrix included in the standard.
- ERA suggests that when subsampling this product prior to analysis you use a minimum sample size of at least 1.00 g. Using a smaller sample size may invalidate the assigned value and/or uncertainty shown on the certificate of analysis.
- Repeated sampling of this product is permitted, provided minimum sample sizes and storage instructions are adhered to.
- The certified values apply to the sample after following the stated instructions.

Helpful Hints:

- This standard is designed to be distilled using the procedures in the most recent revisions of EPA methods 9010, 9012 or equivalent.
- Although all ERA soil standards have been thoroughly blended prior to shipping, the standards should be homogenized prior to taking an aliquot for analysis due to settling which may occur during shipping.

Instructions:

1. Open the Cyanide in Soil standard in a fume hood to avoid inhalation of dust.
2. Mix the sample well prior to removing aliquots for analysis.
3. Distill and analyze the standard using your normal procedures.
4. Determine the percent moisture of an aliquot of the Cyanide in Soil standard.
5. Adjust your results as mg/kg on a dry weight basis.

Safety:

ERA products may be hazardous and are intended for use by professional laboratory personnel trained in the competent handling of such materials. Responsibility for the safe use of these products rests entirely with the buyer and/or user. Safety Data Sheets (SDS) for all ERA products are available through our website www.eraqc.com.

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9060A m

HSA-59-9-10.5

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-01RE1 B	SDG:	21I0042
Sampled:	08/30/21 11:55	Prepared:	09/08/21 10:53	File ID:	CubeData_09152021@0848-011
% Solids:	38.24	Preparation:	PSEP 1986 (modified)	Analyzed:	09/15/21 00:26
Batch:	BJI0215	Sequence:	SJI0211	Initial/Final:	0.1005 g Wet / 0.1005 mL
Instrument:	TOC Cube			Calibration:	EH00065

CAS NO.	Analyte	Concentration (% dry)	Dilution Factor	MDL	MRL	Q
	Total Organic Carbon	23.1	1	0.02	0.02	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9060A m

HSA-60-9-10.5

Laboratory:	Analytical Resources, Inc.				
Client:	GeoEngineers				
Project:	South State Street PRDI				
Matrix:	Solid	Laboratory ID:	21I0042-02RE2 B	SDG:	21I0042
Sampled:	08/30/21 14:20	Prepared:	09/08/21 10:53	File ID:	CubeData_09202021@1216-071
% Solids:	27.05	Preparation:	PSEP 1986 (modified)	Analyzed:	09/18/21 21:52
Batch:	BJI0215	Sequence:	SJI0258	Initial/Final:	0.0237 g Wet / 0.0237 mL
Instrument:	TOC Cube			Calibration:	EH00065

CAS NO.	Analyte	Concentration (% dry)	Dilution Factor	MDL	MRL	Q
	Total Organic Carbon	42.0	1	0.02	0.02	

PREPARATION BATCH SUMMARY

EPA 9060A m

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Batch: BJI0215 Batch Matrix: Solid Preparation: PSEP 1986 (modified)

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
HSA-59-9-10.5	21I0042-01RE1	eData_09152021@0848-	09/08/21 10:53	Added 9/14/2021 By BF
HSA-60-9-10.5	21I0042-02RE2	eData_09202021@1216-	09/08/21 10:53	Added 9/15/2021 By BF
Blank	BJI0215-BLK1	eData_09142021@1126-	09/08/21 10:53	
LCS	BJI0215-BS1	eData_09142021@1126-	09/08/21 10:53	
HSA-59-9-10.5	BJI0215-DUP5	eData_09152021@0848-	09/08/21 10:53	
MRL Check	BJI0215-MRL1	eData_09142021@1126-	09/08/21 10:53	
HSA-59-9-10.5	BJI0215-MS6	eData_09202021@1216-	09/08/21 10:53	
HSA-59-9-10.5	BJI0215-MSD6	eData_09202021@1216-	09/08/21 10:53	

Form I

METHOD BLANK DATA SHEET

EPA 9060A m

TotalAnalytes

Blank

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Batch: BJI0215
Laboratory ID: BJI0215-BLK1
Prepared: 09/08/21 10:53
Matrix: Solid
Preparation: PSEP 1986 (modified)
Analyzed: 09/10/21 09:00
Sequence: SJI0103
Calibration: EH00065
Instrument: TOC Cube

CAS NO.	Analyte	Concentration (% wet)	Dilution Factor	MDL	MRL	Q
	Total Organic Carbon	ND	1	0.02	0.02	U

LCS / LCS DUPLICATE RECOVERY

EPA 9060A m

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/10/21 09:30
Batch:	BJI0215	Laboratory ID:	BJI0215-BS1
Preparation:	PSEP 1986 (modified)	Sequence Name:	LCS
Initial/Final:	0.0235 g / 0.0235 mL		

COMPOUND	SPIKE ADDED (% wet)	LCS CONCENTRATION (% wet)	Q	LCS % REC. #	QC LIMITS REC.
Total Organic Carbon	44.4	43.6		98.2	80 - 120

* Indicates values outside of QC limits

DUPLICATES

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Solid
Laboratory ID: BJI0215-DUP5
Batch: BJI0215
Lab Source ID: 21I0042-01RE1
Preparation: PSEP 1986 (modified)
Initial/Final: 0.1162 g / 0.1162 mL
Source Sample Name: HSA-59-9-10.5
% Solids: 38.24

ANALYTE	CONTROL LIMIT	SAMPLE CONCENTRATION (% dry)	C	DUPLICATE CONCENTRATION (% dry)	C	RPD %	Q
Total Organic Carbon	20	23.1		21.4		7.32	

*: Values outside of QC limits
L: Analyte concentration is <=5 times the reporting limit and the replicate control limit defaults to Dup = +/- RL instead of 20% RPD

MS / MS DUPLICATE RECOVERY

EPA 9060A m

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/18/21 20:51
Batch:	BJI0215	Laboratory ID:	BJI0215-MS6
Preparation:	PSEP 1986 (modified)	Sequence Name:	Matrix Spike
Initial/Final:	0.0274 g / 0.0274 mL	Source Sample:	HSA-59-9-10.5

COMPOUND	SPIKE ADDED (% dry)	SAMPLE CONCENTRATION (% dry)	Q	MS CONCENTRATION (% dry)	Q	MS % REC. #	QC LIMITS REC.
Total Organic Carbon	53.0	23.1		74.3		96.7	75 - 125

* Values outside of QC limits

MS / MS DUPLICATE RECOVERY

EPA 9060A m

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Matrix:	Solid	Analyzed:	09/18/21 21:21
Batch:	BJI0215	Laboratory ID:	BJI0215-MSD6
Preparation:	PSEP 1986 (modified)	Sequence Name:	Matrix Spike Dup
Initial/Final:	0.0376 g / 0.0376 mL	Source Sample:	HSA-59-9-10.5

COMPOUND	SPIKE ADDED (% dry)	MSD CONCENTRATION (% dry)	Q	MSD % REC. #	% RPD #		QC LIMITS RPD	QC LIMITS REC.
Total Organic Carbon	35.6	57.5	*	96.9	25.5	*	20	75 - 125

* Values outside of QC limits

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJH0323
Instrument: TOC Cube
Calibration: EH00065

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Cal Standard	SJH0323-CAL1	CubeData_08252021@1209-001	NA	08/24/21 19:03
Cal Standard	SJH0323-CAL2	CubeData_08252021@1209-002	NA	08/24/21 19:34
Cal Standard	SJH0323-CAL3	CubeData_08252021@1209-003	NA	08/24/21 20:06
Cal Standard	SJH0323-CAL4	CubeData_08252021@1209-004	NA	08/24/21 20:38
Cal Standard	SJH0323-CAL5	CubeData_08252021@1209-005	NA	08/24/21 21:10
Cal Standard	SJH0323-CAL6	CubeData_08252021@1209-006	NA	08/24/21 21:41
Cal Standard	SJH0323-CAL7	CubeData_08252021@1209-007	NA	08/24/21 22:13
Cal Standard	SJH0323-CAL8	CubeData_08252021@1209-008	NA	08/24/21 22:44
Cal Standard	SJH0323-CAL9	CubeData_08252021@1209-009	NA	08/24/21 23:16
Cal Standard	SJH0323-CALA	CubeData_08252021@1209-010	NA	08/24/21 23:48
Cal Standard	SJH0323-CALB	CubeData_08252021@1209-011	NA	08/25/21 00:19
Cal Standard	SJH0323-CALC	CubeData_08252021@1209-012	NA	08/25/21 00:51
Cal Standard	SJH0323-CALD	CubeData_08252021@1209-013	NA	08/25/21 01:22
Cal Standard	SJH0323-CALE	CubeData_08252021@1209-014	NA	08/25/21 01:54
Cal Standard	SJH0323-CALF	CubeData_08252021@1209-015	NA	08/25/21 02:26
Cal Standard	SJH0323-CALG	CubeData_08252021@1209-016	NA	08/25/21 02:58
Cal Standard	SJH0323-CALH	CubeData_08252021@1209-017	NA	08/25/21 03:29
Cal Standard	SJH0323-CALI	CubeData_08252021@1209-018	NA	08/25/21 04:01
Cal Standard	SJH0323-CALJ	CubeData_08252021@1209-019	NA	08/25/21 04:33
Initial Cal Check	SJH0323-ICV1	CubeData_08252021@1209-027	NA	08/25/21 09:19
Initial Cal Blank	SJH0323-ICB1	CubeData_08252021@1209-028	NA	08/25/21 09:51
Cal Standard	SJH0323-CALK	CubeData_08252021@1209-020	NA	08/25/21 11:41
Cal Standard	SJH0323-CALL	CubeData_08252021@1209-021	NA	08/25/21 11:42
Cal Standard	SJH0323-CALM	CubeData_08252021@1209-022	NA	08/25/21 11:43
Cal Standard	SJH0323-CALN	CubeData_08252021@1209-023	NA	08/25/21 11:45
Cal Standard	SJH0323-CALO	CubeData_08252021@1209-024	NA	08/25/21 11:46

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0103
Instrument: TOC Cube
Calibration: EH00065

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Initial Cal Check	SJI0103-ICV1	CubeData_09142021@1126-040	NA	09/08/21 12:05
Initial Cal Blank	SJI0103-ICB1	CubeData_09142021@1126-050	NA	09/08/21 12:36
Calibration Check	SJI0103-CCV1	CubeData_09142021@1126-160	NA	09/08/21 18:11
Calibration Blank	SJI0103-CCB1	CubeData_09142021@1126-173	NA	09/08/21 18:42
Calibration Check	SJI0103-CCV2	CubeData_09142021@1126-294	NA	09/09/21 00:16
Calibration Blank	SJI0103-CCB2	CubeData_09142021@1126-305	NA	09/09/21 00:47
Calibration Check	SJI0103-CCV3	CubeData_09142021@1126-421	NA	09/09/21 06:22
Calibration Blank	SJI0103-CCB3	CubeData_09142021@1126-434	NA	09/09/21 06:52
Calibration Check	SJI0103-CCV4	CubeData_09142021@1126-542	NA	09/09/21 12:26
Calibration Blank	SJI0103-CCB4	CubeData_09142021@1126-552	NA	09/09/21 12:57
Calibration Check	SJI0103-CCV5	CubeData_09142021@1126-644	NA	09/09/21 18:31
Calibration Blank	SJI0103-CCB5	CubeData_09142021@1126-651	NA	09/09/21 19:22
Calibration Check	SJI0103-CCV6	CubeData_09142021@1126-723	NA	09/10/21 00:55
Calibration Blank	SJI0103-CCB6	CubeData_09142021@1126-729	NA	09/10/21 01:26
Calibration Check	SJI0103-CCV7	CubeData_09142021@1126-801	NA	09/10/21 06:59
Calibration Blank	SJI0103-CCB7	CubeData_09142021@1126-807	NA	09/10/21 07:29
MRL Check	BJI0215-MRL1	CubeData_09142021@1126-016	Solid	09/10/21 08:29
Blank	BJI0215-BLK1	CubeData_09142021@1126-028	Solid	09/10/21 09:00
LCS	BJI0215-BS1	CubeData_09142021@1126-039	Solid	09/10/21 09:30
Calibration Check	SJI0103-CCV8	CubeData_09142021@1126-110	NA	09/10/21 13:01
Calibration Blank	SJI0103-CCB8	CubeData_09142021@1126-124	NA	09/10/21 13:31
Calibration Check	SJI0103-CCV9	CubeData_09142021@1126-238	NA	09/10/21 19:03
Calibration Blank	SJI0103-CCB9	CubeData_09142021@1126-247	NA	09/10/21 19:33
Calibration Check	SJI0103-CCVA	CubeData_09142021@1126-369	NA	09/11/21 01:06
Calibration Blank	SJI0103-CCBA	CubeData_09142021@1126-379	NA	09/11/21 01:36
Calibration Check	SJI0103-CCVB	CubeData_09142021@1126-498	NA	09/11/21 07:08
Calibration Blank	SJI0103-CCBB	CubeData_09142021@1126-507	NA	09/11/21 07:38
Calibration Check	SJI0103-CCVC	CubeData_09142021@1126-613	NA	09/11/21 13:11
Calibration Blank	SJI0103-CCBC	CubeData_09142021@1126-619	NA	09/11/21 13:41

Analytical Resources, Incorporated
Analytical Chemists and Consultants

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 9060A m

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Sequence:	SJI0103	Instrument:	TOC Cube
		Calibration:	EH00065

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Calibration Check	SJI0103-CCVD	CubeData_09142021@1126-691	NA	09/11/21 19:13
Calibration Blank	SJI0103-CCBD	CubeData_09142021@1126-697	NA	09/11/21 19:44
Calibration Check	SJI0103-CCVE	CubeData_09142021@1126-768	NA	09/12/21 01:16
Calibration Blank	SJI0103-CCBE	CubeData_09142021@1126-775	NA	09/12/21 01:47
Calibration Check	SJI0103-CCVF	CubeData_09142021@1126-063	NA	09/12/21 07:18
Calibration Blank	SJI0103-CCBF	CubeData_09142021@1126-072	NA	09/12/21 07:48
Calibration Check	SJI0103-CCVG	CubeData_09142021@1126-182	NA	09/12/21 13:19
Calibration Blank	SJI0103-CCBG	CubeData_09142021@1126-192	NA	09/12/21 13:49
Calibration Check	SJI0103-CCVH	CubeData_09142021@1126-314	NA	09/12/21 19:21
Calibration Blank	SJI0103-CCBH	CubeData_09142021@1126-325	NA	09/12/21 19:51
Calibration Check	SJI0103-CCVI	CubeData_09142021@1126-444	NA	09/13/21 01:23
Calibration Blank	SJI0103-CCBI	CubeData_09142021@1126-453	NA	09/13/21 01:53
Calibration Check	SJI0103-CCVJ	CubeData_09142021@1126-562	NA	09/13/21 07:25
Calibration Blank	SJI0103-CCBJ	CubeData_09142021@1126-573	NA	09/13/21 07:55
Calibration Check	SJI0103-CCVK	CubeData_09142021@1126-603	NA	09/13/21 09:25
Calibration Blank	SJI0103-CCBK	CubeData_09142021@1126-612	NA	09/13/21 09:55

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0211
Instrument: TOC Cube
Calibration: EH00065

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Initial Cal Check	SJI0211-ICV1	CubeData_09152021@0848-003	NA	09/14/21 20:26
Initial Cal Blank	SJI0211-ICB1	CubeData_09152021@0848-004	NA	09/14/21 20:56
HSA-59-9-10.5	21I0042-01RE1	CubeData_09152021@0848-011	Solid	09/15/21 00:26
HSA-59-9-10.5	BJI0215-DUP5	CubeData_09152021@0848-012	Solid	09/15/21 00:56
Calibration Check	SJI0211-CCV1	CubeData_09152021@0848-015	NA	09/15/21 02:26
Calibration Blank	SJI0211-CCB1	CubeData_09152021@0848-016	NA	09/15/21 02:56
Calibration Check	SJI0211-CCV2	CubeData_09152021@0848-022	NA	09/15/21 05:57
Calibration Blank	SJI0211-CCB2	CubeData_09152021@0848-023	NA	09/15/21 06:27

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Sequence: SJI0258
Instrument: TOC Cube
Calibration: EH00065

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Initial Cal Check	SJI0258-ICV1	CubeData_09202021@1216-003	NA	09/17/21 11:09
Initial Cal Blank	SJI0258-ICB1	CubeData_09202021@1216-004	NA	09/17/21 11:39
Calibration Check	SJI0258-CCV1	CubeData_09202021@1216-015	NA	09/17/21 17:10
Calibration Blank	SJI0258-CCB1	CubeData_09202021@1216-016	NA	09/17/21 17:40
Calibration Check	SJI0258-CCV2	CubeData_09202021@1216-027	NA	09/17/21 23:13
Calibration Blank	SJI0258-CCB2	CubeData_09202021@1216-028	NA	09/17/21 23:43
Calibration Check	SJI0258-CCV3	CubeData_09202021@1216-039	NA	09/18/21 05:16
Calibration Blank	SJI0258-CCB3	CubeData_09202021@1216-040	NA	09/18/21 05:46
Calibration Check	SJI0258-CCV4	CubeData_09202021@1216-050	NA	09/18/21 11:18
Calibration Blank	SJI0258-CCB4	CubeData_09202021@1216-051	NA	09/18/21 11:48
Calibration Check	SJI0258-CCV5	CubeData_09202021@1216-062	NA	09/18/21 17:20
Calibration Blank	SJI0258-CCB5	CubeData_09202021@1216-063	NA	09/18/21 17:50
HSA-59-9-10.5	BJI0215-MS6	CubeData_09202021@1216-069	Solid	09/18/21 20:51
HSA-59-9-10.5	BJI0215-MSD6	CubeData_09202021@1216-070	Solid	09/18/21 21:21
HSA-60-9-10.5	21I0042-02RE2	CubeData_09202021@1216-071	Solid	09/18/21 21:52
Calibration Check	SJI0258-CCV6	CubeData_09202021@1216-072	NA	09/18/21 22:22
Calibration Blank	SJI0258-CCB6	CubeData_09202021@1216-073	NA	09/18/21 22:52

INITIAL CALIBRATION DATA

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EH00065
Instrument: TOC Cube
Calibration Date: 08/24/2021 17:16

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
		RF		RF		RF		RF		RF		RF
Total Organic Carbon	0.005112	1267041	0.01624	1156589	0.020451	1208352	0.030375	1027852	0.045412	1355038	0.060149	1226039
Total Carbon	0.005112	1267041	0.01624	1156589	0.020451	1208352	0.030375	1027852	0.045412	1355038	0.060149	1226039
Total Inorganic Carbon	0.005112	1267041	0.01624	1156589	0.020451	1208352	0.030375	1027852	0.045412	1355038	0.060149	1226039
% Soot	0.005112	1267041	0.01624	1156589	0.020451	1208352	0.030375	1027852	0.045412	1355038	0.060149	1226039

INITIAL CALIBRATION DATA

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EH00065
Instrument: TOC Cube
Calibration Date: 08/24/2021 17:16

Compound	Level 07		Level 08		Level 09		Level 10		Level 11		Level 12	
		RF		RF		RF		RF		RF		RF
Total Organic Carbon	0.076991	1301360	0.091126	1300200	0.1191	1370840	0.14977	1231288	0.252	1210857	0.336	1231923
Total Carbon	0.076991	1301360	0.091126	1300200	0.1191	1370840	0.14977	1231288	0.252	1210857	0.336	1231923
Total Inorganic Carbon	0.076991	1301360	0.091126	1300200	0.1191	1370840	0.14977	1231288	0.252	1210857	0.336	1231923
% Soot	0.076991	1301360	0.091126	1300200	0.1191	1370840	0.14977	1231288	0.252	1210857	0.336	1231923

INITIAL CALIBRATION DATA

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EH00065
Instrument: TOC Cube
Calibration Date: 08/24/2021 17:16

Compound	Level 13		Level 14		Level 15		Level 16		Level 17		Level 18	
		RF		RF		RF		RF		RF		RF
Total Organic Carbon	0.414	1268309	0.582	1278292	0.882	1265125	1.194	1264020	1.518	1271667	1.812	1261887
Total Carbon	0.414	1268309	0.582	1278292	0.882	1265125	1.194	1264020	1.518	1271667	1.812	1261887
Total Inorganic Carbon	0.414	1268309	0.582	1278292	0.882	1265125	1.194	1264020	1.518	1271667	1.812	1261887
% Soot	0.414	1268309	0.582	1278292	0.882	1265125	1.194	1264020	1.518	1271667	1.812	1261887

INITIAL CALIBRATION DATA

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Calibration: EH00065
Instrument: TOC Cube
Calibration Date: 08/24/2021 17:16

Compound	Level 19		Level 20		Level 21		Level 22		Level 23		Level 24	
		RF		RF		RF		RF		RF		RF
Total Organic Carbon	2.4	1255529	2.988	1141805	4.194	1173122	4.818	1173843	5.412	1191617	7.224	1189552
Total Carbon	2.4	1255529	2.988	1141805	4.194	1173122	4.818	1173843	5.412	1191617	7.224	892723
Total Inorganic Carbon	2.4	1255529	2.988	1141805	4.194	1173122	4.818	1173843	5.412	1191617	7.224	892723
% Soot	2.4	1255529	2.988	1141805	4.194	1173122	4.818	1173843	5.412	1191617	7.224	892723

INITIAL CALIBRATION DATA

EPA 9060A m

Laboratory:	Analytical Resources, Inc.	SDG:	21I0042
Client:	GeoEngineers	Project:	South State Street PRDI
Calibration:	EH00065	Instrument:	TOC Cube
Calibration Date:	08/24/2021 17:16		

COMPOUND	Mean RF	RF RSD	Linear COD	Quad COD	COD Limit	Q
Total Organic Carbon	1234256	5.9	0.9993			
Total Carbon	1221888	8.2	0.9742			
Total Inorganic Carbon	1221888	8.2	0.9742			
% Soot	1221888	8.2	0.9742			

INSTRUMENT BLANKS
EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: TOC Cube
Calibration: EH00065
Sequence: SJH0323
Date Analyzed: 08/25/21 09:51

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SJH0323-ICB1	Total Organic Carbon	0.00	0.02	0.02	%	

INSTRUMENT BLANKS
EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: TOC Cube
Calibration: EH00065
Sequence: SJI0103
Date Analyzed: 09/08/21 12:36

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SJI0103-ICB1	Total Organic Carbon	0.00	0.02	0.02	%	
SJI0103-CCB1	Total Organic Carbon	0.001	0.02	0.02	%	
SJI0103-CCB2	Total Organic Carbon	0.00	0.02	0.02	%	
SJI0103-CCB3	Total Organic Carbon	0.00	0.02	0.02	%	
SJI0103-CCB4	Total Organic Carbon	0.005	0.02	0.02	%	
SJI0103-CCB5	Total Organic Carbon	0.001	0.02	0.02	%	
SJI0103-CCB6	Total Organic Carbon	0.00	0.02	0.02	%	
SJI0103-CCB7	Total Organic Carbon	0.009	0.02	0.02	%	
SJI0103-CCB8	Total Organic Carbon	0.008	0.02	0.02	%	
SJI0103-CCB9	Total Organic Carbon	0.006	0.02	0.02	%	
SJI0103-CCBA	Total Organic Carbon	0.00	0.02	0.02	%	
SJI0103-CCBB	Total Organic Carbon	0.005	0.02	0.02	%	
SJI0103-CCBC	Total Organic Carbon	0.005	0.02	0.02	%	
SJI0103-CCBD	Total Organic Carbon	0.003	0.02	0.02	%	
SJI0103-CCBE	Total Organic Carbon	0.002	0.02	0.02	%	
SJI0103-CCBF	Total Organic Carbon	0.01	0.02	0.02	%	
SJI0103-CCBG	Total Organic Carbon	0.02	0.02	0.02	%	
SJI0103-CCBH	Total Organic Carbon	0.006	0.02	0.02	%	
SJI0103-CCBI	Total Organic Carbon	0.00	0.02	0.02	%	
SJI0103-CCBJ	Total Organic Carbon	0.00	0.02	0.02	%	
SJI0103-CCBK	Total Organic Carbon	0.00	0.02	0.02	%	

INSTRUMENT BLANKS
EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: TOC Cube
Calibration: EH00065
Sequence: SJI0211
Date Analyzed: 09/14/21 20:56

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SJI0211-ICB1	Total Organic Carbon	0.002	0.02	0.02	%	
SJI0211-CCB1	Total Organic Carbon	0.002	0.02	0.02	%	
SJI0211-CCB2	Total Organic Carbon	0.001	0.02	0.02	%	

INSTRUMENT BLANKS
EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: TOC Cube
Calibration: EH00065
Sequence: SJI0258
Date Analyzed: 09/17/21 11:39

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SJI0258-ICB1	Total Organic Carbon	0.00	0.02	0.02	%	
SJI0258-CCB1	Total Organic Carbon	0.00	0.02	0.02	%	
SJI0258-CCB2	Total Organic Carbon	0.00	0.02	0.02	%	
SJI0258-CCB3	Total Organic Carbon	0.00	0.02	0.02	%	
SJI0258-CCB4	Total Organic Carbon	0.002	0.02	0.02	%	
SJI0258-CCB5	Total Organic Carbon	0.00	0.02	0.02	%	
SJI0258-CCB6	Total Organic Carbon	0.001	0.02	0.02	%	

INITIAL AND CONTINUING CALIBRATION CHECK

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: TOC Cube
Calibration: EH00065
Control Limt: +/- 10.00%
Sequence: SJH0323

Lab Sample ID	Analyte	True	Found	%R	Units	Method
SJH0323-ICV1	Total Organic Carbon	44.446	47.2	106	%	EPA 9060A m
	Total Carbon	44.446	48.2	109	%	EPA 9060A m
	Total Inorganic Carbon	0.0000	1.09		%	EPA 9060A m
	% Soot	0.0000	0.14		%	EPA 9060A m

* Values outside of QC limits

INITIAL AND CONTINUING CALIBRATION CHECK

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: TOC Cube
Calibration: EH00065
Control Limt: +/- 10.00%
Sequence: SJI0103

Lab Sample ID	Analyte	True	Found	%R	Units	Method
SJI0103-ICV1	Total Organic Carbon	44.446	44.5	100	%	EPA 9060A m
SJI0103-CCV1	Total Organic Carbon	44.446	44.8	101	%	EPA 9060A m
SJI0103-CCV2	Total Organic Carbon	44.446	46.0	103	%	EPA 9060A m
SJI0103-CCV3	Total Organic Carbon	44.446	45.4	102	%	EPA 9060A m
SJI0103-CCV4	Total Organic Carbon	44.446	43.6	98.0	%	EPA 9060A m
SJI0103-CCV5	Total Organic Carbon	44.446	43.1	96.9	%	EPA 9060A m
SJI0103-CCV6	Total Organic Carbon	44.446	43.8	98.5	%	EPA 9060A m
SJI0103-CCV7	Total Organic Carbon	44.446	42.9	96.6	%	EPA 9060A m
SJI0103-CCV8	Total Organic Carbon	44.446	44.5	100	%	EPA 9060A m
SJI0103-CCV9	Total Organic Carbon	44.446	44.8	101	%	EPA 9060A m
SJI0103-CCVA	Total Organic Carbon	44.446	43.5	98.0	%	EPA 9060A m
SJI0103-CCVB	Total Organic Carbon	44.446	42.7	96.2	%	EPA 9060A m
SJI0103-CCVC	Total Organic Carbon	44.446	44.7	101	%	EPA 9060A m
SJI0103-CCVD	Total Organic Carbon	44.446	43.1	97.1	%	EPA 9060A m
SJI0103-CCVE	Total Organic Carbon	44.446	43.9	98.8	%	EPA 9060A m
SJI0103-CCVF	Total Organic Carbon	44.446	43.0	96.8	%	EPA 9060A m
SJI0103-CCVG	Total Organic Carbon	44.446	45.0	101	%	EPA 9060A m
SJI0103-CCVH	Total Organic Carbon	44.446	43.8	98.5	%	EPA 9060A m
SJI0103-CCVI	Total Organic Carbon	44.446	43.7	98.3	%	EPA 9060A m
SJI0103-CCVJ	Total Organic Carbon	44.446	43.8	98.6	%	EPA 9060A m
SJI0103-CCVK	Total Organic Carbon	44.446	44.0	98.9	%	EPA 9060A m

* Values outside of QC limits

INITIAL AND CONTINUING CALIBRATION CHECK

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: TOC Cube
Calibration: EH00065
Control Limt: +/- 10.00%
Sequence: SJI0211

Lab Sample ID	Analyte	True	Found	%R	Units	Method
SJI0211-ICV1	Total Organic Carbon	44.446	44.8	101	%	EPA 9060A m
SJI0211-CCV1	Total Organic Carbon	44.446	43.6	98.1	%	EPA 9060A m
SJI0211-CCV2	Total Organic Carbon	44.446	44.1	99.3	%	EPA 9060A m

* Values outside of QC limits

INITIAL AND CONTINUING CALIBRATION CHECK

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Instrument ID: TOC Cube
Calibration: EH00065
Control Limt: +/- 10.00%
Sequence: SJI0258

Lab Sample ID	Analyte	True	Found	%R	Units	Method
SJI0258-ICV1	Total Organic Carbon	44.446	44.1	99.3	%	EPA 9060A m
SJI0258-CCV1	Total Organic Carbon	44.446	44.6	100	%	EPA 9060A m
SJI0258-CCV2	Total Organic Carbon	44.446	45.4	102	%	EPA 9060A m
SJI0258-CCV3	Total Organic Carbon	44.446	44.7	100	%	EPA 9060A m
SJI0258-CCV4	Total Organic Carbon	44.446	44.8	101	%	EPA 9060A m
SJI0258-CCV5	Total Organic Carbon	44.446	45.3	102	%	EPA 9060A m
SJI0258-CCV6	Total Organic Carbon	44.446	45.5	102	%	EPA 9060A m

* Values outside of QC limits

HOLDING TIME SUMMARY

Analysis: EPA 9060A m

Laboratory: Analytical Resources, Inc. SDG: 21I0042

Client: GeoEngineers Project: South State Street PRDI

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
HSA-59-9-10.5 21I0042-01RE1	08/30/21 11:55	09/02/21 10:52	09/08/21 10:53	8	14	09/15/21 00:26			
HSA-60-9-10.5 21I0042-02RE2	08/30/21 14:20	09/02/21 10:52	09/08/21 10:53	8	14	09/18/21 21:52			
Duplicate BJI0215-DUP5	08/30/21 11:55	09/02/21 10:52	09/08/21 10:53	8	14	09/15/21 00:56			
Matrix Spike BJI0215-MS6	08/30/21 11:55	09/02/21 10:52	09/08/21 10:53	8	14	09/18/21 20:51			
Matrix Spike Dup BJI0215-MSD6	08/30/21 11:55	09/02/21 10:52	09/08/21 10:53	8	14	09/18/21 21:21			

* Indicates hold time exceedance.

METHOD DETECTION AND REPORTING LIMITS

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 21I0042
Client: GeoEngineers
Project: South State Street PRDI
Matrix: Solid
Instrument: TOC Cube

Analyte	MDL	RL	Units
Total Organic Carbon	0.02	0.02	%

4001822

MP Biomedicals, LLC
29525 Fountain Parkway
Solon, Ohio 44139
Telephone: 440/337-1200
Toll Free: 800/854-0530
Fax: 440/337-1180
web: www.mpbio.com

Certificate of Analysis

Product Description: Microcrystalline Cellulose Powder
Catalog Number: 191499
Lot: Q9483

Formula: $(C_6H_{10}O_5)n$
CAS #: 9004-34-6
Physical Description: White Powder

Formula Weight: N/A
Storage: 15 - 30°C

Test	Specification	Result
Identity Test	Passes	Passes
Purity	97.0 - 102.0%	97.0 - 102.0%
Moisture	<5.0%	3.4%
Particle Size/Mesh +60 mesh +200 mesh	Wt % <8% >45%	 <1% 55%
pH	5 - 7	6.73
Residue on Ignition	<0.05%	<0.05%
Water Soluble Substances	<12.0 mg/5 g	4.5 mg/5 g
Heavy Metals	<10 ppm	<10 ppm

Identification A & B: Passes
Bulk Density: 0.29 g/ml
Bulk Density (graduated cylinder): 0.31 g/ml
Conductivity: 18 µS/cm
Starch: Negative
Ether Soluble Substances: 0.01%
Total Aerobic microbial Count: 100 cfu/g
Total Mold and Yeast Count: 20 cfu/g
Staphylococcus aureus: Absent/1 g
Pseudomonas aeruginosa: Absent/1 g
E. coli: Absent/1 g
Salmonella: Absent/10 g
Particle size:
- 450 mesh: 77%
- d10: 37 um
- d50: 139 um
- d90: 271 um
TUP: <9/600 cm^2
Degree of brightness: >88%
Powder flow-angle of repose: <42°
Recommended Retest Date: 11/30/2022

07/26/2018 - John Huang, PhD
MP Biomedicals, LLC.
Quality Control Manager