BIOSPECTRA
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ANALYTICAL METHOD OF ANALYSIS: HEPES VIA ICP-MS

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1. PURPOSE:

1.1. To provide a procedure for the assessment of Elemental Impurities + Bismuth in HEPES products via the NexION 350X S/N 85VN5093001 ICP-MS. This procedure was assessed as a fully quantitative option-3 procedure as per validation report BSI-RPT-1450 and follows the validation parameters for quantitation procedures as outlined in USP <233>.

1.2. Elements under validated for this test method include:

1.2.1. Class 1: Hg, As, Cd, and Pb

1.2.2. Class 2A: Co, V, and Ni

1.2.3. Class 2B: Tl, Au, Pd, Ir, Os, Rh, Ru, Se, Ag, and Pt

1.2.4. Class 3: Li, Sb, Ba, Mo, Cu, Cr, and Sn

1.2.5. Class 4: Fe, Mn, Ca, K, Mg, and Zn

1.2.6. Other: Bi

2. SCOPE:

2.1. Applies to all HEPES products manufactured at BioSpectra.

2.2. Applies to the NexION 350X S/N 85VN5093001 ICP-MS located in the Quality Control (QC) Laboratory at the BioSpectra Bangor, PA facility.

3. RESPONSIBILITIES:

3.1. Laboratory Technology Manager, or other qualified designated individual, is responsible for the control, implementation, training, and maintenance of this method.

3.2. The Laboratory Staff are responsible for complying with the requirements of this Test Method.

3.3. If any abnormalities are determined during routine use of the ICP-MS or during calibration, the Laboratory Technology Manager shall be promptly notified. If necessary, the ICP-MS will be serviced and recalibrated by Perkin Elmer before being approved for use.

4. REFERENCES:

4.1. BSI-PRL-0508, Analytical Method Validation Protocol: Determination of ICH Q3D Elemental Impurities by Inductively Coupled Plasma Nass Spectrometry (ICP-MS) in HEPES

4.2. BSI-RPT-1450, Analytical Method Validation Report: Determination of Elemental Impurities in HEPES by ICP-MS Revalidation

4.3. BSI-SOP-0303, NexION 350X ICP-MS SOP

4.4. BSI-SOP-0304, NexION 350X ICP-MS Care and Maintenance

4.5. BSI-SOP-0436, Analytical Methods Validation Master Plan

4.6. ICH Guideline for Elemental Impurities Q3D Current

4.7. ICH Q3D Elemental Impurities Guidance for Industry FDA (Current)

4.8. USP <232> Elemental Analysis

4.9. USP <233> Elemental Analysis-Procedures

4.10. USP <730> Plasma Spectrochemistry

4.11. USP <1730> Plasma Spectrochemistry—Theory and Practice

TABLE 1: LIMITS FOR HEPES (10 GRAM/DAY PATIENT EXPOSURE)

Elements	ICH Class	Parenteral PDE Limits (µg/day)	0.1J LOQ (µg/g) in sample	0.3J Target (µg/g) in sample	0.5J Target (µg/g) in sample	1.0J Target (µg/g) in sample	1.5J Target (µg/g) in sample
As	1	15	0.15	0.45	0.75	1.50	2.25
Cd	1	2.0	0.02	0.06	0.10	0.20	0.30
Hg	1	3.0	0.03	0.09	0.15	0.30	0.45
Pb	1	5.0	0.05	0.15	0.25	0.50	0.75
Co	2A	5.0	0.05	0.15	0.25	0.50	0.75
Ni	2A	20	0.20	0.60	1.0	2.0	3.0
V	2A	10	0.10	0.30	0.50	1.0	1.5
Tl	2B	8.0	0.08	0.24	0.40	0.80	1.2
Se	2B	80	0.80	2.4	4.0	8.0	12
Ag	2B	10	0.10	0.30	0.50	1.0	1.5
Au	2B	100	1.0	3.0	5.0	10	15
Pd	2B	10	0.10	0.30	0.50	1.0	1.5
Ir	2B	10	0.10	0.30	0.50	1.0	1.5
Os	2B	10	0.10	0.30	0.50	1.0	1.5
Pt	2B	10	0.10	0.30	0.50	1.0	1.5
Rh	2B	10	0.10	0.30	0.50	1.0	1.5
Ru	2B	10	0.10	0.30	0.50	1.0	1.5
Ba	3	700	7.0	21	35	70	105
Sb	3	90	0.90	2.7	4.5	9.0	13.5
Li	3	250	2.5	7.5	12.5	25	37.5
Mo	3	[1]150	1.5	4.5	7.5	15	22.5
Cu	3	[1]50	0.50	1.5	2.5	5.0	7.5
Sn	3	600	6.0	18	30	60	90
Cr	3	[1]50	0.50	1.5	2.5	5.0	7.5
Fe	4	[2]50	Not Applicable	1.5	2.5	5.0	7.5
Mn	4	[2]50	0.50	1.5	2.5	5.0	7.5
Zn	4	[2]50	0.50	1.5	2.5	5.0	7.5
Ca	4	[2]500	5.0	15	25	50	75
K	4	[2]500	5.0	15	25	50	75
Mg	4	[2]50	0.50	1.5	2.5	5.0	7.5
Bi	Not Applicable	[2]50	0.50	1.5	2.5	5.0	7.5

[1]PDE limits set based on customer specifications.
[2]No PDE limits for Class 4 elements; limits derived from customer specifications or other internal product specifications.

5. MATERIALS AND EQUIPMENT:

5.1. Equipment
- 5.1.1. Analytical Balance
- 5.1.2. ICP-MS: NexION 350X S/N 85VN5093001, or equivalent qualified ICP-MS

5.2. Reagents
- 5.2.1. Nitric Acid, Trace metals grade or equivalent
- 5.2.2. Hydrochloric Acid, Trace metals grade or equivalent
- 5.2.3. Sulfuric acid, Trace metals grade or equivalent
- 5.2.4. Deionized water (Type 1 Ultrapure)
- 5.2.5. Thiourea, 99+ % grade
- 5.2.6. NexION Setup Solution
- 5.2.7. NexION KED Setup Solution, or equivalent preparation
- 5.2.8. Solid Phase Extraction (SPE) Cartridges
  - 5.2.8.1. SCP Science DigiSEP - Green Label 250 mg/6 ml, or equivalent
  - 5.2.8.2. Silicycle SPE Cartridges Silica-Based AMPA

5.3. Consumable Supplies
- 5.3.1. SCP Digitubes® 15 mL, 50 mL, and 100 mL
- 5.3.2. Pipette Tips of various sizes

TABLE 2: REFERENCE STANDARDS

Identification[1]	Manufacturer	Concentrations / Elements
Pharma-CAL Standard Parenteral STD# 1 IA 140-131-201	SCP Science	Ag (10 µg/mL), As (15 µg/mL), Cd (2 µg/mL), Co (5 µg/mL), Hg (3 µg/mL), Ni (20 µg/mL), Pb (5 µg/mL), Se (80 µg/mL), Tl (8 µg/mL), V (10 µg/mL)
USP232/ICH Q3D Parenteral STD# 2 IA 140-131-211	SCP Science	Au (100 µg/mL); Ir, Os, Pd, Pt, Rh, & Ru (10 µg/mL)
Pharma-CAL Custom Standard Parenteral STD# 3 AQ0-150-191	SCP Science	Ba (700 µg/mL), Cr (50 µg/mL), Cu (50 µg/mL), Li (250 µg/mL), Mo (150 µg/mL), Sb (90 µg/mL), Sn (600 µg/mL), Fe (50 µg/mL), Mn (50 µg/mL), Zn (50 µg/mL), Ca (500 µg/mL), K (500 µg/mL)
1,000 µg/mL Bismuth Standard	Perkin Elmer	Bi (1,000 µg/mL)
1,000 µg/mL Magnesium Standard	Perkin Elmer	Mg (1,000 µg/mL)
1,000 µg/mL Beryllium Standard	SCP Science	Be (1,000 µg/mL)
1,000 µg/mL Germanium Standard	SCP Science	Ge (1,000 µg/mL)
1,000 µg/mL Rhenium Standard	SCP Science	Re (1,000 µg/mL)
1,000 µg/mL Scandium Standard	SCP Science	Sc (1,000 µg/mL)
1,000 µg/mL Tellurium Standard	SCP Science	Te (1,000 µg/mL)
1,000 µg/mL Terbium Standard	SCP Science	Tb (1,000 µg/mL)
1,000 µg/mL Yttrium Standard	SCP Science	Y (1,000 µg/mL)

[1] Additional standards/custom standards can be used as long as the concentration remains the same in final preparations.

6. PROCEDURE:

6.1. All standards will be prepared volumetrically from stock solutions purchased from certified vendors. If the vendor supplied stock reference standard is within 2% of the nominal value as per the certificate of analysis, then the nominal value will be used to calculate the concentration of the standard. If the stock standard certificate of analysis value is greater than or less than 2% of the nominal value, then the certificate of analysis value will be used for the stock standard concentration.

6.2. **Acid Digestion Mix**

[2:1] Nitric Acid (HNO_3): Sulfuric Acid (H_2SO_4) (Prepare same day)

6.2.1. Caution: Combining nitric acid and sulfuric acid generates excessive heat. Never seal cap tightly before solution has completely cooled.

6.2.2. To prepare, add 50 mL of nitric acid to a 100 mL Digitube® and then slowly add 25 mL of sulfuric acid. Solution can be placed in a cold-water bath to aid cooling.

6.2.3. Scale proportionally as needed for use.

6.3. **2% Thiourea Complexing Solution**

6.3.1. Weigh approximately 1.0 gram of Thiourea into a 50 mL Digitube®.

6.3.2. Add approximately 20 mL of deionized water and mix to dissolve.

6.3.3. Filter solution through a Solid Phase Extraction (SPE) cartridge.

6.3.4. Dilute to a final volume of 50 mL with deionized water and mix well.

6.3.5. Scale proportionally as needed for use.

6.4. **Internal Standard Stock Solution**

6.4.1. Prepare a stock standard solution as described in Table 3 below containing standards listed in Table 2 above.

TABLE 3: REFERENCE STANDARDS

Identification	Element	Stock Identification	Amount Added (mL)	Final Volume (mL)	Final Concentration (µg/L)
Internal Standard Stock	Ge	1,000 µg/mL	0.05	10	5.0
	Tb		0.05		5.0
	Y		0.10		10
	Re		0.10		10
	Be		0.10		10
	Sc		0.10		10
	Te		0.25		25

6.5. **Internal Standard Solution**

6.5.1. Weigh approximately 1.0 gram of Thiourea into a 50 mL Digitube®.

6.5.2. Add approximately 20 mL of deionized water and mix to dissolve.

6.5.3. Filter solution through a Solid Phase Extraction (SPE) cartridge.

6.5.4. Transfer 2.5 mL of Internal Standard Stock to the filtered solution and add 25 mL of hydrochloric acid.

6.5.5. Dilute to a final volume of 50 mL with deionized water and mix well.

6.5.6. Scale proportionally as needed for use.

6.6. **Intermediate Standard**

6.6.1. Prepare an intermediate standard solution containing the elements listed in Table 4.
6.6.2. Add 1.0 mL of each STD#1 IA, STD#2 IA, and STD #3.
6.6.3. Add 0.050 mL of 1,000 µg/mL Bi standard and 0.050 mL of 1,000 µg/mL Mg standard.
6.6.4. Add deionized water to approximately the 8 mL mark on the digitube. Do not allow stock standards to contact concentrated acids while preparing solutions.
6.6.5. Add 1.0 mL of HCl and dilute to volume using DI Water. Mix well.
6.6.6. Do not allow concentrated acids to contact stock standards. Prepare fresh each day.

TABLE 4: INTERMEDIATE STANDARD

Identification	Element	Stock Identification	Amount Added (mL)	HCl (mL)	Final Volume (mL)	Final Concentration (µg/mL)
Intermediate Standard	As	STD# 1 IA 140-131-201	1.0	1.0	10	1.5
	Cd					0.20
	Hg					0.30
	Pb					0.50
	Co					0.50
	Ni					2.0
	V					1.0
	Tl					0.80
	Se					8.0
	Ag					1.0
	Au	STD# 2 IA 140-131-211	1.0			10
	Pd					1.0
	Ir					1.0
	Os					1.0
	Pt					1.0
	Rh					1.0
	Ru					1.0
	Ba	STD# 3 AQ0-150-191	1.0			70
	Sb					9.0
	Li					25
	Mo					15
	Cu					5.0
	Sn					60
	Cr					5.0
	Fe					5.0
	Mn					5.0
	Zn					5.0
	Ca					50
	K					50
	Mg	1,000 µg/mL Mg Std	0.050			5.0
	Bi	1,000 µg/mL Bi Std	0.050			5.0

6.7. **0.5J Calibration Standard Preparation**

6.7.1. Prepare a solution containing the elements listed in Table 5 below in a solution containing 5.0% HNO_3, 2.5% H_2SO_4, 1.0% HCl, and 400 µg/mL Thiourea.

6.7.2. Add 0.050 mL of Intermediate Standard to a 50 mL Digitube® and add approximately 35 mL of DI Water.

6.7.3. Add 3.75 mL of Acid Digestion Mix and add DI Water to approximately 45 mL mark.

6.7.4. Add 1.0 mL Internal Standard/Complexing Solution before diluting to 50 mL final volume using DI Water.

6.7.5. Do not allow concentrated acids to contact Intermediate Standard.

6.7.6. Prepare fresh each day.

TABLE 5: 0.5J CALIBRATION STANDARD

Identification	Element	Intermediate Standard (mL)	Acid Mix (mL)	Internal Standard/ Complexing Solution (mL)	Final Volume (mL)	Final Concentration (µg/L)
0.5J Calibration Standard	As	0.050	3.75	1.0	50	1.5
	Cd					0.20
	Hg					0.30
	Pb					0.50
	Co					0.50
	Ni					2.0
	V					1.0
	Tl					0.80
	Se					8.0
	Ag					1.0
	Au					10
	Pd					1.0
	Ir					1.0
	Os					1.0
	Pt					1.0
	Rh					1.0
	Ru					1.0
	Ba					70
	Sb					9.0
	Li					25
	Mo					15
	Cu					5.0
	Sn					60
	Cr					5.0
	Fe					5.0
	Mn					5.0
	Zn					5.0
	Ca					50
	K					50
	Mg					5.0
	Bi					5.0

6.8. **1.5J Calibration Standard Preparation**

6.8.1. Prepare a solution containing the elements listed in Table 6 below in a solution containing 5.0% HNO_3, 2.5% H_2SO_4, 1.0% HCl, and 400 µg/mL Thiourea.

6.8.2. Add 0.150 mL of Intermediate Standard to a 50 mL Digitube® and add approximately 35 mL of DI Water.

6.8.3. Add 3.75 mL of Acid Digestion Mix and add DI Water to approximately 45 mL mark.

6.8.4. Add 1.0 mL Internal Standard/Complexing Solution before diluting to 50 mL final volume using DI Water.

6.8.5. Do not allow concentrated acids to contact Intermediate Standard.

6.8.6. Prepare fresh each day.

TABLE 6: 1.5J CALIBRATION STANDARD

Identification	Element	Intermediate Standard (mL)	Acid Mix (mL)	Internal Standard/ Complexing Solution (mL)	Final Volume (mL)	Final Concentration (µg/L)
1.5J Calibration Standard	As	0.150	3.75	1.0	50	4.5
	Cd					0.60
	Hg					0.90
	Pb					1.5
	Co					1.5
	Ni					6.0
	V					3.0
	Tl					2.4
	Se					24
	Ag					3.0
	Au					30
	Pd					3.0
	Ir					3.0
	Os					3.0
	Pt					3.0
	Rh					3.0
	Ru					3.0
	Ba					210
	Sb					27
	Li					75
	Mo					45
	Cu					15
	Sn					180
	Cr					15
	Fe					15
	Mn					15
	Zn					15
	Ca					150
	K					150
	Mg					15
	Bi					15

6.9. **2.0J Calibration Standard Preparation**

6.9.1. Prepare a solution containing the elements listed in Table 7 below in a solution containing 5.0% HNO_3, 2.5% H_2SO_4, 1.0% HCl and 400 µg/mL Thiourea.

6.9.2. Add 0.200 mL of Intermediate Standard to a 50 mL Digitube® and add approximately 35 mL of DI Water.

6.9.3. Add 3.75 mL of Acid Digestion Mix and add DI Water to approximately 45 mL mark.

6.9.4. Add 1.0 mL Internal Standard/Complexing Solution before diluting to 50 mL final volume using DI Water.

6.9.5. Do not allow concentrated acids to contact Intermediate Standard.

6.9.6. Prepare fresh each day.

TABLE 7: 2.0J CALIBRATION STANDARD

Identification	Element	Intermediate Standard (mL)	Acid Mix (mL)	Internal Standard/ Complexing Solution (mL)	Final Volume (mL)	Final Concentration (µg/L)
2.0J Calibration Standard	As	0.200	3.75	1.0	50	6.0
	Cd					0.80
	Hg					1.2
	Pb					2.0
	Co					2.0
	Ni					8.0
	V					4.0
	Tl					3.2
	Se					32
	Ag					4.0
	Au					40
	Pd					4.0
	Ir					4.0
	Os					4.0
	Pt					4.0
	Rh					4.0
	Ru					4.0
	Ba					280
	Sb					36
	Li					100
	Mo					60
	Cu					20
	Sn					240
	Cr					20
	Fe					20
	Mn					20
	Zn					20
	Ca					200
	K					200
	Mg					20
	Bi					20

6.10. **Calibration Blank**

6.10.1. Prepare a solution containing 5.0% HNO_3, 2.5% H_2SO_4, 1.0% HCl and 400 µg/mL Thiourea as described in Table 8 below.

6.10.2. Add approximately 35 mL of DI Water to a 50 mL Digitube®.

6.10.3. Add 3.75 mL of Acid Digestion Mix and add DI Water to approximately 45 mL mark.

6.10.4. Add 1.0 mL of 2% Thiourea Solution and 1.0 mL Internal Standard before diluting to 50 mL final volume using DI Water.

6.10.5. Prepare fresh each day.

TABLE 8: CALIBRATION BLANK

Description	Acid Mix (mL)	Internal Standard/ Complexing Solution (mL)	Final Volume (mL)
Cal Blank	3.75	1.0	50

6.11. **Method Blank Preparation**

6.11.1. Refer to Calibration Blank

6.12. **Sample Preparation**

6.12.1. Weigh approximately 100 mg of the sample into a 50 mL Digitube®.

6.12.2. Add 30 mL of deionized water and swirl solution to mix.

6.12.3. Add 3.75 mL of Acid Mixture and swirl to mix.

6.12.4. Add deionized water to approximately 45 mL and then transfer 1.0 mL of Internal Standard/Complexing Solution.

6.12.5. Dilute to a final volume of 50 mL with deionized water and mix thoroughly.

6.12.6. Samples are stable for 24 hours.

6.13. **Isobaric Overlap Corrections**

6.13.1. An isobaric interference results from equal mass isotopes of different elements present in the sample solution. Analysis sequences that are processed utilizing multi-element standards will require the use of correction equations to compensate for known isobaric overlaps originating from the elemental standard and sample. The following correction equations should be used:

KED Mode:

$M_c(58) = M_u(58) \times 1 - M_{(rm)}(57) \times 0.13208$
$M_c(98) = Mu(98) \times 1 - M(rm)(99) \times 0.14655$
$Mc(106) = Mu(106) \times 1 - M(rm)(111) \times 0.09766$
$Mc(108) = Mu(108) \times 1 - M(rm)(111) \times 0.06953$
$Mc(120) = Mu(120) \times 1 - M(rm)(125) \times 0.01273$
$Mc(123) = Mu(123) \times 1 - M(rm)(125) \times 0.12588$
$Mc(190) = Mu(190) \times 1 - M(rm)(195) \times 0.00036$
$Mc(192) = Mu(192) \times 1 - M(rm)(195) \times 0.02315$
$Mc(196) = Mu(196) \times 1 - M_{(rm)}(202) \times 0.005023$

The correction equations can be derived from the following equation:
$Mc = Mu - [M(rm) \times (A(ie)/A(rm))]$

Where:

M_c = Corrected Count Rate for the analyte
Mu = Uncorrected count rate for the analyte
M(rm) = Count Rate of Reference Mass (rm) for the Interfering Element
A(ie) = Percent Abundance of Interfering Element at the analyte mass
A(rm) = Percent Abundance of Interfering Element at the Reference Mass (rm)

Example:

$M_c(58) = M_u(58) \times 1 - M_{(rm)}(57) \times (0.28 / 2.12)$

Where $0.28/ 2.12 = 0.13208$

6.13.2. All correction coefficients were calculated based on the Agilent Technologies 2016 Relative Isotopic Abundance Table.

6.13.3. Multiplier used in the correct equation may differ slightly from the multiplier used in the Syngistix instrument method due to rounding.

7. INSTRUMENT PROCEDURE:

7.1. Perform the ICP-MS daily performance check prior to beginning the analytical sequence. Refer to NexION 350X ICP-MS SOP, DCN: BSI-SOP-0303, for Daily Check procedures.

7.2. A calibration curve of no less than two standards and a blank must be used. The calibration correlation coefficient (R) must be ≥ 0.99.

7.3. Set up the sequence as per the example sequence in Table 9.

7.4. Confirm the calibration by analyzing the 1.5J standard after the calibration. The calibration check must recover ± 20% of the calculated theoretical concentration for multi-element analysis and ± 10% for single element determinations.

7.5. The check standard must be verified after the calibration. A re-analysis of the check standard will be performed a minimum of once every 10 samples and at the end of the analytical run.

7.6. Bracketing standard checks must recover ± 20% of the calculated theoretical concentration for multi-element analysis and ± 10% for single element determinations. Additionally, the drift (calculated as absolute difference) between the bracketing standard checks must be NMT 20% for each Target element (NMT 10% for single element determinations).

7.7. The sample concentration is calculated as:

$$\text{Conc. } (\mu g/g) = \frac{\text{Solution Conc. } (\mu g/L) \times \text{Solution vol. (L)} \times \text{Dilution Factor}}{\text{Sample Mass (g)}}$$

TABLE 9: EXAMPLE SAMPLE ANALYSIS SEQUENCE

ID	Type	Level
Cal Blank	Cal Blank	Level 1
0.5J Cal Std	Cal Std	Level 2
1.5J Cal Std	Cal Std	Level 3
2.0J Cal Std	Cal Std	Level 4
Cal Blank Check	QC Check	Not Applicable
1.5J Check Std 1	QC Check	Not Applicable
Method Blank	Sample	Not Applicable
Sample(s) 10 or less	Sample	Not Applicable
1.5J Check Std 2	QC Check	Not Applicable

7.8. **Instrument Setup and Parameters**

7.8.1. Instrument settings are listed only as guidelines. Settings may be changed in order to accommodate changes in sample matrix or hardware configurations.

7.8.2. The AMS-II makeup gas must be engaged during analysis using a minimum dilution gas ratio of 15%.

7.8.3. Multiple elements are analyzed using hydrogen reaction gas in order to remove polyatomic interferences. A hydrogen DRC flow rate of approximately 4-5 mL/min should be used.

7.8.4. The instrument method is stored under the Approved Test Method Folder labelled as "HEPES_EI_Profile+Bi.mth" for elemental impurities testing along with

TABLE 10: ICP-MS PARAMETERS

ICP-MS System	Perkin Elmer NexION350X Inductively Coupled Plasma Mass Spectrometry (ICP-MS) with Syngistix Software Version 2.4
Sweeps/Reading	20
Replicates	3
Nebulizer Gas	Argon
Collision Gas	Helium
Reaction Cell Gas	Hydrogen
Dilution Gas	Argon
Sample and Skimmer Cone	Platinum
Sample Rinses	Rinse-1: 60 sec at 45 rpm 5.0% HNO_3, 2.5% HCl with 0.04% Thiourea (or as applicable to mitigate carry over)

TABLE 11: LINEAR RANGE AND CORRESPONDING TUNING MODE

Isotope	Internal Standard	Mode	Linear Range (µg/L)	Isotope	Internal Standard	Mode	Linear Range (µg/L)
7Li	9Be	STD	5.0-100	108Pd	185Re	KED	0.20-4.0
24Mg	45Sc	KED	1.0-20	109Ag	185Re	KED	0.20-4.0
39K	45Sc	KED	10-200	111Cd	125Te	KED	0.04-0.80
44Ca	45Sc	KED	10-200	113Cd	125Te	KED	0.04-0.80
51V	45Sc	KED	0.20-4.0	118Sn	125Te	KED	12-240
52Cr	45Sc	KED	1.0-20	119Sn	125Te	KED	12-240
53Cr	45Sc	KED	1.0-20	120Sn	125Te	KED	12-240
55Mn	72Ge	KED	1.0-20	121Sb	125Te	KED	1.8-36
56Fe	45Sc	H_2 DRC	1.0-20	123Sb	125Te	KED	1.8-36
57Fe	72Ge	KED	1.0-20	135Ba	89Y	KED	14-280
58Ni	72Ge	KED	0.40-8.0	136Ba	89Y	KED	14-280
59Co	72Ge	KED	0.10-2.0	137Ba	89Y	KED	14-280
60Ni	72Ge	KED	0.40-8.0	138Ba	89Y	KED	14-280
62Ni	72Ge	KED	0.40-8.0	188Os	185Re	KED	0.20-4.0
63Cu	72Ge	KED	1.0-20	189Os	185Re	KED	0.20-4.0
65Cu	72Ge	KED	1.0-20	190Os	185Re	KED	0.20-4.0
66Zn	72Ge	KED	1.0-20	191Ir	185Re	KED	0.20-4.0
67Zn	72Ge	KED	1.0-20	192Os	185Re	KED	0.20-4.0
68Zn	72Ge	KED	1.0-20	193Ir	185Re	KED	0.20-4.0
75As	72Ge	H_2 DRC	0.30-6.0	194Pt	185Re	KED	0.20-4.0
75As	72Ge	KED	0.30-6.0	195Pt	185Re	KED	0.20-4.0
77Se	89Y	H_2 DRC	1.6-32	196Pt	185Re	KED	0.20-4.0
78Se	89Y	H_2 DRC	1.6-32	197Au	185Re	KED	2.0-40
95Mo	89Y	KED	3.0-60	199Hg	185Re	KED	0.06-1.2
97Mo	89Y	KED	3.0-60	200Hg	185Re	KED	0.06-1.2
98Mo	89Y	KED	3.0-60	202Hg	185Re	KED	0.06-1.2
99Ru	89Y	KED	0.20-4.0	203Tl	185Re	KED	0.16-3.2
101Ru	89Y	KED	0.20-4.0	205Tl	185Re	KED	0.16-3.2
103Rh	125Te	KED	0.20-4.0	206Pb	185Re	KED	0.10-2.0
105Pd	185Re	KED	0.20-4.0	207Pb	185Re	KED	0.10-2.0
106Pd	185Re	KED	0.20-4.0	208Pb	185Re	KED	0.10-2.0
107Ag	185Re	KED	0.20-4.0	209Bi	185Re	KED	1.0-20

8. REPORTING:

8.1. Any result below the 0.1J target concentration will be reported as less than the corresponding LOQ value listed in Table 1. Iron (Fe) has an LOQ of 0.3J for both isotopes. Results above the LOQ concentration will be reported in µg/g to 2 significant figures. The average result will be reported for multiple isotopes of the same element that are above the LOQ concentration.