

Operational Qualification PlasmaQuant MS product family



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1 Customer and Service Data

Customer address

Company	SERVICIO GEOLÓGICO COLOMBIANO
Department	REGIONAL MEDELLIN
Name	JOHN MAURO CASTAÑO
Address (Number, Street, City, Zip code, Country)	CALLE 75 No. 79A-51; MEDELLIN - COLOMBIA
Telephone	+57 321 8822173
E-mail	jmcastano@sgc.gov.co
Customer no.	CU1907-0007
Order no.	AR20-0269

Device data

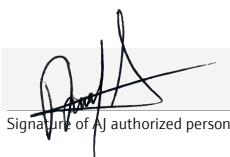
Device Type	PLASMAQUANT MS ELITE S	Software version	4.3
Serial number	10-5000-063-62-AV700	Firmware version	6.02
PC (serial number, operating system)	DELL VOSTRO-7PPBWA00- WIN10 PRO	Instrument location	LAB ICP-MS

Data of the authorized person for the Operational Qualification

Name, Company	NELSON JAIMES/JORGE ZORRO/DIDINSON MUÑOZ - ANALITICA Y REDES S.A.S
Date of the Operational Qualification	25.10.2023

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2 Instrument and accessories to be tested

The following instrument is to be tested within the scope of the Operational Qualification.

Configuration/Model	PlasmaQuant MS	PlasmaQuant MS Q	PlasmaQuant MS Elite S	PlasmaQuant MS Elite
Standard	☐	☐	☒	☐
with Adaptive Mass Range (AMR) technology	☐	☐	☐	☐
with Nitrox (NI)	☐	☐	☒	☐
with Aerosol Dilution (AD)	☐	☐	☐	☐
with NI and AD	☐	☐	☐	☐

In this document, all these instrument models are collectively called "PlasmaQuant MS". Any differences between the models are explained in the relevant section.

It is defined that the standard sample introduction system is to be tested on the PlasmaQuant MS within the scope of the Operational Qualification. Techniques and accessories that are not included in the supply shall not be subjected to OQ.

For instrument models without AMR technology, the customer can optionally order a tuning solution containing ^{232}Th as the isotope with the greatest mass. If the customer provides this tuning solution, ^{232}Th can optionally be tested in the Sensitivity Test (p. 9).

3 General notes on the Operational Qualification

Analytical instrument qualification is performed for compliance with the technical specifications warranted by Analytik Jena (AJ). The qualification complies with the normative target guidelines issued by the United States Pharmacopoeia (monograph <730>).

Please note that the Operational Qualification must be carried out by qualified personnel. A copy of the certificate that the AJ representative is authorized and qualified to perform installation and operational qualifications on the device can be found in Annex A of this document.

The copy of the certificate of the AJ representative, the result records created by software and the copies of the certificates of the standards are all part of the documentation for the Operational Qualification.

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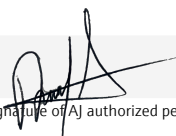
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- Print all software reports and all protocols created during the tests and attach them to Annex B of this document.
- Attach copies of the certificates of the standards used to the Annex C of this document.
- There are testing worksheets delivered with ASpect MS Software. In preparation of the OQ, these testing worksheets have to be copied from the CD with instrument data into a program folder.

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4 Qualification of Metrological Properties

4.1 Instrument Setup Test

The purpose of the Instrument Setup test is to verify that the PlasmaQuant MS is adequately setup for routine analysis.

The following solutions will be required for this test (refer to the annex for the solution preparations):

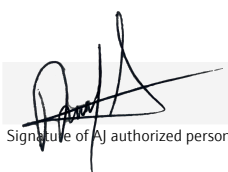
- Blank Solution (1 % HNO_3)
- 1 $\mu\text{g/L}$ Working Tuning Solution – MS-TS (prepared in 1 % HNO_3)

Test Details and Results

1. Create a new folder YYYYMMDD_OQ in the directory C:\PROGRAMDATA\ANALYTIK JENA\ASPECT MS.
2. Create a new WordPad document and save it as "YYYYMMDD_OQ_Instrument Setup Test" in the YYYYMMDD_OQ folder.
3. In ASpect MS select NEW FROM TEMPLATE in the FILE menu. Select the Worksheet "System Setup" and click [OK].
Enter the File name YYYYMMDD_OQ_System Setup" and save the worksheet in the YYYYMMDD_OQ folder.
4. Ensure that the worksheet "YYYYMMDD_OQ_System Setup.msxs" has been selected in the worksheet area in each of the following INSTRUMENT SETUP pages:
 - Plasma Align
 - Resolution and Trim
 - Mass Calibration
 - Detector Setup
5. Ensure that the pump tubing and the tubing tension are correct for the introduction of aqueous samples.
6. Ensure that the nickel sampler cone and skimmer cone are installed in the instrument.
7. Present the Blank Solution and click the PLASMA ON icon to ignite the plasma.
8. Select the PLASMA ALIGN page and select TIME in the SCAN TYPE box and press [START].
Leave the SCAN SETUP window by clicking on [OK]. In the PLASMA ALIGN window, select MANUAL SAMPLE INTRODUCTION. Click [READ] to start the scan.
9. Allow the plasma and the instrument to warm up and equilibrate for at least 30 minutes. After 30 minutes have elapsed click [STOP].
10. Present the 1 $\mu\text{g/L}$ Working Tuning Solution – MS-TS and select the AUTOMATIC ALIGNMENT check box and click [START].
On the PLASMA ALIGN page, select MANUAL SAMPLE INTRODUCTION again. Click [READ] to begin the automated sequence.

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	Complies	Does not comply
At the end of the automated sequence, the correct results are displayed in the PLASMA POSITION section of the page.	☒	☐

11. Select the RESOLUTION AND TRIM page and click [START].

In the RESOLUTION AND TRIM window, select MANUAL SAMPLE INTRODUCTION. Click [READ] to begin the automated sequence

	Complies	Does not comply
A dialog box appears stating that the Resolution and Trim passes when the automated sequence ends.	☒	☐

12. Perform a screen capture of the dialog box and paste it to the WordPad document created in Step 2.

13. Click [OK] on the dialog box.

14. Select the MASS CAL page. Click on the [DEFAULTS] button to apply the newly determined values for resolution and trim. Click [START] to begin the automated sequence.

	Complies	Does not comply
A dialog box appears stating that the Mass Calibration passes when the automated sequence ends.	☒	☐

15. Perform a screen capture of the dialog box and paste it to the document created in Step 2.

16. Click [OK] on the dialog box.

17. Select the DETECTOR SETUP page and set the scan range volts, then click [START] to begin the automated sequence.

	Complies	Does not comply
A dialog box appears stating that the optimum detector voltage was found when the automated sequence ends.	☒	☐

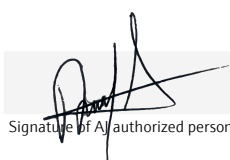
18. Perform a screen capture of the dialog box and paste it to the document created in Step 2.

19. Click [OK] on the dialog box.

20. Click [APPLY] at the DETECTOR VOLTAGE (VOLTS) section of the page.

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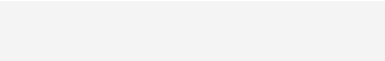
	Complies	Does not comply
The DETECTOR VOLTAGE VALUE field changes its background color.	☒	☐

- 21. Click FILE ► REPORT. Name the report "YYYYMMDD_OQ".
- 22. Attach the printed report to annex B.
- 23. Save and print the "YYYYMMDD_OQ_Instrument Setup Test" document and then attach it to the annex B.

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4.2 Sensitivity Test

The purpose of the Sensitivity Test is to verify that the PlasmaQuant MS meets the required specification. The following solutions will be required for this test (refer to the annex for preparation of solutions):

- Blank Solution (1 % HNO₃)
- 1 µg/L Working Tuning Solution – MS-TS (prepared in 1 % HNO₃)

Test Details and Results

1. Ensure that the Instrument Setup Test has passed.
2. Ensure that the instrument has been on and running for at least 30 minutes while aspirating the Blank Solution.
3. Present the 1 µg/L Working Tuning Solution – MS-TS and open the "YYYYMMDD_OQ_System Setup" worksheet.
4. Select the METHOD tab, click [EDIT METHOD], and then select the OPTIMIZATION tab and click [START] to observe the time scan.
5. Optimize the plasma settings to ensure that the signal for the Cerium Oxide Ratio (CeO⁺/Ce⁺) is within specification: CeO⁺/Ce⁺ < 2 %

	Complies	Does not comply
The plasma signal is optimized.	☒	☐

6. At the bottom left of the page, click the arrow next to the OPTIMIZE list button and select STANDARD MODE.
7. Click [START] in the OPTIMIZATION window to begin the Ion Optics optimization.

	Complies	Does not comply
The responses are automatically optimized. When this is completed, a dialog box appears with the message: Auto optimization is complete.	☒	☐

8. Close the OPTIMIZATION window. Click [YES] to the dialog box REPLACE CURRENT CONDITIONS WITH OPTIMAL CONDITIONS FOUND and save the method.

	Complies	Does not comply
The optimum parameters of this scan are set in the fields under ION OPTICS (VOLTS).	☒	☐

9. Copy the Optimization parameters, then close the EDIT METHOD window and save the worksheet.
10. Select NEW FROM TEMPLATE in the FILE menu. Select worksheet "System Test" and click [OK]. Enter the file name "YYYYMMDD_OQ_System Test" and save the worksheet in the YYYYMMDD_OQ folder.
11. Select the METHOD tab then [EDIT METHOD] and then the OPTIMIZATION tab and paste the copied parameters. Click [YES] to the Confirm dialog box.

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12. Enter 60 under STABILIZATION DELAY (S) and save the method. Close the EDIT METHOD window and then save the worksheet.
13. Present the Blank Solution and fast pump for approximately 2 minutes.
14. Deselect SAMPLE 1 from the sample sequence and click [RUN].
15. Click [OK] when the ANALYSIS CHECKLIST/RACK LOADING GUIDE dialog box appears and then click [READ] when the MANUAL RUN dialog box appears requesting the Blank Solution.
16. Present the 1 µg/L Working Tuning Solution – MS-TS, fast pump for approximately 1 minute then click [READ].

	Complies	Does not comply
Data is collected and logged in the worksheet datalog. Then a dialog box appears stating: Manual run of "YYYYMMDD_OQ_System Test.msxs" completed [<time and date>].	☒	☐

17. In the next section, compare the test results with the specifications of your instrument model:
PlasmaQuant MS, PlasmaQuant MS Q, PlasmaQuant MS Elite or PlasmaQuant MS Elite S.

Note: If the sensitivity test fails, it should be repeated with the worksheet saved with a new name so as to prevent overwriting of the failed test.

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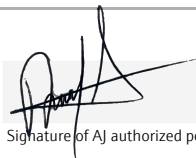
4.2.1 Specification of PlasmaQuant MS

Mass Calibration	Specification		Complies	Does not comply
Deviation Exact Mass	≤ 0.05		☒	☐
Resolution Test	0.8 ± 0.2 AMU		☒	☐

Test	Specification	Result	Complies	Does not comply
Sensitivity Test				
⁹ Be	>20 000 c/s		☐	☐
¹¹⁵ In	>500 000 c/s		☐	☐
²⁰⁸ Pb	>225 000 c/s		☐	☐
☐ ²³² Th	>300 000 c/s		☐	☐
Precision Test (short term and long term stability)				
⁹ Be	≤ 3 % RSD		☐	☐
¹¹⁵ In	≤ 3 % RSD		☐	☐
²⁰⁸ Pb	≤ 3 % RSD		☐	☐
☐ ²³² Th	≤ 3 % RSD		☐	☐
Background Test				
5 AMU	< 0.5 c/s		☐	☐
Oxide Test			☐	☐
156/140 AMU	≤ 2 %		☐	☐
Doubly Charged Test				
69/138 AMU (Ba)	≤ 3 %		☐	☐

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4.2.2 Specification of PlasmaQuant MS Q

Mass Calibration	Specification		Complies	Does not comply
Deviation Exact Mass	≤ 0.05		☐	☐
Resolution Test	0.8 ± 0.2 AMU		☐	☐

Test	Specification	Result	Complies	Does not comply
Sensitivity Test				
⁹ Be	>25 000 c/s		☐	☐
¹¹⁵ In	>800 000 c/s		☐	☐
²⁰⁸ Pb	>315 000 c/s		☐	☐
☐ ²³² Th	>500 000 c/s		☐	☐
Precision Test (short term and long term stability)				
⁹ Be	≤ 3 % RSD		☐	☐
¹¹⁵ In	≤ 3 % RSD		☐	☐
²⁰⁸ Pb	≤ 3 % RSD		☐	☐
☐ ²³² Th	≤ 3 % RSD		☐	☐
Background Test				
5 AMU	<0.7 c/s		☐	☐
Oxide Test			☐	☐
156/140 AMU	≤ 2 %		☐	☐
Doubly Charged Test				
69/138 AMU (Ba)	≤ 3 %		☐	☐

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4.2.3 Specification of PlasmaQuant MS Elite S

Mass Calibration	Specification		Complies	Does not comply
Deviation Exact Mass	≤ 0.05	<0.05	☒	☐
Resolution Test	0.8 ± 0.2 AMU	0.6 - 1.0	☒	☐
Test	Specification	Result	Complies	Does not comply
Sensitivity Test				
⁹ Be	>35 000 c/s	36362,00	☒	☐
¹¹⁵ In	>1 100 000 c/s	1184022	☒	☐
²⁰⁸ Pb	>450 000 c/s	503021,8	☒	☐
☒ ²³² Th	>700 000 c/s	818865,1	☒	☐
Precision Test (short term and long term stability)				
⁹ Be	≤ 3 % RSD	2.50	☒	☐
¹¹⁵ In	≤ 3 % RSD	2.89	☒	☐
²⁰⁸ Pb	≤ 3 % RSD	2.93	☐	☐
☒ ²³² Th	≤ 3 % RSD	2.07	☐	☐
Background Test				
5 AMU	<0.7 c/s	0	☒	☐
Oxide Test 156/140 AMU	≤ 2 %	1,9%	☒	☐
Doubly Charged Test				
69/138 AMU (Ba)	≤ 3 %	2.5%	☒	☐

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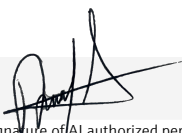
4.2.4 Specification of PlasmaQuant MS Elite

Mass Calibration	Specification		Complies	Does not comply
Deviation Exact Mass	≤ 0.05		☐	☐
Resolution Test	0.8 ± 0.2 AMU		☐	☐

Test	Specification	Result	Complies	Does not comply
Sensitivity Test				
^9Be	$>50\,000$ c/s		☐	☐
^{115}In	$>1\,500\,000$ c/s		☐	☐
^{208}Pb	$>580\,000$ c/s		☐	☐
☐ ^{232}Th	$>1\,000\,000$ c/s		☐	☐
Precision Test (short term and long term stability)				
^9Be	≤ 3 % RSD		☐	☐
^{115}In	≤ 3 % RSD		☐	☐
^{208}Pb	≤ 3 % RSD		☐	☐
☐ ^{232}Th	≤ 3 % RSD		☐	☐
Background Test				
5 AMU	<1 c/s		☐	☐
Oxide Test				
156/140 AMU	≤ 2 %		☐	☐
Doubly Charged Test				
69/138 AMU (Ba)	≤ 3 %		☐	☐

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4.3 Detector Attenuation Test

The purpose of the Detector Attenuation is to extend the upper concentration range of the instrument.

The following solutions will be required for this test (refer to the annex for preparation of solutions):

- Blank Solution (1 % HNO_3)
- Solution A (prepared in 1 % HNO_3)
- Solution B (prepared in 1 % HNO_3)

Test Details and Results

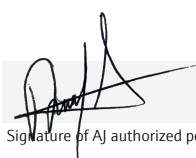
1. Create a new WordPad document and save it as "YYYYMMDD_OQ_Detector Attenuation" in the YYYYMMDD_OQ folder.
2. Ensure that the Sensitivity Test has passed.
3. Ensure that the instrument has been on and running using the "YYYYMMDD_OQ_System Setup" worksheet for at least 30 minutes while aspirating the Blank Solution.
4. Select the METHOD tab and click EDIT METHOD, then select the OPTIMIZATION tab.
5. Copy the Optimization parameters then close the EDIT METHOD window.
6. In ASpect MS select NEW FROM TEMPLATE in the FILE menu. Select the worksheet "Detector Calibration Test" and click [OK].
7. Enter file name "YYYYMMDD_OQ_Detector Calibration Test" and save the worksheet in the YYYYMMDD_OQ folder.
8. Select the OPTIMIZATION tab and paste the copied parameters. Click [YES] to the Confirm dialog box.
9. Enter 20 under STABILIZATION DELAY (S), save the method and close the EDIT METHOD window.
10. Select WINDOW ► INSTRUMENT SETUP and select the DETECTOR ATTENUATION page.
11. Click [BROWSE] at the bottom of the page and open the "YYYYMMDD_OQ_Detector Calibration Test" worksheet. Ensure that the COUNT LIMIT is set at 4 MHZ rather than DEFAULT (this can be changed by opening the password protected pages).
12. Click [START] and follow the prompts.
13. Present the Solution A, then Solution B and click [READ].

	Complies	Does not comply
At the completion of the test the DETECTOR ATTENUATION CORRECTION FACTORS Viewer window appears.	☒	☐

14. Compare the detector attenuation correction factors with the specifications.

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Detector Attenuation Test	Specification	Result	Complies	Does not comply
Low to Medium	$22 < x < 170$	68.915 - 94.404	☒	☐
Medium to High	$22 < x < 170$	120.978-143.047	☒	☐
Product	>1100	>9782,62	☒	☐
Precision	$<3 \%$	2.0	☒	☐

15. Perform a screen capture of the DETECTOR ATTENUATION CORRECTION FACTORS VIEWER window and paste it to the document created in Step 1 of this section.
16. Click [APPLY] in the DETECTOR ATTENUATION CORRECTION FACTORS VIEWER window and then click [SAVE] on the DETECTOR ATTENUATION page.
17. Ensure that SAVE FACTORS TO CURRENT METHOD is selected in the SAVE ATTENUATION CORRECTION FACTORS dialog box, click [OK] then.
18. Click [OK] on the subsequent information dialog box.

	Complies	Does not comply
The time and date of the detector attenuation are set in the LAST UPDATE field on the DETECTOR ATTENUATION page.	☒	☐

19. Perform a screen capture of the DETECTOR ATTENUATION page and paste it to the document created in Step 1 of this section.
20. Select the "YYYYMMDD_OQ_Detector Calibration Test" worksheet and save it.
21. Save and print the "YYYYMMDD_OQ_Detector Attenuation" document and attach it to the annex B.

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4.4 iCRC Test – Hydrogen and Helium mode (Optional)

The purpose of the iCRC Test is to verify that the PlasmaQuant MS integrated Collision Reaction Cell (iCRC) is working correctly. The test is designed to prove that the gas lines are connected, the MFC is delivering the required gas flow, the switching valves are working and the pressure sensors provide correct reading.

The iCRC Test is optional: the test is only to be performed if hydrogen or helium gas supply is provided for the instrument.

The iCRC Test can be performed either in H₂ or Helium mode, depending on the provided gases. If both gases are supplied to the instrument, preferably carry out the test in H₂ mode. It is not necessary to perform the test in both modes.

Provided Gases		iCRC Test to be performed	
Hydrogen (H ₂)	☒	H ₂ mode	☒
Helium (He)	☒	He mode	☒

Signals to be observed within the iCRC Test:

Analyte	⁵⁹ Co	aim: to maintain sensitivity
Interference	⁷⁸ ArAr	aim: to attenuate the interfering signal

The following solutions will be required for this test (refer to the annex for preparation of solutions):

- Blank Solution (1 % HNO₃)
- 1 µg/L Working Tuning Solution – MS-TS (prepared in 1 % HNO₃)

Test Details and Results

- Time scan without iCRC gases

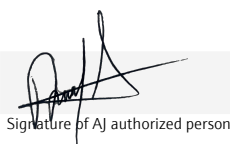
1. Create a new WordPad document and save it as "YYYYMMDD_OQ_iCRC" in the YYYYMMDD_OQ folder.
2. Ensure that the Sensitivity Test has passed.
3. Select the menu command ACTIONS ► ICRC GAS SUPPLY PURGE.

	Complies	Does not comply
The supply purge is completed and the iCRC gases are detected.	☒	☐

4. Close the ICRC GAS SUPPLY PURGE window.
5. Ensure that the instrument has been on and running for at least 30 minutes while aspirating the Blank Solution.
6. In the FILE menu, select NEW FROM TEMPLATE. Select the worksheet "iCRC system test" and click [OK]. Enter file name "YYYYMMDD_OQ_iCRC" and save the worksheet in the YYYYMMDD_OQ folder.
7. Present the 1 µg/L Working Tuning Solution – MS-TS and open the "YYYYMMDD_OQ_iCRC" worksheet.

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8. Select the METHOD tab, then click [EDIT METHOD]. Select the OPTIMIZATION tab. Enter the species ^{59}Co , $^{78}\text{ArAr}$ and ^{208}Pb in the SCAN SETUP window. Click [START] to observe the time scan.

9. Verify that the ^{59}Co signal is at a level close to the data recorded in the Sensitivity Test or that it meets the factory final specifications.

Expect $^{78}\text{ArAr}$ signal at approximately 100 000 to 300 000 Counts (PlasmaQuant MS/MS Q) and 100 000 to 400 000 Counts (PlasmaQuant MS Elite S/MS Elite).

■ Time scan in H_2 mode

1. Select H_2 gas for the skimmer cone in the ICRC (mL/min) section of the parameters.
2. Set the flow rate to 140 mL/min for at least 30 seconds to flush the iCRC with Hydrogen.
3. Set the flow rates to 0 mL/min, 20 mL/min, 40 mL/min, 60 mL/min and 90 mL/min and monitor the time scan for at least 20 seconds each checking the signals.

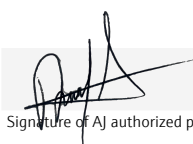
	Complies	Does not comply
Sharp signal steps can be observed when changing the H_2 skimmer gas flow.	☒	☐

4. Perform a screen capture of the time scan and paste it to the WordPad document.
5. Check if the signals for the analyte and the interference are within specification when applying a H_2 skimmer gas flow of 90 ± 10 mL/min.
6. If necessary optimize the Ion Optics settings to ensure that the signal for ^{59}Co is within specification:
 - Reduce the voltage applied on the Entrance Lens to 0 to +2 V.
 - Reduce the voltages applied on the Ion Mirror Lenses (Left, Right, Bottom) by 10 to 20 %.
 - Increase the voltages applied on the Extraction Lenses.
 - Adjust the other voltages if needed.

Monitor the signal for $^{78}\text{ArAr}$ during the optimization to ensure that it meets the specification.

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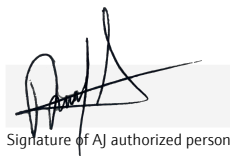
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Model/Species	Specification	Result	Complies	Does not comply
☐ PlasmaQuant MS				
⁵⁹ Co	>20 000		☐	☐
⁷⁸ ArAr	<50		☐	☐
☐ PlasmaQuant MS Q				
⁵⁹ Co	>30 000		☐	☐
⁷⁸ ArAr	<80		☐	☐
☒ PlasmaQuant MS Elite S				
⁵⁹ Co	>30 000	33606,10	☒	☐
⁷⁸ ArAr	<80	56,5	☒	☐
☐ PlasmaQuant MS Elite				
⁵⁹ Co	>50 000		☐	☐
⁷⁸ ArAr	<100	-	☐	☐
The signal for ⁵⁹ Co and ⁷⁸ ArAr are within the specifications.			☒	☐

7. Stop the time scan.
8. Save the method with the optimized Ion Optics settings.
9. Save and print the "YYYYMMDD_OQ_iCRC" document and attach it to annex B.

26.10.2023

Date



 Signature of AJ authorized person

Reviewed by user

 Version B (07/2023)
 TecDoc

■ Time scan in He mode

Carry out a time scan without iCRC gases as described on page 17 using the worksheet "iCRC system test" and saving it under a new name: YYYYMMDD_OQ_iCRC.mswn.

1. Select Helium gas for the skimmer cone in the ICRC (ML/MIN) section of the parameters.
2. Set the flow rate to 160 mL/min for at least 30 seconds to flush the iCRC with Helium.
3. Set the flow rates to 0 mL/min, 20 mL/min, 40 mL/min, 60 mL/min, 80 mL/min and 100 mL/min and monitor the time scan for at least 20 seconds each checking the signals.

	Complies	Does not comply
Sharp signal steps can be observed when changing the He skimmer gas flow.	☒	☐

4. Perform a screen capture of the time scan and paste it to the WordPad document.
5. Check if the signals for the analyte and the interference are within specification when applying a He skimmer gas flow of 100 ± 10 mL/min.
6. If necessary optimize the Ion Optics settings to ensure that the signal for ^{59}Co is within specification:
 - Reduce the voltage applied on the Entrance Lens to 0 to +2 V.
 - Reduce the voltages applied on the Ion Mirror Lenses (Left, Right, Bottom) by 10 to 20 %.
 - Increase the voltages applied on the Extraction Lenses.
 - Adjust the other voltages if needed.

Monitor the signal for $^{78}\text{ArAr}$ during the optimization to ensure that it meets the specification.

Model/Species	Specification	Result	Complies	Does not comply
☐ PlasmaQuant MS				
^{59}Co	>30 000		☐	☐
$^{78}\text{ArAr}$	<500		☐	☐
☐ PlasmaQuant MS Q				
^{59}Co	>40 000		☐	☐
$^{78}\text{ArAr}$	<800		☐	☐

26.10.2023

Date


 Signature of AJ authorized person

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 TecDoc

20/28

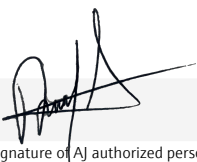
Operational Qualification

Model/Species	Specification	Result	Complies	Does not comply
☒ PlasmaQuant MS Elite S				
⁵⁹ Co	>40 000	83568,30	☒	☐
⁷⁸ ArAr	<800	171,900	☒	☐
☐ PlasmaQuant MS Elite				
⁵⁹ Co	>50 000		☐	☐
⁷⁸ ArAr	<1000		☐	☐
			Complies	Does not comply
The signal for ⁵⁹ Co and ⁷⁸ ArAr are within the specifications.			☒	☐

7. Stop the time scan.
8. Save the method with the optimized Ion Optics settings.
9. Save and print the "YYYYMMDD_OQ_iCRC" document and attach it to annex B.

26.10.2023

Date


Signature of AJ authorized person

Reviewed by user

Version B (07/2023)
TecDoc

5 Complaints ascertained in Operational Qualification

This page is intended to list any complaints that may have occurred during operational qualification. If possible, measures should be recorded. If no complaints have occurred during the tests, this should be countersigned by the Analytik Jena representative and by the responsible laboratory manager or his deputy.

Complaints
N/A

Measures for elimination
N/A

	Complies	Does not comply
All complaints during the operational qualification are documented in this section.	☒	☐
The instrument did not show any further recognizable complaints during the operational qualification.		

6 Conclusion of Operational Qualification

The following documents were added to the document:

	Complies	Does not comply
Annex A: Copy of the AJ representative's certificate of entitlement to perform the operational qualification	☒	☐
Annex B: Software test reports	☒	☐
Annex C: Copies of the certificates of the standards used for qualification	☒	☐

	Complies	Does not comply
The operational qualification was carried out and successfully completed.	☐	☐
This is to establish that the instrument has the required metrological properties and is ready for operation.	☐	☐

Name	Function	Date	Signature
JORGE ZORRO	Analytik Jena representative	26.10.2023	
NELSON JAIMES	Analytik Jena representante	26.10.2023	Nelson Jaimes Ascanio
DIDINSON MUÑOZ	Analytik Jena representante	26.10.2023	
John Mauro Castaño	Servicio Geológico Colombiano	26.10.2023	

7 Revision overview

Version	Effective date	Changes
01.16	11.03.2016	First version
02.16	04.05.2016	Correction of specifications in section 4.2
03.18	19.01.2018	Correction of specifications for iCRC Test in He mode
04.19	10.06.2019	Document layout in Endress+Hauser format Introduction of new models PlasmaQuant MS Q and PlasmaQuant MS Elite S with their specifications
05.20	01.09.2020	Introduction of Adaptive Mass Range (AMR) technology with new specifications and tuning solution
A (01/2021)	15.01.2021	Change of address from Analytik Jena AG to Analytik Jena GmbH due to change of company legal form
B (07/2023)	15.07.2023	Change of address to Analytik Jena GmbH+Co. KG due to change of company legal form

Annex A – Certificate of entitlement

The Analytik Jena representative

Nelson Jaimes/Jorge Zorro/Didinson Muñoz

is entitled to carry out the operational qualification.

The copy of the certificate is filed in this annex.

The certificate contains **3** pages.

The pages are to be numbered as follows: A current page/total number of pages

Example A 1/10, A 2/10...

25.10.2023

Date



Signature of AJ authorized person

Reviewed by user

Version B (07/2023)

Annex B – Software test reports

The printout of the software test reports is filed in this annex.

The test reports contain 24 pages.

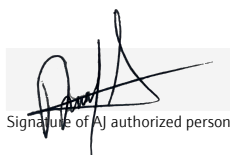
	Section	Test	Inserted pages (from ... to ...)	
☒	4.1	Instrument Setup Test	B 1 / 24	B 15 / 24
☒	4.3	Detector Attenuation Test	B 16 / 24	B 18 / 24
☒	4.4	iCRC Test – Hydrogen and Helium mode (Optional)	B 19 / 24	B 24 / 24

The pages shall be numbered as follows: B current page/total number of pages

Example B 1/10, B 2/10...

26.10.2023

Date


Signature of AJ authorized person

Reviewed by user

Version B (07/2023)

Annex C – Certificates of the standards used

In this annex the copies of the certificates of the used standards are stored.

The copies of the standards contain a total of **4** pages.

The pages are to be numbered as follows: C current page/total number of pages

Example C 1/10, C 2/10...

26.10.2023

Date



Signature of AJ authorized person

Reviewed by user

Version B (07/2023)

Annex D – Preparation of standard solutions

Standard Solutions	Preparation
Instrument Setup Test, Sensitivity Test, iCRC Test	
Required materials	Ultra-high purity concentrated HNO_3 Analytik Jena Tuning Solution: 10 ppm Ba, Be, Ce, Co, In, Pb, Mg Ultrapure Water Volumetric flask (plastic) class A
100 µg/L Intermediate Tuning Standard	Fill about 90 mL of ultrapure water into a 100 mL volumetric flask. 1 mL of Analytik Jena Tuning Solution 1 mL of concentrated HNO_3 With ultrapure water, fill the volumetric flask to 100 mL.
1 µg/L Working Tuning Solution – MS-TS	Fill about 90 mL of ultrapure water into a 100 mL volumetric flask. 1 mL of 100 µg/L Intermediate Tuning Standard 1 mL of concentrated HNO_3 With ultrapure water, fill the volumetric flask to 100 mL.
Blank Solution – 1% HNO_3	Fill about 190 mL of ultrapure water into a 200 mL volumetric flask. 2 mL of concentrated HNO_3 With ultrapure water, fill the volumetric flask to 200 mL.
Detector Attenuation Test	
Required materials	Ultra-high purity concentrated HNO_3 Analytik Jena Tuning Solution: 10 ppm Ba, Be, Ce, Co, In, Pb, Mg Ultrapure Water Volumetric flask (plastic) class A
Solution B (50 µg/L)	Fill about 190 mL of ultrapure water into a 200 mL volumetric flask. 1 mL of Analytik Jena Tuning Solution 2 mL of concentrated HNO_3 With ultrapure water, fill the volumetric flask to 200 mL.
Solution A (1 µg/L)	Fill about 40 mL of ultrapure water into a 50 mL volumetric flask. 1 mL of Solution B 0.5 mL of concentrated HNO_3 With ultrapure water, fill the volumetric flask to 50 mL.

CERTIFICATE

Analytik Jena GmbH,
certified to DIN EN ISO 9001:2015,
confirms that

Didinson Munoz

Analytica y Redes SAS, Colombia

**successfully attended the Online Video Training session
covering the following aspects of installation:**

- ICP-MS

**We authorize him to install the above
mentioned product group.**



Martin Becker
Head of Technical Service
Analytik Jena GmbH

Jena, 20 April 2021

Validity: 2 years

This certificate expires with termination of employment or cooperation with Analytik Jena.

CERTIFICATE

Analytik Jena GmbH,
certified to DIN EN ISO 9001:2015,
confirms that

Jorge Zorro

Analitica y Redes, Colombia

successfully attended the Online Video Training session
covering the following aspects of installation:

- PQ MS

We authorize him to install the above
mentioned product group.



Martin Becker
Head of Technical Service
Analytik Jena GmbH

Jena, 30 September 2022

Validity: 2 years

This certificate expires with termination of employment or cooperation with Analytik Jena.

CERTIFICATE

Analytik Jena GmbH,
certified to DIN EN ISO 9001:2015,
confirms that

Nelson Jaimes

Analitica y Redes SAS, Colombia

successfully attended the Online Video Training session
covering the following aspects of installation:

- ICP-MS

We authorize him to install the above
mentioned product group.



Martin Becker
Head of Technical Service
Analytik Jena GmbH

Jena, 05 May 2022

Validity: 2 years

This certificate expires with termination of employment or cooperation with Analytik Jena.

Report Date 2023-10-25 14:20:24 GMT--5:00

Worksheet System Setup Test - 2023-10-24.mswn

Analyst

Report Header

Aquí va el encabezado del laboratorio...

Worksheet Summary

Worksheet: System Setup Test - 2023-10-24.mswn
 Created: 2022-10-31 10:48:42 GMT--5:00
 Analyst:
 Computer: ICP-MC-LAB-MED
 Last Saved: 2023-10-25 14:18:42 GMT--5:00
 Software Ver.: 4.3 r19995
 Firmware Ver.: 6.08
 Samples: 1
 Comment:

Chemistry

Matrix:
 Acids Used:
 Keywords:
 CRM:

Measurement Parameters

Analysis Modes Analysis Type: Quantitative, Acquisition Mode: Steady State, Scan Mode: Segmented
 Spacing: Fine, Points/Peak: 5, Scans/Replicate: 5, Replicates/Sample: 10

Plasma Plasma flow: 10,50 L/min Auxiliary flow: 1,50 L/min Sheath Gas Flow: 0,00 L/min Nebulizer flow: 1,00 L/min
 Sampling depth: 5,00 mm
 Power: 1,35 kW Pump rate: 21 rpm Stabilization delay: 50 sec Nitrox Flow: 0,00 mL/min

Ion Optics (Volt)

Skimmer Bias: 0,00
 First Extraction Lens: -70,00 Second Extraction Lens: -549,00 Third Extraction Lens: -379,00
 Left Mirror Lens: 65,00 Right Mirror Lens: 57,00 Bottom Mirror Lens: 38,00
 Corner Lens: -392,00 Entrance Lens: 2,00
 Fringe Bias: -7,90 Entrance Plate: -105,00
 Detector Focus: True Pole Bias: 0,00

iCRC Skimmer Cone: Off iCRC Skimmer Gas Flow: 0 mL/min

Nitrox 0 mL/min

Sampling Aerosol generation: Nebulizer, Source: Autosampler
 Fast pump during sample delay/rinse: On, Enable device control: Off
 Probe height: 0 mm, Premix: Off, Rinse time: 10 sec
 Spray Chamber Cooling: On Spray Chamber Temp: 3,00 °C
 Sample uptake delay: 50 sec, Smart Rinse: No, Switch Delay: OFF
 Scan time: 7160 msec, Replicate time: 35,80 sec

Analytes (7)

Be9, Mg24, Co59, In115, Ce140, Pb208, Th232

SemiQuant Analytes (0)**Internal Standards (0)****No. of isotope ratio standards: 0****Isotope Ratios (2)**

CeO/Ce(Ce140O16/Ce140), Ba++/Ba(Ba138++/Ba138)

Default exclusions (11)

Ar40, Ar40Ar40, N14, N14H1, O16, O16H1, Ar40H1, Fm257, Md258, No259, Md260

User-specified exclusions (0)**Scan Segments (12)**

Start (m/z)	Stop (m/z)	Dwell (µsec)	Attenuation mode	Norm-Med	Med-High
9	9	5000	None		
24	26	5000	None		
59	59	5000	None		
69	69	5000	None		
111	115	5000	None		
118	118	5000	None		

Report Date 2023-10-25 14:20:24 GMT--5:00

Worksheet System Setup Test - 2023-10-24.mswn

Analyst

Start (m/z)	Stop (m/z)	Dwell (µsec)	Attenuation	mode	Norm-Med	Med-High
129	129	5000		None		
136	142	5000		None		
146	146	5000		None		
156	156	5000		None		
202	208	5000		None		
228	232	5000		None		

No. of standards: 1

Standard Concentrations

Element	Units	1 estándar
Be	ppb	1,0000
Mg	ppb	1,0000
Co	ppb	1,0000
In	ppb	1,0000
Ce	ppb	1,0000
Pb	ppb	1,0000
Th	ppb	1,0000

Calibration Parameters

Analyte	Curve type	Thru blank	Weighted fit	Max % error	Reslope std	Max % reslope	Corr. coeff. limit
Be9	Linear	No	No	25,0	1 estándar	10,0	0,9900
Mg24	Linear	No	No	25,0	1 estándar	10,0	0,9900
Co59	Linear	No	No	25,0	1 estándar	10,0	0,9900
In115	Linear	No	No	25,0	1 estándar	10,0	0,9900
Ce140	Linear	No	No	25,0	1 estándar	10,0	0,9900
Pb208	Linear	No	No	25,0	1 estándar	10,0	0,9900
Th232	Linear	No	No	25,0	1 estándar	10,0	0,9900

Calibration Actions

On Calibration Failure	Continue analysis
On recalibration failure	Continue analysis
On reslope failure	Continue analysis

En blanco [En blanco]

Tube: 1:1, Replicates: 10, Auto Dilutions factor: -, Cal Set 1, Time measured: 2023-10-25 14:02:26

Actual weight: 1,0000 g, Actual volume: 1,00 mL, Dilution Factor: 1,00

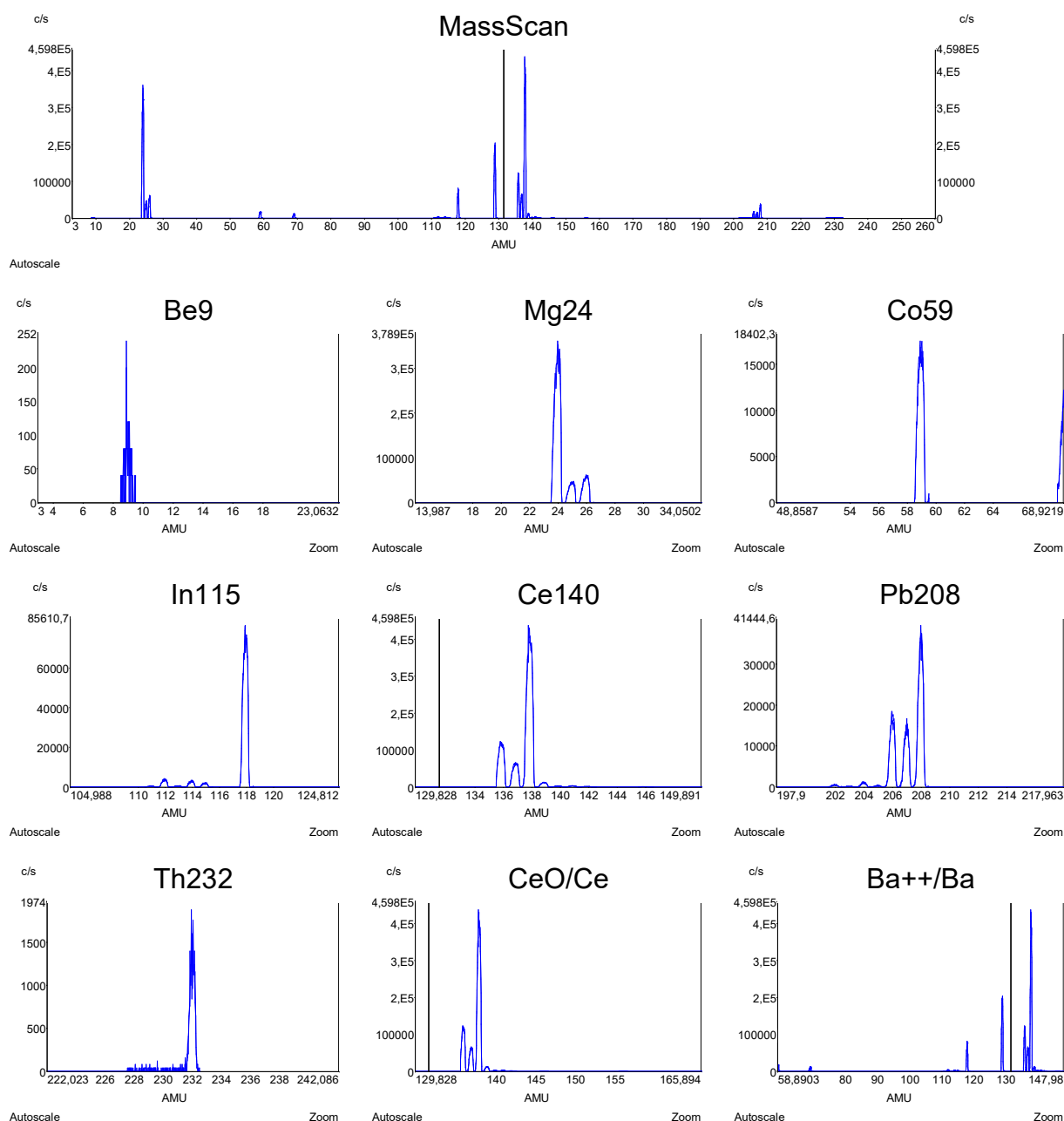
Position Horizontal: -0,20 mm Position Vertical: 0,00 mm Detector Voltage: 2746,70 volt

Analyte	Soln Conc	Unit	QC	Mean c/s	%RSD	SD	Replicates (c/s)				
Be9	0,0000d	ppb	-	62,4000	37,65	23,5	64	64	32	88	
							24	56	56	104	
							72	64			
Mg24	0,0000d	ppb	-	324932,9	2,45	7952,0	336156	321924	334085	312709	
							322828	314314	326708	320503	
							327984	332119			
Co59	0,0000d	ppb	-	15885,94	3,36	533,0	15885	16630	16430	14829	
							15845	15605	15781	15981	
							16429	15445			
In115	0,0000d	ppb	-	618,4225	15,17	93,8	623	533	560	538	
							497	671	746	576	
							667	773			
Ce140	0,0000d	ppb	-	1984,000	6,99	138,6	1768	1968	2056	2120	
							1912	1856	2120	1832	
							2176	2032			
Pb208	0,0000d	ppb	-	34534,52	3,15	1088,5	34023	36243	34704	32629	
							34007	34936	34808	33190	
							35369	35434			
Th232	0,0000d	ppb	-	1698,400	11,87	201,6	1304	1384	1768	1720	
							1872	1760	1768	1952	
							1704	1752			
Isotope Ratio	Ratio		%RSD	SD Replicates (ratio)							
Ce140O16/Ce140	0,049d		26,61	0,013	0,054	0,069	0,039	0,034	0,071	0,043	0,052
					0,048	0,039					
Ba138++/Ba138	0,027d		5,32	0,001	0,028	0,027	0,028	0,026	0,029	0,029	0,027
					0,028	0,024					

Report Date 2023-10-25 14:20:24 GMT--5:00

Worksheet System Setup Test - 2023-10-24.mswn

Analyst

**1 estándar [1 estándar]**

Tube: 1:2, Replicates: 10, Auto Dilutions factor: -, Cal Set 1, Time measured: 2023-10-25 14:10:34

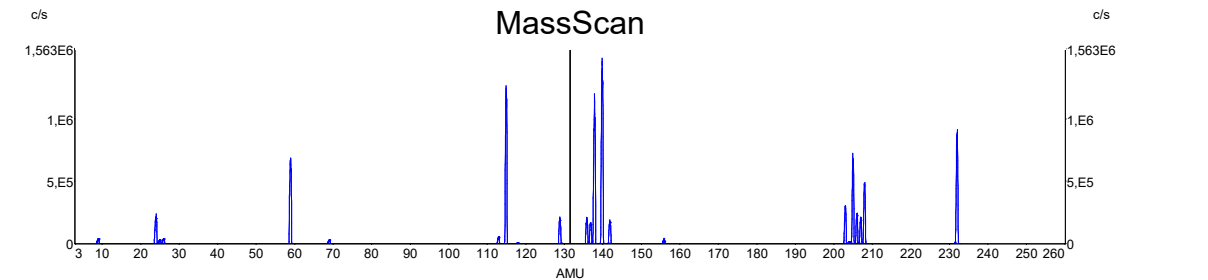
Actual weight: 1,0000 g, Actual volume: 1,00 mL, Dilution Factor: 1,00

Position Horizontal: -0,20 mm Position Vertical: 0,00 mm Detector Voltage: 2746,70 volt

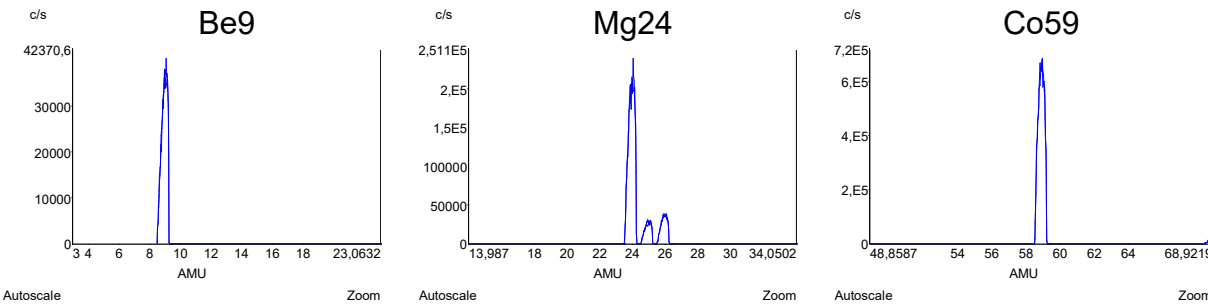
Analyte	Soln Conc	Unit	QC	Mean c/s	%RSD	SD	Replicates (c/s)			
Be9	1,0000d	ppb	-	37062,18	2,97	1099,4	34824	37741	37332	37260
							35826	37957	37044	36972
							36892	38774		
Mg24	1,0000d	ppb	-	202952,8	2,65	5377,4	206548	210536	197573	203078
							198444	196045	204744	209747
							197011	205802		
Co59	1,0000d	ppb	-	642242,6	3,36	21605,6	642886	651741	620994	687909
							614188	623119	657686	649392
							630870	643641		
In115	1,0000d	ppb	-	1153781	2,26	26022,7	1174252	1188499	1159129	1124400
							1150349	1121172	1192933	1159099
							1142890	1125084		

Report Date 2023-10-25 14:20:24 GMT--5:00
Worksheet System Setup Test - 2023-10-24.mswn
Analyst

Analyte	Soln Conc	Unit	QC	Mean c/s	%RSD	SD	Replicates (c/s)
Ce140	1,0000d	ppb	-	1307067	2,64	34470,7	1279211 1290250 1279098 1309269 1261189 1338759 1375576 1299624 1337723 1299966
Pb208	1,0000d	ppb	-	464868,2	3,42	15888,9	471349 470128 442722 448007 477898 444597 478321 453766 484534 477361
Th232	1,0000d	ppb	-	821822,7	2,38	19551,1	844084 828936 817998 811050 826824 807723 855937 832095 799708 793873
Isotope Ratio	Ratio	%RSD	SD	Replicates (ratio)			
Ce140O16/Ce140	0,020d	9,25	0,002	0,022 0,020 0,018 0,020	0,021 0,017 0,020 0,019 0,021 0,023		
Ba138+/Ba138	0,026d	2,92	0,001	0,025 0,027 0,026 0,026	0,025 0,025 0,026 0,026 0,027 0,026		



Autoscale



Autoscale

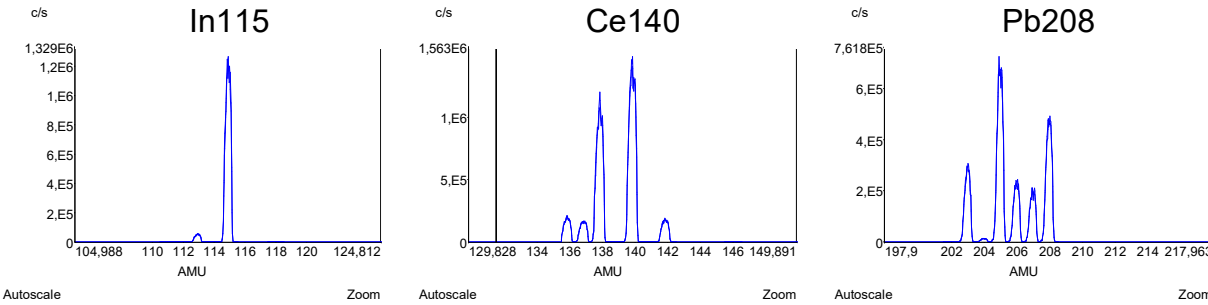
Zoom

Autoscale

Zoom

Autoscale

Zoom



Autoscale

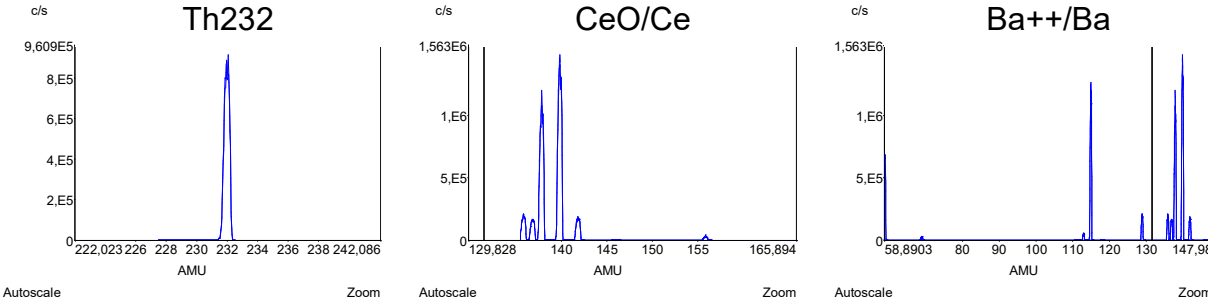
Zoom

Autoscale

Zoom

Autoscale

Zoom



Autoscale

Zoom

Autoscale

Zoom

Autoscale

Zoom

Report Date 2023-10-25 14:20:24 GMT--5:00

Worksheet System Setup Test - 2023-10-24.mswn

Analyst

Be9 Calibration (ppb), Cal Set 1, 2023-10-25 14:10:34

Soln Type	c/s	SD(c/s)	%RSD	Std Conc	Calc Conc	Error	%Error	Flags
En blanco	62	23,5	37,65	0,0000	0,0000	0,0000	-	d
1 estándar	37062	1099,4	2,97	1,0000	1,0000	0,0000	0,00	d

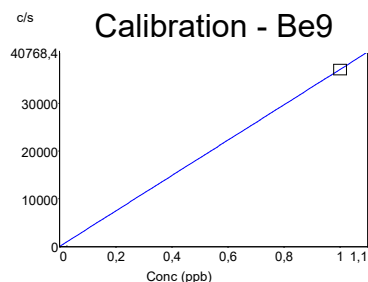
Curve Fit: Linear, Weighted Fit: No, Thru Blank: No

Correlation Coefficient: 1,000000

Limit of detection: 0,0019 ppb

Limit of quantitation: 0,0063 ppb

Blank Equivalent Concentration: 0,0017 ppb

Calibration Equation: $c/s = (62,4 + 37000 \cdot \text{conc}) \cdot [I/S \text{ Ratio}]$ **Mg24 Calibration (ppb), Cal Set 1, 2023-10-25 14:10:34**

Soln Type	c/s	SD(c/s)	%RSD	Std Conc	Calc Conc	Error	%Error	Flags
En blanco	324933	7952,0	2,45	0,0000	-	-	-	d
1 estándar	202953	5377,4	2,65	1,0000	-	-	-	d

Curve Fit: Linear, Weighted Fit: No, Thru Blank: No

Error 428 : 1 estándar signal not increasing

Co59 Calibration (ppb), Cal Set 1, 2023-10-25 14:10:34

Soln Type	c/s	SD(c/s)	%RSD	Std Conc	Calc Conc	Error	%Error	Flags
En blanco	15886	533,0	3,36	0,0000	0,0000	0,0000	-	d
1 estándar	642243	21605,6	3,36	1,0000	1,0000	0,0000	0,00	d

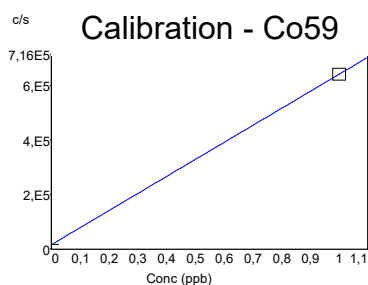
Curve Fit: Linear, Weighted Fit: No, Thru Blank: No

Correlation Coefficient: 1,000000

Limit of detection: 0,0026 ppb

Limit of quantitation: 0,0085 ppb

Blank Equivalent Concentration: 0,0254 ppb

Calibration Equation: $c/s = (15885,9 + 626400 \cdot \text{conc}) \cdot [I/S \text{ Ratio}]$ **In115 Calibration (ppb), Cal Set 1, 2023-10-25 14:10:34**

Soln Type	c/s	SD(c/s)	%RSD	Std Conc	Calc Conc	Error	%Error	Flags
En blanco	618	93,8	15,17	0,0000	0,0000	0,0000	-	d
1 estándar	1153781	26022,7	2,26	1,0000	1,0000	0,0000	0,00	d

Curve Fit: Linear, Weighted Fit: No, Thru Blank: No

Correlation Coefficient: 1,000000

Limit of detection: 0,0002 ppb

Limit of quantitation: 0,0008 ppb

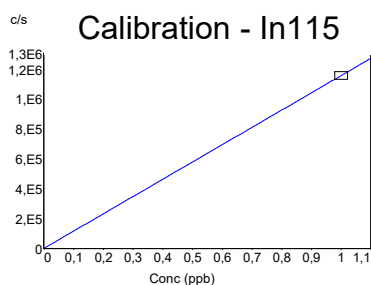
Blank Equivalent Concentration: 0,0005 ppb

Calibration Equation: $c/s = (618,4 + 1153000 \cdot \text{conc}) \cdot [I/S \text{ Ratio}]$

Report Date 2023-10-25 14:20:24 GMT--5:00

Worksheet System Setup Test - 2023-10-24.mswn

Analyst

**Ce140 Calibration (ppb), Cal Set 1, 2023-10-25 14:10:34**

Soln Type	c/s	SD(c/s)	%RSD	Std Conc	Calc Conc	Error	%Error	Flags
En blanco	1984	138,6	6,99	0,0000	0,0000	0,0000	-	d
1 estándar	1307067	34470,7	2,64	1,0000	1,0000	0,0000	0,00	d

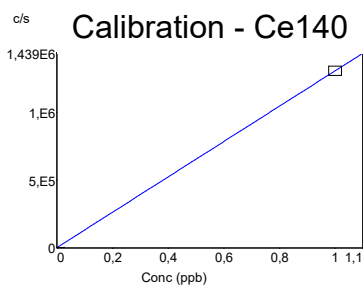
Curve Fit: Linear, Weighted Fit: No, Thru Blank: No

Correlation Coefficient: 1,000000

Limit of detection: 0,0003 ppb

Limit of quantitation: 0,0011 ppb

Blank Equivalent Concentration: 0,0015 ppb

Calibration Equation: $c/s = (1984,0 + 1305000 \cdot \text{conc}) \cdot [I/S \text{ Ratio}]$ **Pb208 Calibration (ppb), Cal Set 1, 2023-10-25 14:10:34**

Soln Type	c/s	SD(c/s)	%RSD	Std Conc	Calc Conc	Error	%Error	Flags
En blanco	34535	1088,5	3,15	0,0000	0,0000	0,0000	-	d
1 estándar	464868	15888,9	3,42	1,0000	1,0000	0,0000	0,00	d

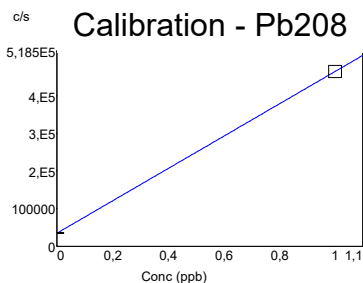
Curve Fit: Linear, Weighted Fit: No, Thru Blank: No

Correlation Coefficient: 1,000000

Limit of detection: 0,0076 ppb

Limit of quantitation: 0,0253 ppb

Blank Equivalent Concentration: 0,0803 ppb

Calibration Equation: $c/s = (34534,5 + 430300 \cdot \text{conc}) \cdot [I/S \text{ Ratio}]$ **Th232 Calibration (ppb), Cal Set 1, 2023-10-25 14:10:34**

Soln Type	c/s	SD(c/s)	%RSD	Std Conc	Calc Conc	Error	%Error	Flags
En blanco	1698	201,6	11,87	0,0000	0,0000	0,0000	-	d
1 estándar	821823	19551,1	2,38	1,0000	1,0000	0,0000	0,00	d

Curve Fit: Linear, Weighted Fit: No, Thru Blank: No

Correlation Coefficient: 1,000000

Limit of detection: 0,0007 ppb

Limit of quantitation: 0,0025 ppb

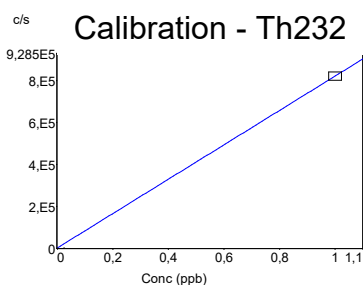
Blank Equivalent Concentration: 0,0021 ppb

Calibration Equation: $c/s = (1698,4 + 820100 \cdot \text{conc}) \cdot [I/S \text{ Ratio}]$

Report Date 2023-10-25 14:20:24 GMT--5:00

Worksheet System Setup Test - 2023-10-24.mswn

Analyst

**Tuning 1 ppb [Sample]**

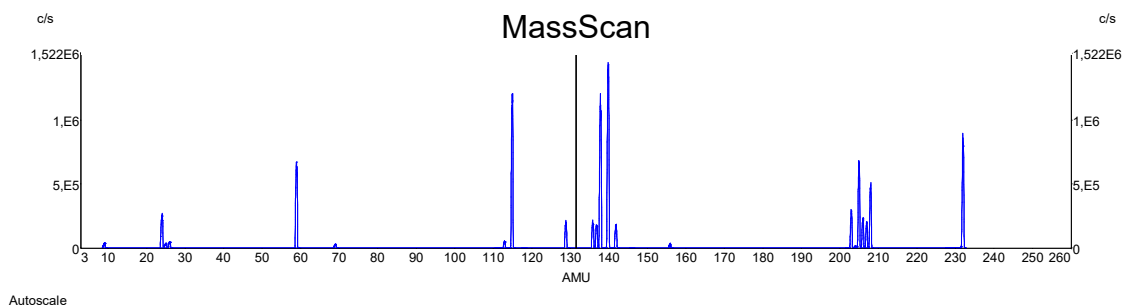
Tube: 2:1, Replicates: 10, Auto Dilutions factor: -, Cal Set 1, Time measured: 2023-10-25 14:18:42

Actual weight: 1,0000 g, Actual volume: 1,00 mL, Dilution Factor: 1,00

Position Horizontal: -0,20 mm Position Vertical: 0,00 mm Detector Voltage: 2746,70 volt

Analyte	Soln Conc	Unit	QC	Mean c/s	%RSD	SD	Replicates (c/s)				
Be9	0,9818bd	ppb	-	36387,58	3,69	0,0362	37180	36307	34224	36058	
							34312	36243	37925	37909	
							36058	37661			
Mg24	Uncalib	ppb	-	247553,9	-	-	260110	227545	248764	244680	
							250979	241737	246819	263910	
							242329	248666			
Co59	0,9818bd	ppb	-	630870,1	2,44	0,0239	605940	651032	642296	622927	
							623607	637868	650867	633049	
							626882	614232			
In115	0,9985bd	ppb	-	1152021	2,55	0,0255	1166082	1116188	1160307	1179419	
							1133891	1156044	1179648	1161739	
							1091225	1175670			
Ce140	1,0304d	ppb	-	1346772	2,08	0,0214	1381099	1331707	1360048	1284152	
							1347152	1380001	1349611	1333413	
							1340465	1360073			
Pb208	1,0361d	ppb	-	480394,0	3,37	0,0349	469038	470703	468198	469572	
							485502	500537	462009	480306	
							505117	492957			
Th232	1,0000d	ppb	-	821839,0	1,63	0,0163	799777	810985	817705	825114	
							810331	832158	822733	833748	
							846032	819808			

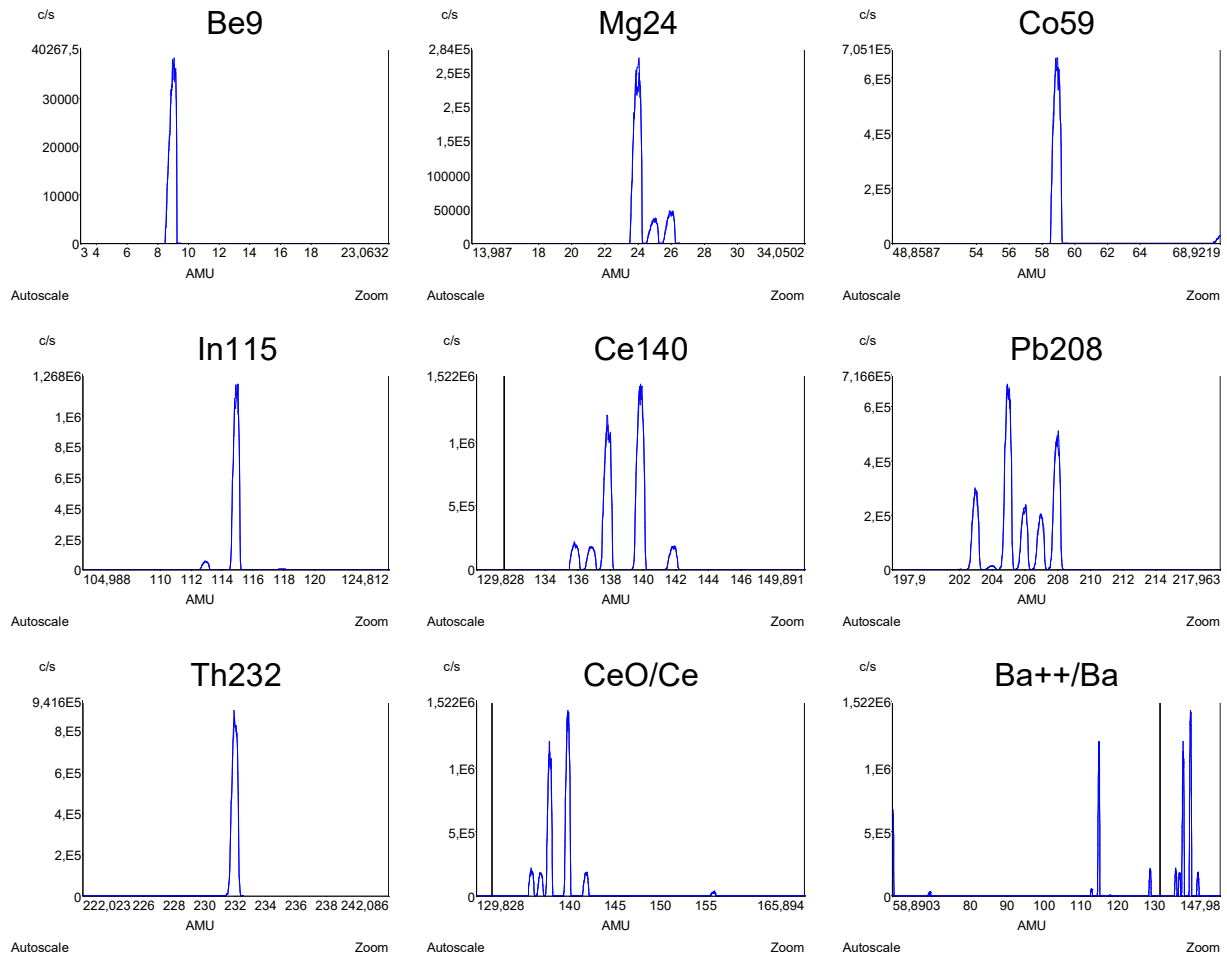
Isotope Ratio	Ratio	%RSD	SD	Replicates (ratio)							
Ce140O16/Ce140	0,020d	10,28	0,002	0,016	0,023	0,018	0,019	0,021	0,022	0,019	0,018
				0,019	0,019						
Ba138++/Ba138	0,026d	6,26	0,002	0,026	0,026	0,028	0,024	0,025	0,028	0,025	0,026
				0,029	0,025						



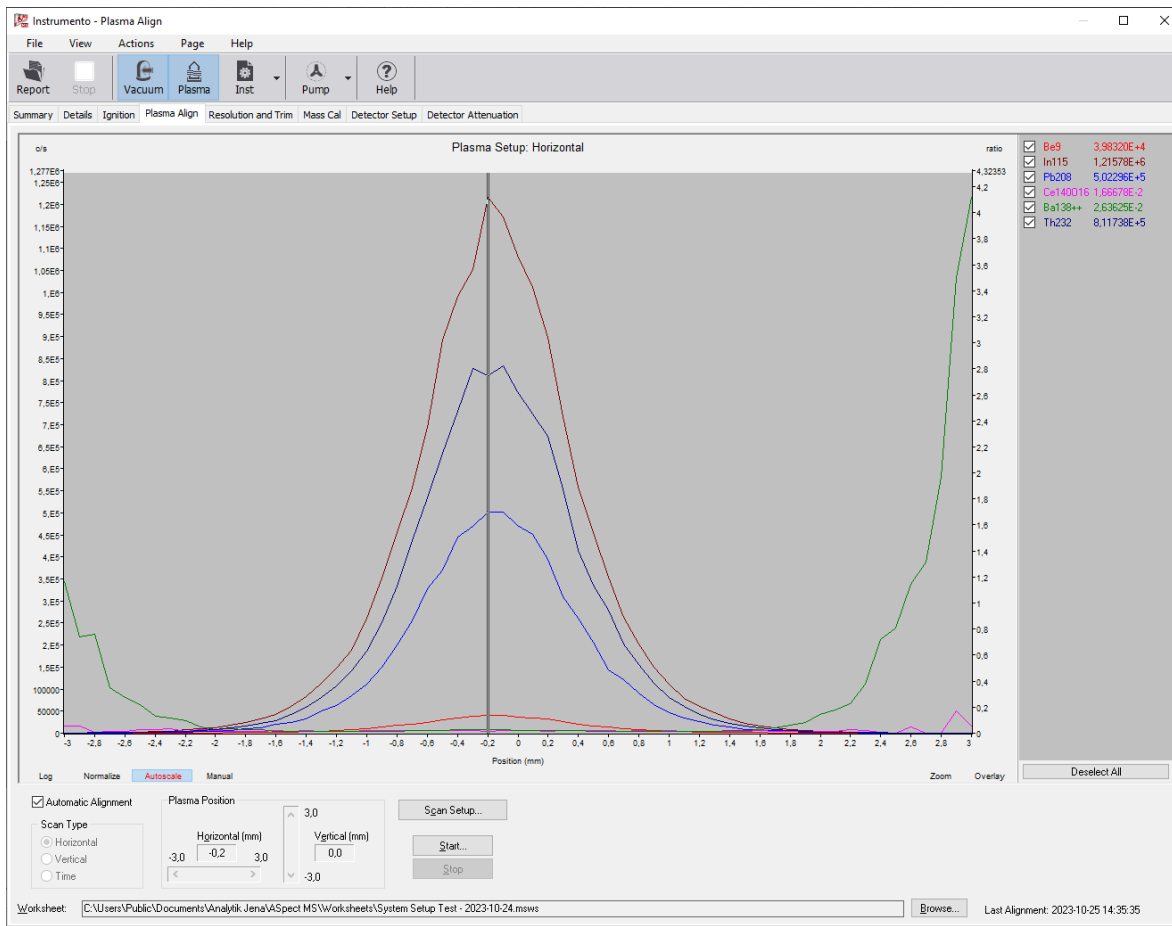
Report Date 2023-10-25 14:20:24 GMT--5:00

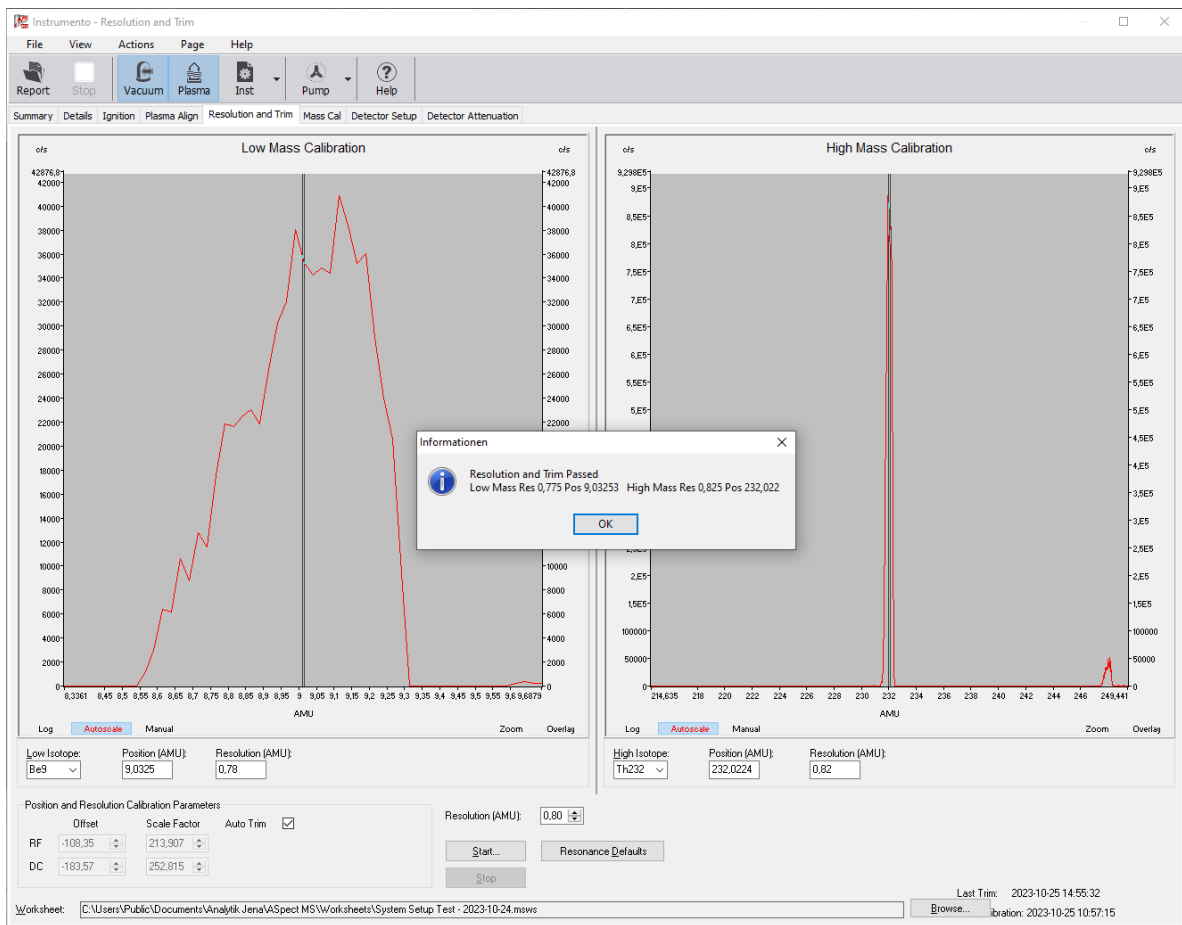
Worksheet System Setup Test - 2023-10-24.mswn

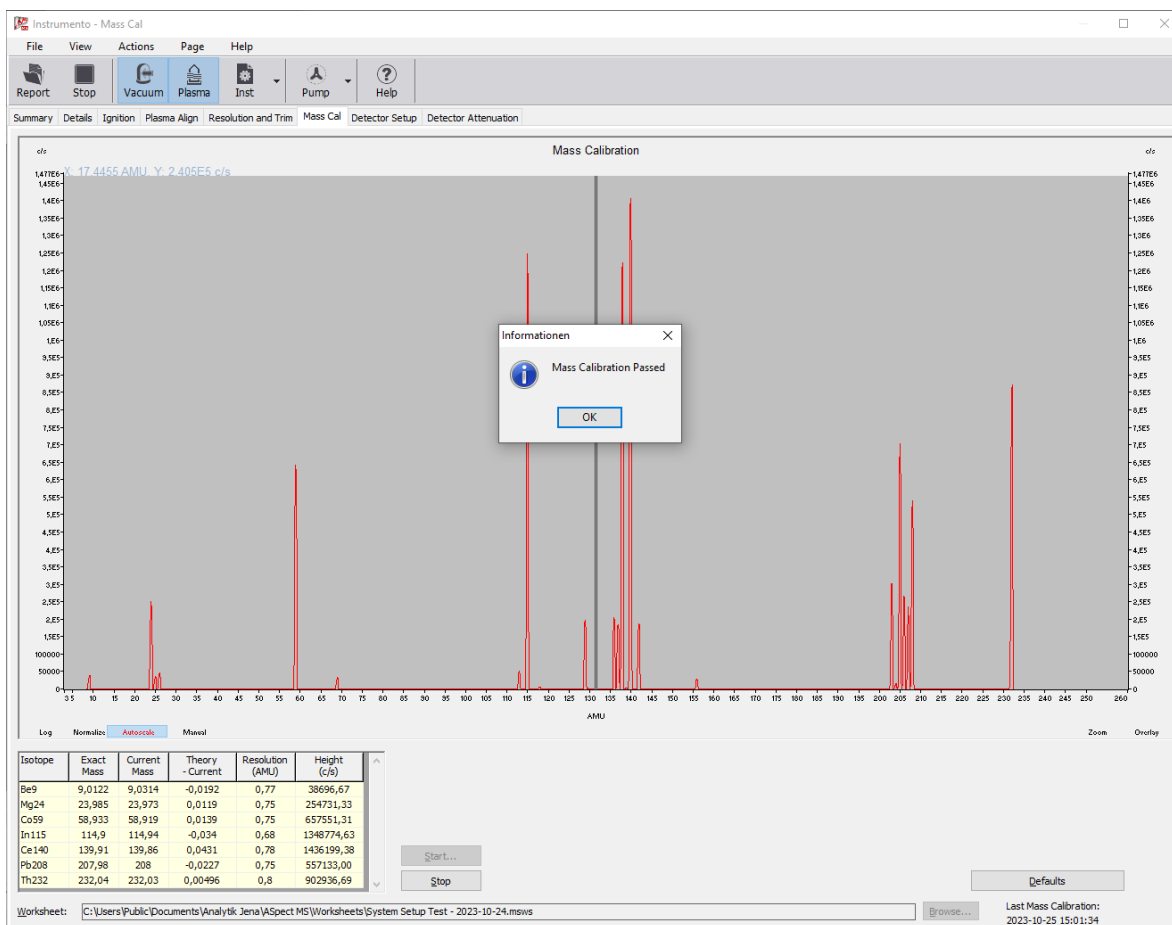
Analyst



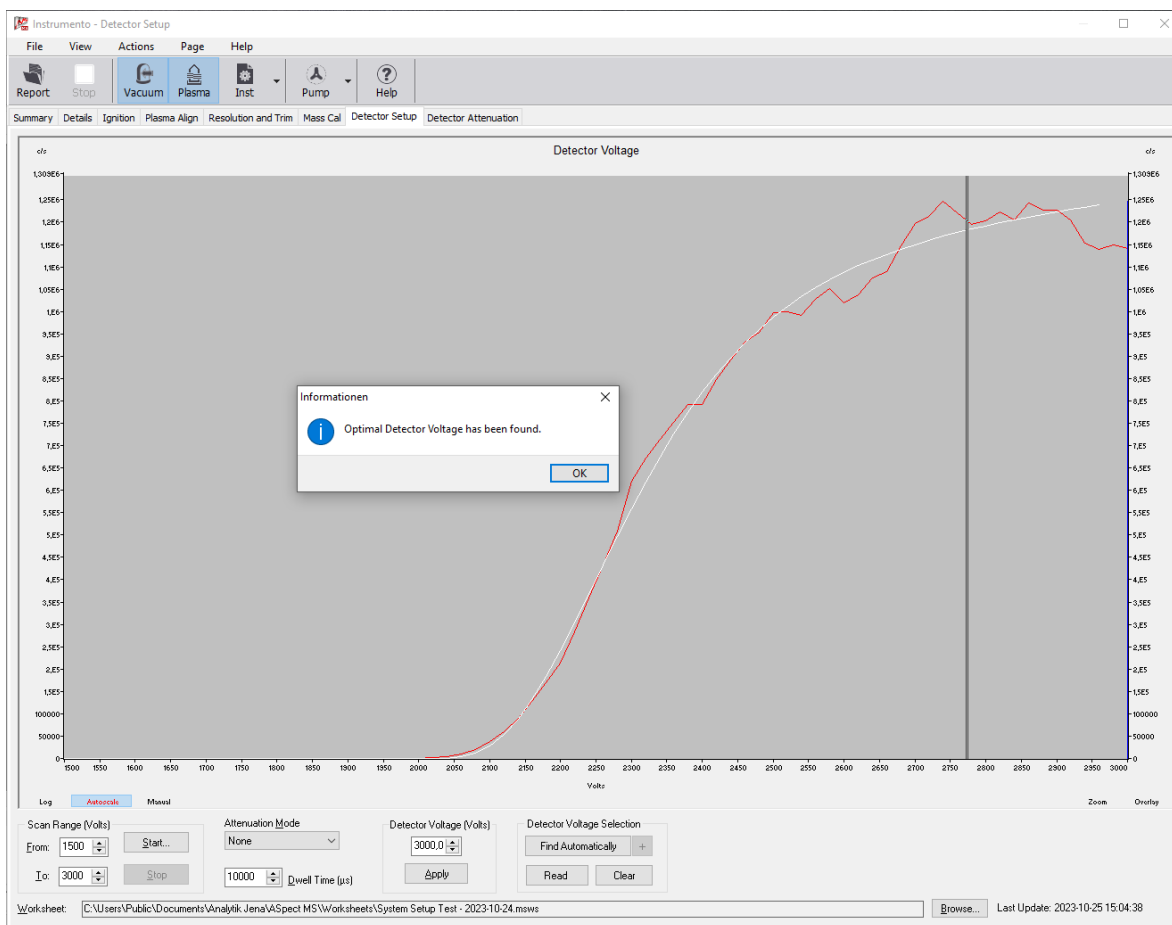
4.2 - Instrument Setup Test



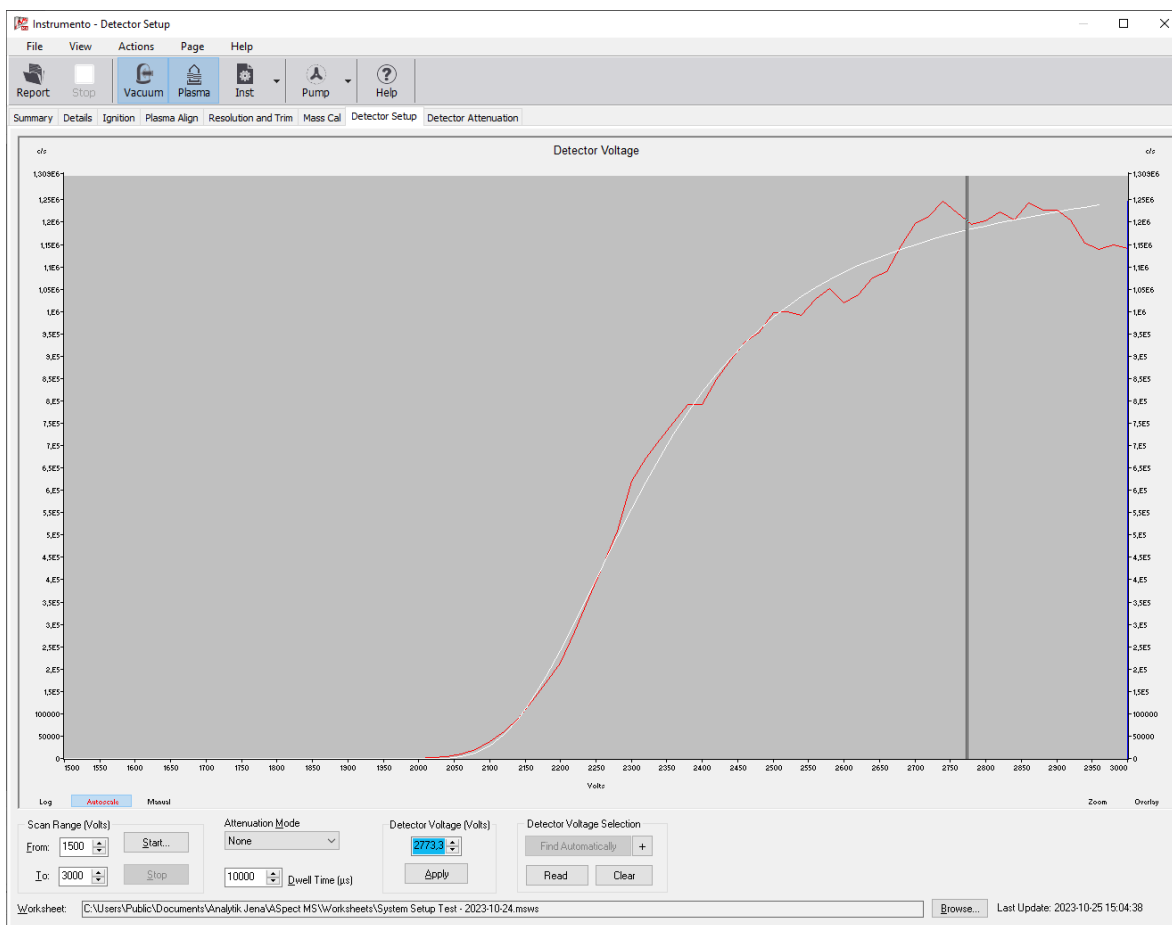




Isotope	Exact Mass	Current Mass	Theory - Current	Resolution (AMU)	Height (c/s)
Be9	9,0122	9,0314	-0,0192	0,77	38696,67
Mg24	23,985	23,973	0,0119	0,75	254731,33
Co59	58,933	58,919	0,0139	0,75	657551,31
In115	114,9	114,94	-0,034	0,68	1348774,63
Ce140	139,91	139,86	0,0431	0,78	1436199,38
Pb208	207,98	208	-0,0227	0,75	557133,00
Th232	232,04	232,03	0,00496	0,8	902936,69



B13/24



Sensitivity Test

1. Method		2. Sequence		3. Worksheet		☐ Show samples only		☐ Show corrected Conc		☐ Prep. Blank correction		☐ Hide Sol. Flags	
Rack# Tube	Sample Label	Be9 c/s	Mg24 c/s	Co59 c/s	In115 c/s	Ce140 c/s	Pb208 c/s	Th232 c/s	Ce140/16/Ce140 c/s	Ba138+/-Ba138 c/s			
1	En blanco	86,4000	343023,2	17027,54	836,1295	2511,200	43827,16	1708,000		0,042			0,027
2	1 estándar												
3	Tuning 1 ppb	36362,00	250177,5	637518,6	1184022	1378905	503021,8	818865,1		0,019			0,025

Edit Replicates

Type: Be9 (Analyte)
Int. Std: N/A

Flags: d Active Solution: 1
Dilution: - Time: 2023-10-25 15:29:25

Enabled	Reading	Counts/sec	Conc ppb
☒	Mean 1	36362,00	-d
☒	Rep 1	36106	-
☒	Rep 2	35121	-
☒	Rep 3	36611	-
☒	Rep 4	35714	-
☒	Rep 5	36723	-
☒	Rep 6	35449	-
☒	Rep 7	35585	-
☒	Rep 8	36980	-
☒	Rep 9	37749	-
☒	Rep 10	37581	-

SD (c/s): 909,5
%RSD (c/s): 2,50

1 [Arun]

Apply Close Help

Edit Replicates

Type: In115 (Analyte)
Int. Std: N/A

Flags: d Active Solution: 1
Dilution: - Time: 2023-10-25 15:29:25

Enabled	Reading	Counts/sec	Conc ppb
☒	Mean 1	1184022	-d
☒	Rep 1	1211248	-
☒	Rep 2	1196398	-
☒	Rep 3	1217048	-
☒	Rep 4	1212068	-
☒	Rep 5	1191687	-
☒	Rep 6	1105796	-
☒	Rep 7	1148697	-
☒	Rep 8	1198800	-
☒	Rep 9	1173661	-
☒	Rep 10	1184820	-

SD (c/s): 34195,5
%RSD (c/s): 2,89

1 [Arun]

Apply Close Help

Edit Replicates

Type: Th232 (Analyte)
Int. Std: N/A

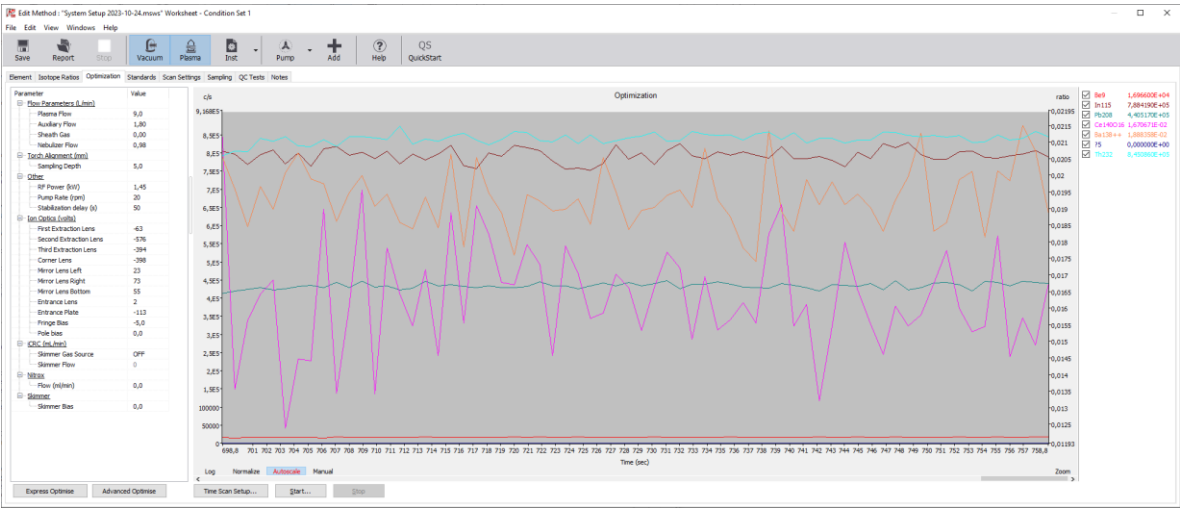
Flags: d Active Solution: 1
Dilution: - Time: 2023-10-25 15:29:25

Enabled	Reading	Counts/sec	Conc ppb
☒	Mean 1	818865,1	-d
☒	Rep 1	827830	-
☒	Rep 2	846792	-
☒	Rep 3	826850	-
☒	Rep 4	823350	-
☒	Rep 5	795848	-
☒	Rep 6	823993	-
☒	Rep 7	831077	-
☒	Rep 8	803833	-
☒	Rep 9	792348	-
☒	Rep 10	816731	-

SD (c/s): 16941,4
%RSD (c/s): 2,07

1 [Arun]

Apply Close Help



☒	Be9	1,696600E+04
☒	In115	7,884190E+05
☒	Pb208	4,405170E+05
☒	Ce140016	1,670671E-02
☒	Ba138++	1,888358E-02
☒	75	0,000000E+00
☒	Th232	8,450860E+05

Report Date 2023-10-31 11:28:20 GMT--5:00

Worksheet 20231023_OQ_Detector Calibration Test.msww

Analyst

Worksheet Summary

Worksheet: 20231023_OQ_Detector Calibration Test.msww
 Created: 2023-10-25 15:50:13
 Analyst:
 Computer: APPLICATIONICP
 Last Saved: 2023-10-25 16:23:47 GMT--5:00
 Software Ver.: 4.3 r17816
 Firmware Ver.: 0.00
 Samples: 1
 Comment:

Chemistry

Matrix:
 Acids Used:
 Keywords:
 CRM:

Measurement Parameters

Analysis Modes Analysis Type: Quantitative, Acquisition Mode: Steady State, Scan Mode: Peak Hopping
 Spacing: Fine, Points/Peak: 1, Scans/Replicate: 50, Replicates/Sample: 5

Plasma Plasma flow: 10,50 L/min Auxiliary flow: 1,50 L/min Sheath Gas Flow: 0,00 L/min Nebulizer flow: 1,00 L/min
 Plasma flow: 10,50 L/min Auxiliary flow: 1,50 L/min Sheath Gas Flow: 0,00 L/min Nebulizer flow: 1,00 L/min
 Sampling depth: 5,00 mm
 Power: 1,35 kW Pump rate: 21 rpm Stabilization delay: 20 sec Nitrox Flow: 0,00 mL/min

Ion Optics

(Volt) First Extraction Lens: -70,00 Second Extraction Lens: -549,00 Third Extraction Lens: -379,00
 Left Mirror Lens: 65,00 Right Mirror Lens: 57,00 Bottom Mirror Lens: 38,00
 Corner Lens: -392,00 Entrance Lens: 2,00
 Fringe Bias: -7,90 Entrance Plate: -105,00
 Detector Focus: True Pole Bias: 0,00

iCRC (Hardware not fitted)

Skimmer Cone: Off iCRC Skimmer Gas Flow: 0 mL/min

Sampling

Aerosol generation: Nebulizer, Source: Manual
 Fast pump during sample delay/rinse: On, Enable device control: Off
 Spray Chamber Cooling: On Spray Chamber Temp: 3,00 °C
 Sample uptake delay: 15 sec, Smart Rinse: No, Switch Delay: OFF
 Scan time: 519 msec, Replicate time: 25,93 sec

Analytes (5)

Be9, Co59, In115, Ce140, Pb208

SemiQuant Analytes (0)**Internal Standards (0)**

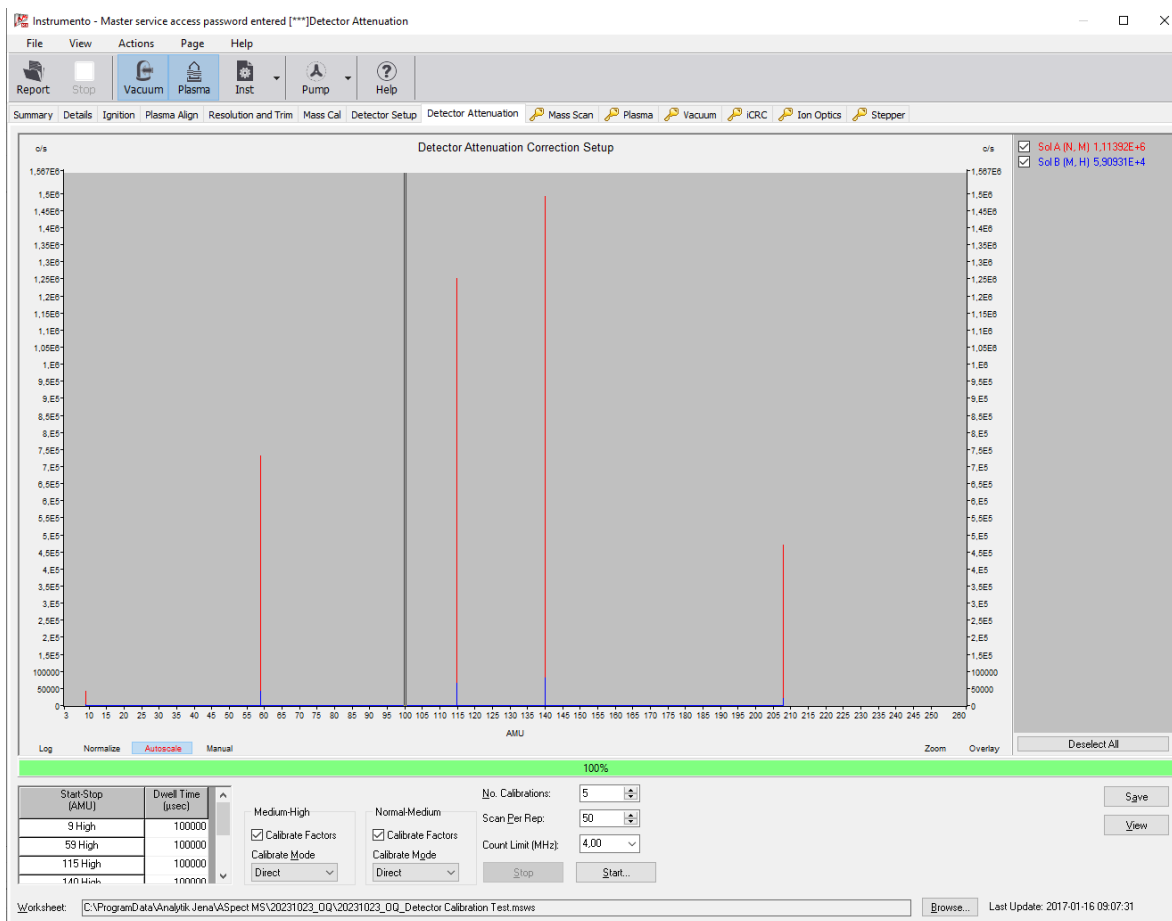
No. of isotope ratio standards: 0

Isotope Ratios (0)**Default exclusions (7)**

Ar40, Ar40Ar40, N14, N14H1, O16, O16H1, Ar40H1

User-specified exclusions (0)**Scan Segments (5)**

Start (m/z)	Stop (m/z)	Dwell (µsec)	Attenuation mode	Norm-Med	Med-High
9	9	100000	High	68,915	141,952
59	59	100000	High	85,157	144,146
115	115	100000	High	92,940	143,047
140	140	100000	High	88,891	133,878
208	208	100000	High	94,404	120,978



Detector Attenuation Correction Factors Viewer

Selected Table
☒ Current Factors ☐ Previous Factors

Mass	Edit	Norm-Med	No. Calib...	RSD	Edit	Med-High	No. Calib...	RSD
9	☐	68,915	5	1,9	☐	141,952	5	7,1
59	☐	85,157	5	1,0	☐	144,146	5	3,7
115	☐	92,940	5	0,9	☐	143,047	5	1,7
140	☐	88,891	5	0,8	☐	133,878	5	2,0
208	☐	94,404	5	1,3	☐	120,978	5	1,8
	☐				☐			
	☐				☐			
	☐				☐			
	☐				☐			
	☐				☐			
	☐				☐			
	☐				☐			
	☐				☐			
	☐				☐			

Table Show Options
 Directly Calculated Only ☒
 All masses ☐

Report Date 2023-10-26 13:36:03 GMT--5:00

Worksheet 20231025_OQ iCRC.msws

Analyst

Worksheet Summary

Worksheet: 20231025_OQ iCRC.msws
 Created: 2023-10-26 10:46:30
 Analyst:
 Computer: APPLICATIONICP
 Last Saved: 2023-10-26 13:35:44 GMT--5:00
 Software Ver.: 4.3 r19995
 Firmware Ver.: 6.08
 Samples: 2
 Comment:

Chemistry

Matrix:
 Acids Used:
 Keywords:
 CRM:

Measurement Parameters

Analysis Modes Analysis Type: Quantitative, Acquisition Mode: Steady State, Scan Mode: Peak Hopping
 Spacing: Fine, Points/Peak: 1, Scans/Replicate: 50, Replicates/Sample: 10

Plasma Plasma flow: 10,50 L/min Auxiliary flow: 1,50 L/min Sheath Gas Flow: 0,00 L/min Nebulizer flow: 1,02 L/min
 Sampling depth: 5,00 mm
 Power: 1,20 kW Pump rate: 22 rpm Stabilization delay: 0 sec Nitrox Flow: 0,00 mL/min

Ion Optics (Volt)

Skimmer Bias: 0,00
 First Extraction Lens: -175,00 Second Extraction Lens: -556,00 Third Extraction Lens: -367,00
 Left Mirror Lens: 27,00 Right Mirror Lens: 34,00 Bottom Mirror Lens: 35,00
 Corner Lens: -392,00 Entrance Lens: 4,00
 Fringe Bias: -8,00 Entrance Plate: -45,00
 Detector Focus: True Pole Bias: 0,00

iCRC Skimmer Cone: H2 iCRC Skimmer Gas Flow: 100 mL/min

Nitrox 0 mL/min

Sampling Aerosol generation: Nebulizer, Source: Manual
 Fast pump during sample delay/rinse: On, Enable device control: Off
 Spray Chamber Cooling: On Spray Chamber Temp: 3,00 °C
 Sample uptake delay: 30 sec, Smart Rinse: No, Switch Delay: OFF
 Scan time: 189 msec, Replicate time: 9,47 sec

Analytes (2)

Co59, In115

SemiQuant Analytes (0)**Internal Standards (0)****No. of isotope ratio standards: 0****Isotope Ratios (0)****Default exclusions (7)**

Ar40, Ar40Ar40, N14, N14H1, O16, O16H1, Ar40H1

User-specified exclusions (0)**Scan Segments (3)**

Start (m/z)	Stop (m/z)	Dwell (µsec)	Attenuation mode	Norm-Med	Med-High
59	59	60000	None		
78	78	60000	None		
115	115	60000	None		

1 ppb Tuning Solution [Sample]

Tube: 1, Replicates: 10, Auto Dilutions factor: -, Method calibration, Time measured: 2023-10-26 13:35:44
 Actual weight: 1,0000 g, Actual volume: 1,00 mL, Dilution Factor: 1,00
 Position Horizontal: -0,10 mm Position Vertical: 0,30 mm Detector Voltage: 2746,70 volt

Report Date 2023-10-26 13:36:03 GMT--5:00

Worksheet 20231025_OQ iCRC.msww

Analyst

Analyte	Soln Conc	Unit	QC	Mean c/s	%RSD	SD	Replicates (c/s)				
Co59	-	ppb	-	33606,10	-	-	34368	33237	33375	33572	
							33469	33457	33725	33599	
							33572	33687			
In115	-	ppb	-	147480,8	-	-	147637	148106	147526	147340	
							147230	147276	147386	147737	
							147047	147523			
Add Masses	Soln Conc	Unit	Mean c/s	%RSD	SD	Replicates (c/s)					
?78	56,5000	c/s	56,5000	9,70	5,4823	43	53	58	56	57	56
						62	59	62	59		
Kr78	56,5000	c/s	56,5000	9,70	5,4823	43	53	58	56	57	56
						62	59	62	59		
Sn115	147481	c/s	147481	0,20	299,365	147637	148106	147526	147340	147230	147276
						147386	147737	147047	147523		

Report Date 2023-10-26 13:52:40 GMT--5:00

Worksheet 20231025_OQ iCRC He.mswws

Analyst

Worksheet Summary

Worksheet: 20231025_OQ iCRC He.mswws
 Created: 2023-10-26 10:46:30
 Analyst:
 Computer: APPLICATIONICP
 Last Saved: 2023-10-26 13:51:37 GMT--5:00
 Software Ver.: 4.3 r19995
 Firmware Ver.: 6.08
 Samples: 2
 Comment:

Chemistry

Matrix:
 Acids Used:
 Keywords:
 CRM:

Measurement Parameters

Analysis Modes Analysis Type: Quantitative, Acquisition Mode: Steady State, Scan Mode: Peak Hopping
 Spacing: Fine, Points/Peak: 1, Scans/Replicate: 50, Replicates/Sample: 10

Plasma Plasma flow: 10,50 L/min Auxiliary flow: 1,50 L/min Sheath Gas Flow: 0,00 L/min Nebulizer flow: 1,02 L/min
 Sampling depth: 5,00 mm
 Power: 1,20 kW Pump rate: 22 rpm Stabilization delay: 0 sec Nitrox Flow: 0,00 mL/min

Ion Optics (Volt)

Skimmer Bias: 0,00
 First Extraction Lens: -175,00 Second Extraction Lens: -556,00 Third Extraction Lens: -367,00
 Left Mirror Lens: 27,00 Right Mirror Lens: 34,00 Bottom Mirror Lens: 35,00
 Corner Lens: -392,00 Entrance Lens: 4,00
 Fringe Bias: -8,00 Entrance Plate: -45,00
 Detector Focus: True Pole Bias: 0,00

iCRC Skimmer Cone: He iCRC Skimmer Gas Flow: 100 mL/min

Nitrox 0 mL/min

Sampling Aerosol generation: Nebulizer, Source: Manual
 Fast pump during sample delay/rinse: On, Enable device control: Off
 Spray Chamber Cooling: On Spray Chamber Temp: 3,00 °C
 Sample uptake delay: 30 sec, Smart Rinse: No, Switch Delay: OFF
 Scan time: 189 msec, Replicate time: 9,47 sec

Analytes (2)

Co59, In115

SemiQuant Analytes (0)**Internal Standards (0)****No. of isotope ratio standards: 0****Isotope Ratios (0)****Default exclusions (7)**

Ar40, Ar40Ar40, N14, N14H1, O16, O16H1, Ar40H1

User-specified exclusions (0)**Scan Segments (3)**

Start (m/z)	Stop (m/z)	Dwell (µsec)	Attenuation mode	Norm-Med	Med-High
59	59	60000	None		
78	78	60000	None		
115	115	60000	None		

1 ppb Tuning Solution [Sample]

Tube: 1, Replicates: 10, Auto Dilutions factor: -, Method calibration, Time measured: 2023-10-26 13:51:37
 Actual weight: 1,0000 g, Actual volume: 1,00 mL, Dilution Factor: 1,00
 Position Horizontal: -0,10 mm Position Vertical: 0,30 mm Detector Voltage: 2746,70 volt

Report Date 2023-10-26 13:52:40 GMT--5:00

Worksheet 20231025_OQ iCRC He.msws

Analyst

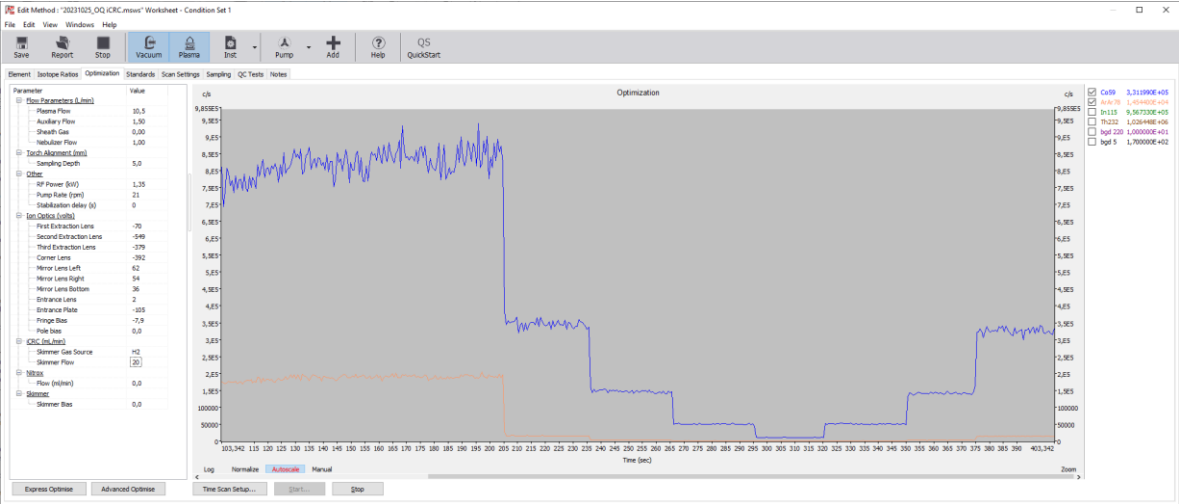
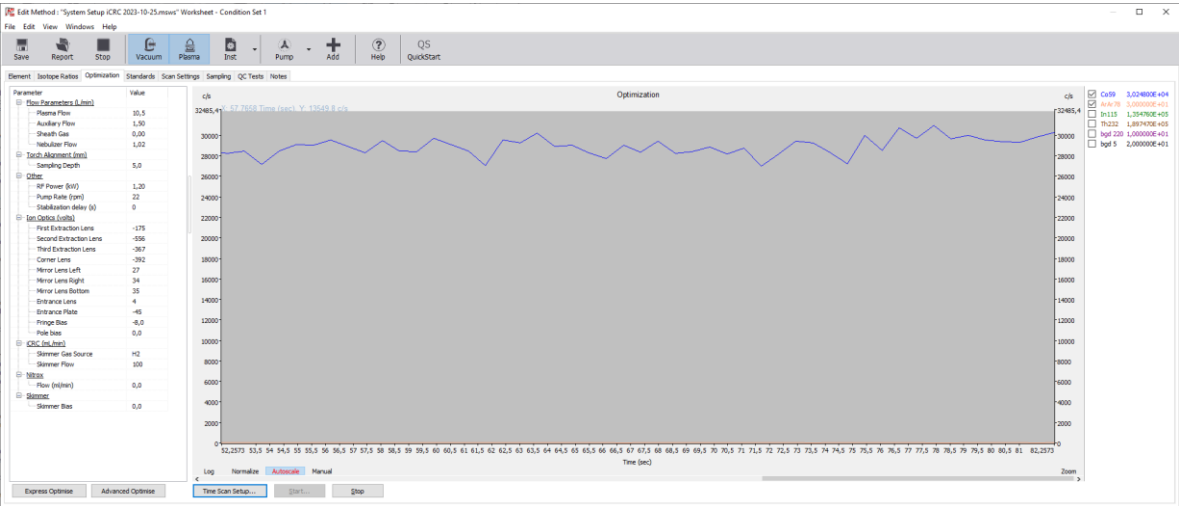
Analyte	Soln Conc	Unit	QC	Mean c/s	%RSD	SD	Replicates (c/s)				
Co59	-	ppb	-	83568,30	-	-	79042	83427	84162	84523	
							83767	84061	83789	84375	
							84315	84222			
In115	-	ppb	-	34122,50	-	-	33512	34238	34277	34252	
							34171	34185	34102	34260	
							34175	34053			
Add Masses	Soln Conc	Unit	Mean c/s	%RSD	SD	Replicates (c/s)					
?78	171,900	c/s	171,900	5,28	9,0732	152	171	166	179	167	171
						172	184	178	179		
Kr78	171,900	c/s	171,900	5,28	9,0732	152	171	166	179	167	171
						172	184	178	179		
Sn115	34122,5	c/s	34122,5	0,66	226,044	33512	34238	34277	34252	34171	34185
						34102	34260	34175	34053		

B23/24



4.4 iCRC Test

Hydrogen

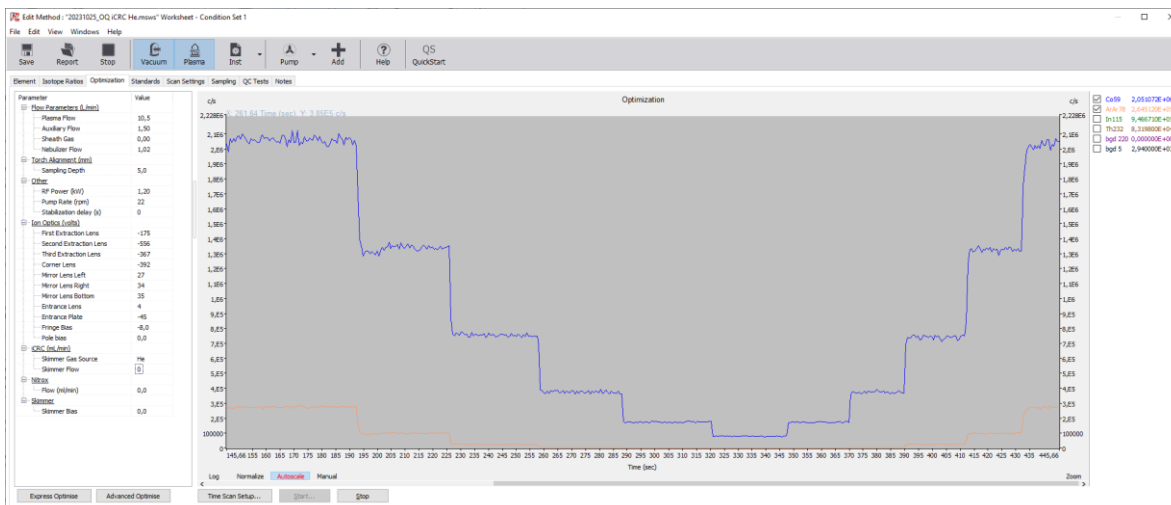
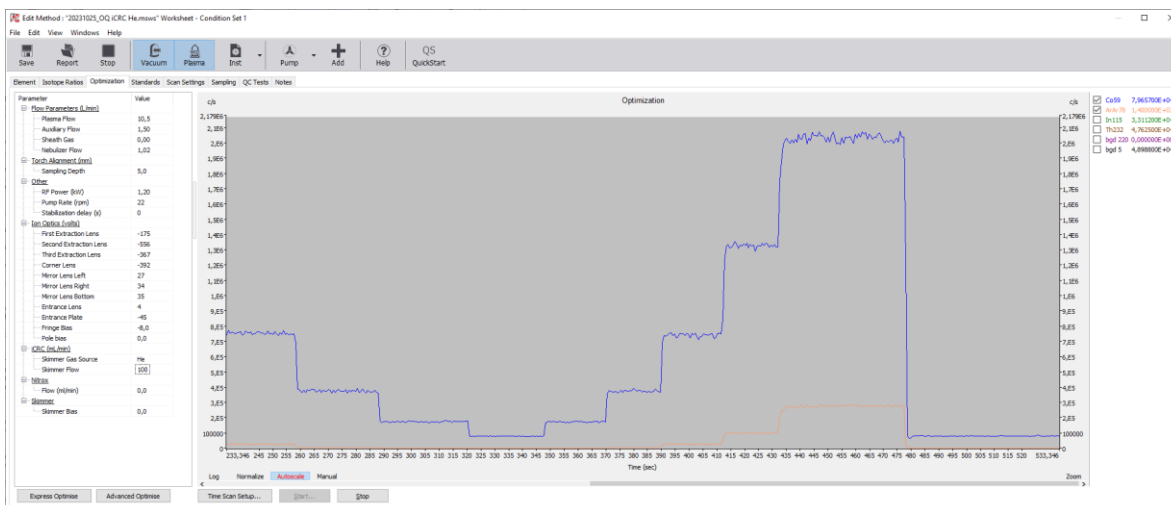


1. Method		2. Sequence		3. Worksheet		☐ Show samples only	
Rack#	Sample Label	Co59 c/s	In115 c/s	78 c/s			
1	1 ppb Tuning Solution	33606,10	147480,8	56,5000			
2	blank						

B24/24



Helium



☒ Co59 8,092100E+04
☒ ArAr78 1,700000E+02
☐ In115 3,358300E+04
☐ Th232 4,646300E+04
☐ bgd 220 0,000000E+00
☐ bgd 5 5,304600E+04

REPORT OF ANALYSIS

Multi-Element Aqueous RM

Product #: 10-405-810

ICP-MS Tuning Solution

Lot #: 1085757-1

Matrix: 2% HNO₃

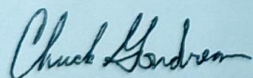
Element	Certified Concentration	Element	Certified Concentration	Element	Certified Concentration
Ba	9.984 µg/mL	Co	10.00 µg/mL	Pb	10.01 µg/mL
Be	10.01 µg/mL	In	10.01 µg/mL	Th	10.00 µg/mL
Ce	9.989 µg/mL	Mg	10.03 µg/mL	Ti	9.976 µg/mL

Intended Use: This solution is intended for use as a reference material (RM) or calibration standard for inductively coupled plasma optical emission spectroscopy (ICP-OES), inductively coupled plasma mass spectrometry (ICP-MS), flame or furnace atomic absorption spectroscopy (AA or GFAA), and other techniques for elemental analysis.

Certification & Traceability: This RM was manufactured, processed, and/or certified under a quality management system that is registered/accredited to **ISO 9001**, **ISO 17034**, and **ISO/IEC 17025**. This RM was prepared to the certified concentrations shown above by gravimetric methods using single-element concentrates, and was stabilized using high purity nitric acid (HNO₃) and diluted with filtered (0.22 µm), 18 M-ohm deionized water. The balances used in the preparation of this RM are calibrated regularly with traceability to NIST, using a calibration provider that is accredited to ISO/IEC 17025 by a mutually recognized accreditation body. All volumetric dilutions are performed in Class A calibrated glassware. The certified concentrations were determined based upon gravimetric procedures. Secondary verification of the certified concentrations was performed using ICP-OES that was calibrated and/or referenced against **NIST SRMs (see reverse side)**. The uncertainty associated with the certified concentration is $\pm 0.5\%$ relative, which is the sum of the estimated errors due to the purity of the raw materials, the gravimetric preparation of the solution, and transpiration through the container. This represents the expanded uncertainty at the 95% confidence level using a coverage factor of $k=2$.

Instructions for Use: We recommend that the solution be thoroughly mixed by repeated shaking or swirling of the bottle immediately prior to use. To achieve the highest accuracy, the analyst should: (1) use only pre-cleaned containers and transferware, (2) not pipette directly from the RM's original container, (3) never pour used product back into the original container, (4) make dilutions using calibrated balances or certified class A volumetric flasks and pipettes, (5) use a minimum sub-sample size of 500 µL, and (6) dilute with the same matrix as the original RM or other chemically suitable matrix. The solution should be kept tightly capped and stored under normal laboratory conditions. Do not freeze, heat, or immerse the bottle or its contents, and avoid exposure to direct sunlight or moisture.

Period of Validity: Analytikjena ensures the accuracy of this solution for **18 months** from the certification date shown below, provided the instructions for use are followed. During the period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution.



Chuck Goudreau, Certifying Officer

March 17, 2021

Certification Date

Analytikjena waives all responsibility for any damages resulting from the usage and/or implementation of the products/data described herein.

This CRM is traceable to the following NIST SRMs:

Analyte	Aq. SRM	MO SRM	Analyte	Aq. SRM	MO SRM	Analyte	Aq. SRM	MO SRM
Ag	3151	-	Hf	3122	-	S	3154	2770
Al	3101a	-	Hg	3133	3133	Sb	3102a	3102a
As	3103a	3103a	Ho	3123a	-	Sc	3148a	3148a
Au	3121	-	In	3124a	3124a	Se	3149	3149
B	3107	3107	K	3141a	3141a	Si	3150	-
Ba	3104a	-	La	3127a	3127a	Sm	3147a	-
Be	3105a	3105a	Li	3129a	3129a	Sn	3161a	-
Bi	3106	3106	Lu	3130a	-	SO ₄ ²⁻	3181	-
Br	3184	-	Mg	3131a	3131a	Sr	3153a	3153a
Ca	3109a	3109a	Mn	3132	3132	Ta	3155	-
Cd	3108	-	Mo	3134	3134	Tb	3157a	-
Ce	3110	3110	Na	3152a	-	Te	3156	-
Cl	3182	1818a	Nb	3137	-	Th	-	-
Co	3113	3113	Nd	3135a	-	Ti	3162a	3162a
Cr	3112a	-	Ni	3136	-	Tl	3158	3158
Cs	3111a	-	NO ₃ ⁻	3185	-	Tm	3160a	-
Cu	3114	-	P	3139a	3139a	U	3164	-
Dy	3115a	-	Pb	3128	-	V	3165	-
Er	3116a	-	Pd	3138	-	W	3163	3163
Eu	3117a	-	PO ₄ ³⁻	3186	-	Y	3167a	3167a
F ⁻	3183	-	Pr	3142a	-	Yb	3166a	-
Fe	3126a	-	Pt	3140	3140	Zn	3168a	3168a
Ga	3119a	-	Rb	3145a	-	Zr	3169	3169
Gd	3118a	-	Re	3143	-			
Ge	3120a	-	Rh	3144	3144			



Specification

1.00456.1000 Nitric acid 65% for analysis EMSURE® Reag. Ph Eur,ISO

	Specification	
Assay (alkalimetric)	≥ 65.0	%
Identity	passes test	
Appearance	passes test	
Color (Hazen)	≤ 10	Hazen
Density (d 20/20)	1.384 - 1.416	
Chloride (Cl)	≤ 0.2	ppm
Phosphate (PO ₄)	≤ 0.2	ppm
Sulfate (SO ₄)	≤ 0.5	ppm
Heavy metals (as Pb)	≤ 0.2	ppm
Ag (Silver)	≤ 0.010	ppm
Al (Aluminium)	≤ 0.050	ppm
As (Arsenic)	≤ 0.010	ppm
Au (Gold)	≤ 0.050	ppm
Ba (Barium)	≤ 0.010	ppm
Be (Beryllium)	≤ 0.010	ppm
Bi (Bismuth)	≤ 0.020	ppm
Ca (Calcium)	≤ 0.100	ppm
Cd (Cadmium)	≤ 0.010	ppm
Co (Cobalt)	≤ 0.010	ppm
Cr (Chromium)	≤ 0.020	ppm
Cu (Copper)	≤ 0.010	ppm
Fe (Iron)	≤ 0.100	ppm
Ga (Gallium)	≤ 0.050	ppm
Ge (Germanium)	≤ 0.020	ppm
In (Indium)	≤ 0.020	ppm
K (Potassium)	≤ 0.100	ppm
Li (Lithium)	≤ 0.010	ppm
Mg (Magnesium)	≤ 0.050	ppm
Mn (Manganese)	≤ 0.010	ppm
Mo (Molybdenum)	≤ 0.010	ppm
Na (Sodium)	≤ 0.200	ppm
Ni (Nickel)	≤ 0.020	ppm
Pb (Lead)	≤ 0.010	ppm
Pt (Platinum)	≤ 0.100	ppm
Sr (Strontium)	≤ 0.010	ppm
Ti (Titanium)	≤ 0.020	ppm
Tl (Thallium)	≤ 0.020	ppm
V (Vanadium)	≤ 0.010	ppm
Zn (Zinc)	≤ 0.020	ppm
Zr (Zirconium)	≤ 0.020	ppm
Residue on ignition (as SO ₄)	≤ 3	ppm

Specification

1.00456.1000 Nitric acid 65% for analysis EMSURE® Reag. Ph Eur,ISO

Date of expiry: see product label
ISO-reagent

Dr. Nina Hegmann

Responsible laboratory manager quality control

This document has been produced electronically and is valid without a signature.