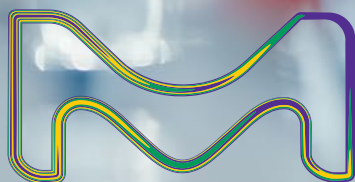




MERCK

High-Purity Chemicals for Inorganic Trace Analysis

Certified Reference Materials,
Acids and Bases



The Life Science business
of Merck operates as
MilliporeSigma in the
U.S. and Canada.

Supelco®
Analytical Products

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Introduction

Our unwavering commitment to quality is a top priority as a leading provider of analytical reagents and high-quality Certified Reference material grade standards. We have established a comprehensive Quality Assurance System that adheres to ISO 9001 standards, ensuring the highest level of quality across all our products. With a strong focus on precision, every product we offer is manufactured to exact specifications with guaranteed consistency in quality and reliability. Our *TraceCERT*[®] and *Certipur*[®] line of ICP and AAS single- and multi-element certified reference material standard solutions are derived from exceptionally pure starting materials produced in accordance with ISO 17034 guidelines and characterized following ISO/IEC 17025 standards.

To demonstrate our dedication to quality, we employ a wide range of advanced analytical methods such as ICP-OES, ICP-MS, flame AAS, and graphite furnace AAS. These cutting-edge techniques allow for customized control and analysis processes, guaranteeing that our products consistently surpass the highest standards for accuracy and quality.

For accurate measurements, the quality of the reference standard used for calibration is paramount. That's why we stress the importance of starting each analysis with a fresh vial of certified reference or calibration standards of exceptional quality.

Our Quality Grades

TraceCERT[®] and *Certipur*[®] Traceable Certified Reference Materials (CRMs)

What makes *TraceCERT*[®] and *Certipur*[®] stand above others?

Elemental and ion standards are available from various suppliers. Why should I buy *TraceCERT*[®] or *Certipur*[®] certified standards?

Indeed, many different standards are available covering a wide range of quality, service, and price. As the world's number one supplier of research chemicals and standards, we introduced *TraceCERT*[®] and *Certipur*[®] reference materials to underpin our **leading position** in terms of **quality** and customer convenience.

What makes *TraceCERT*[®] and *Certipur*[®] standards higher in quality?

These CRMs are produced and certified in accordance with metrological guidelines: **highest accuracy**, low uncertainties, and in-depth documentation make *TraceCERT*[®] and *Certipur*[®] products completely reliable. These solutions are traceable to at least two independent references; NIST traceability is mostly made possible. In addition, we have extensive packaging knowledge, and we guarantee all certified values until the bottle is in the customer's hands.

What is the value of our double accreditation to the customer?

Reliability! Every analytical laboratory will demonstrate the correctness of its measurement results. The use of accurate and well-documented standards is, therefore, the first step to achieving correct measurement results. Our double accreditation, according to ISO/IEC 17025 and ISO 17034, is an explicit affirmation of our competence to produce, certify and supply certified reference materials. Our **customers can count on this competence** and refer to it. We know: Buying certified reference standards is a matter of trust.

Our *TraceCERT*[®] and *Certipur*[®] ICP and AAS single- and multi-element certified reference material standard solutions are analyzed by our ISO / IEC 17025 accredited laboratories in Buchs & Germany

Laboratories that either work in regulated environments, or are ISO/IEC 17025 accredited, are better prepared for audits. ISO/IEC 17025 is a recognized international accreditation for laboratories and is accepted worldwide through the International Laboratory Accreditation Organization (ILAC), and every country has its own accreditation bodies that are members of the ILAC. Our *TraceCERT*[®] and *Certipur*[®] ICP and AAS single- and multi-element certified reference material standard solutions are produced from the highest purity starting material, fulfilling both ISO/IEC 17025 and ISO 17034 international standards.

Accreditation



The Deutsche Akkreditierungsstelle attests with this **Accreditation Certificate** that the calibration laboratory

Merck KGaA
Kalibrierlaboratorium für chemische Messgrößen
Frankfurter Straße 250, 64293 Darmstadt

meets the minimum requirements according to DIN EN ISO/IEC 17025:2018 for the conformity assessment listed in the annex to this certificate. This includes additional existing legal and normative requirements, including those in relevant sectoral schemes.

The management system requirements of DIN EN ISO/IEC 17025 are written in the language relevant to the operations of calibration laboratories and confirm generally with the principles of DIN EN ISO 9001.

This accreditation was issued in accordance with Art. 5 Para. 1 Sentence 2 of Regulation (EC) 765/2008, after an accreditation procedure was carried out in compliance with the minimum requirements of DIN EN ISO/IEC 17011 and on the basis of a review and decision of the appointed accreditation committees.

This accreditation certificate only applies in connection with the notices of 07.02.2023 with accreditation number D-K-15185-01. It consists of this cover sheet, the reverse side of the cover sheet and the following annex with a total of 4 pages.

Registration number of the accreditation certificate: **D-K-15185-01-00**

Berlin, 07.02.2023

Translation issued:
14.02.2023

Tim Harnisch
Dipl.-Wirtsch.-Ing. (BA) Tim Harnisch
Head of Technical Unit

The certificate together with the annex reflects the status as indicated by the date of issue. The current status of any given scope of accreditation can be found in the directory of accredited bodies maintained by Deutsche Akkreditierungsstelle GmbH (www.dakks.de).

This document is a translation. The definitive version is the original German accreditation certificate.
See notes on back

Deutsche Akkreditierungsstelle

Annex to the Accreditation Certificate D-K-15185-01-00
according to DIN EN ISO/IEC 17025:2018

Valid from: 07.02.2023
Date of issue: 07.02.2023

Holder of accreditation certificate:

Merck KGaA
Kalibrierlaboratorium für chemische Messgrößen
Frankfurter Straße 250, 64293 Darmstadt

The calibration laboratory meets the minimal requirements of DIN EN ISO/IEC 17025:2018 and, if applicable, additional legal and normative requirements, including those in relevant sectoral schemes, in order to carry out the conformity assessment activities listed below. The management system requirements of DIN EN ISO/IEC 17025 are written in the language relevant to the operations of calibration laboratories and confirm generally with the principles of DIN EN ISO 9001.

Calibration in the fields:

Chemical and medical quantities

- Chemical analysis and reference materials**
- pH value
 - Electrolytic conductivity
 - Mass fraction of elements in standard solutions
 - Mass concentration of elements in standard solutions
 - Mass fraction of elements in multi standard solutions
 - Mass concentration of elements in multi standard solutions
 - Mass fraction of titrimetric standards
 - Mass fraction of water in water standards and titrimetric standards
 - Amount-of-substance concentration in volumetric solutions
 - Mass fraction in ion chromatography standard solutions
 - Mass concentration in ion chromatography standard solutions

This certificate annex is only valid together with the written accreditation certificate and reflects the status as indicated by the date of issue. The current status of any given scope of accreditation can be found in the directory of accredited bodies maintained by Deutsche Akkreditierungsstelle GmbH at <https://www.dakks.de>.

Abbreviations used: see last page

Page 1 of 4



Swiss Confederation

Based on the Accreditation and Designation Ordinance dated 17 June 1996 and on the advice of the Federal Accreditation Commission, the Swiss Accreditation Service (SAS) grants to

Sigma-Aldrich Production GmbH
Industriestrasse 25
9470 Buchs



Period of accreditation:
05.09.2022 until 04.09.2027
(1st accreditation 14.11.2007)

the accreditation as

Producer of certified reference materials in the fields of organic compounds, organic and inorganic pure substances, solutions and microbiological discs

International standard: ISO 17034:2016
Swiss standard: SN EN ISO 17034:2017

3003 Berne, 29.08.2022
Swiss Accreditation Service SAS

Konrad Flück
Head of SAS
Konrad Flück

SAS is a signatory of the multilateral agreements of the European Cooperation for Accreditation (EAC) for the fields of testing, calibration, inspection and certification of management systems, certification of personnel and certification of products, processes and services; of the International Accreditation Forum (IAF) for the fields of certification of management systems and certification of products, processes and services; and of the International Laboratory Accreditation Cooperation (ILAC) for the fields of testing, calibration and inspection.



Swiss Confederation

STS Directory **Accreditation number: STS 0490**

International standard: ISO/IEC 17025:2017
Swiss standard: SN EN ISO/IEC 17025:2018

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Internet: <http://www.sigma-aldrich.com>
Initial accreditation: 05.09.2007
Current accreditation: 05.09.2022 to 04.09.2027
Scope of accreditation see: www.sas.admin.ch (Accredited bodies)

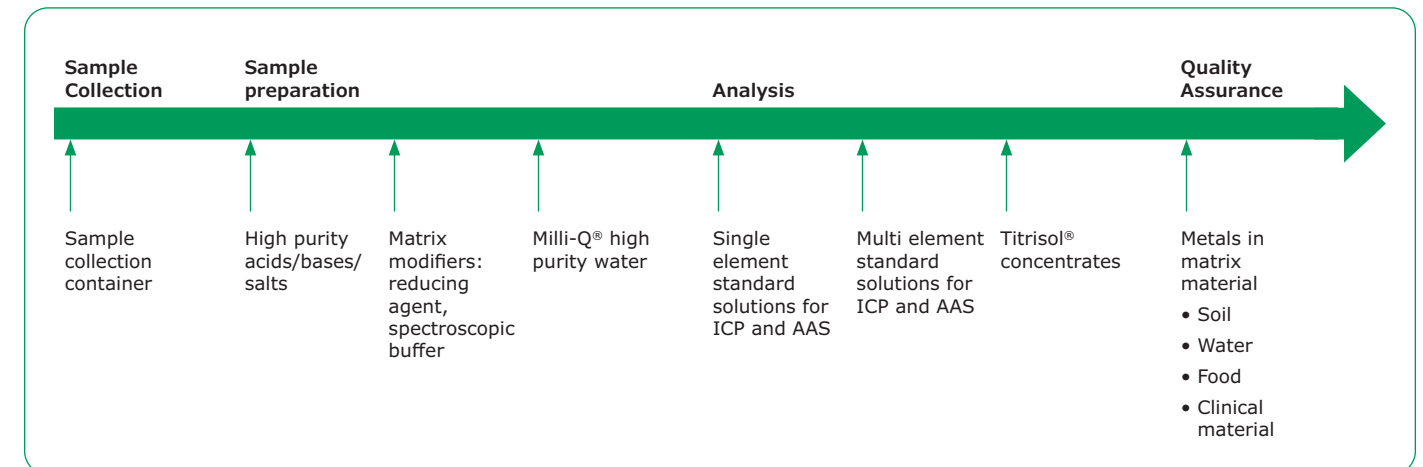
Scope of accreditation as of 25.04.2023

Testing laboratory for chemical, physical and microbiological analyses for certification of reference materials

Group of products or materials, field of activity	Principle of measurement ³⁾ (characteristics, measuring ranges, type of test)	Test methods, remarks (national, international standards, in-house test methods)
CHEMICAL REFERENCE MATERIALS		
Organic compounds	Spectrometry Identify by NMR Determination of content using: Quantitative high-performance NMR (qNMR) Chromatography Quantitative determination of main and minor components using: - LC-MS (IDMS) - LC-MS	in-house procedures in-house procedures in-house procedures

01.05.2023 / P qum/bsg 0490stsvz en.docx 1/4
1) Scope of accreditation type A (fix)
2) Scope of accreditation type B (flexible) Definition of flexibility see SAS Document 741
3) Scope of accreditation type C (flexible)

Workflow Scheme for Inorganic Trace Analysis



Sample Collection

We offer a wide variety of containers made in many sizes and materials to meet sample, temperature and chemical compatibility needs, for sampling as well as for storage.

Sample Preparation

A. Digestion Reagents

Sensitive trace analysis applications require extremely pure sample preparation reagents with low impurities. Further, complete decomposition of the sample is required to achieve reproducible and accurate elemental results by instrumental analytical methods.

Sample wet digestion/dissolution is a method that breaks down the components of a matrix into simple chemical forms. This digestion can occur with the introduction of energy, such as heat; by using a chemical reagent, such as an acid; or by a combination of the two methods. Most analytical measurements using highly sensitive methods (AAS, ICP-AES, stripping voltammetry, ion chromatography, etc.) are performed on samples in solution. One of the most effective and economical sample preparation methods is microwave digestion. In most cases, achieving homogeneity and mineralization of the sample is sufficient.

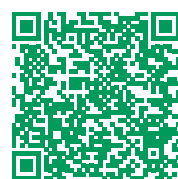
UV photolysis using hydrogen peroxide and either potassium persulfate or nitric acid is very often the method of choice for the decomposition of organic impurities in aqueous solutions.

The most used reagents for wet decomposition are mineral and oxidizing acids. Wet decomposition has the advantage of being effective on both inorganic and organic materials. It often destroys or removes the sample matrix, thus helping to reduce or eliminate some types of interference.

We offer two lines of acids for different trace determination levels: Suprapur® and Ultrapur types in grade.

Suprapur® acids are filled in borosilicate or extra pure PE bottles. The material minimizes any elemental impurity of the acid, so the specification of the unopened bottle is maintained during the minimum shelf life. The bottles are cleaned and pre-conditioned before filling. Quality control is done after filling to ensure that the certified batch values are those of the filled acid. Suprapur® Hydrogen peroxide is packed in a black bottle to protect it against light. The bottles are closed with the SafetyCap, which has a PTFE membrane through which pressure is released without any risk of contamination.

Have a closer look at the possibilities on our webpage:



Our Ultrapur products for ultra-trace analysis at ppb and even ppt levels are produced by sub-boiling distillation. Sub-boiling is recognized as the best way to obtain high purity acids with the lowest blank values for ultra-trace analysis. This technique is based on the evaporation of liquid by infrared heating at the surface. It avoids violent boiling and the formation of liquid aerosols that can be transported with the distillate.

To maintain their high purity, Ultrapur products are supplied in **pre-conditioned PFA (fluoropolymer) bottles**. Water is supplied in **specialty pre-leached HDPE bottles**.



HNO₃

Nitric acid is the most frequently utilized sample dissolution medium. It oxidizes metals not dissolved by HCl and other non-oxidizing acids. Au, Pt metals (except Pd), Nb, Ta, and Z are not dissolved. Al and Cr are passivated. Sn, Sb, and W give insoluble hydrous oxides. Dissolves most sulfides (except HgS). Unfortunately, the carbon contained in organic materials is only partly converted to CO₂ by HNO₃ at temperatures up to 200 °C. Nitric acid should never be used for the digestion of highly aromatic compounds because of the potential for the formation of highly explosive compounds. In the case of alcohols, the samples should be pretreated with sulfuric acid.

HCl

Hydrochloric acid is used for many salts of weak acids, e.g. carbonates, phosphates, some oxides, and some sulfides.

H₂SO₄

Sulfuric acid is used when its high boiling point (300 °C) is an advantage, as in expelling a volatile product or increasing the reaction rate. It provides dehydrating and oxidizing properties at high temperatures.

HClO₄

Perchloric acid is a very powerful oxidizing agent at fuming temperatures (boiling point 203 °C). It is usually mixed with H₂SO₄ (dehydrating agent) to increase oxidizing power. Good solvent for stainless steel and for sulfides.

HF

Hydrofluoric acid is used for digestion of siliceous samples and as an auxiliary reagent to HNO₃, or HClO₄, to eliminate fluoride. With HNO₃, HF dissolves Ti, W, Nb, and Zr (and their carbides, nitrides, and borides) as a result of formation of complex fluorides. Certain refractory silicates and other minerals are not decomposed these must be dissolved by fusion.

H₂O₂

Hydrogen peroxide is a very popular oxidizing reagent as it is converted to water and oxygen during the oxidation of biological material. Additional advantages are that there is no acid corrosion of the digestion vessel PTFE walls, no formation of insoluble salts with an acid anion, and no change of the sample matrix by an acid. Because of its strong oxidation power, only small amounts of H₂O₂ need be used so concentrated sample solutions can be obtained.

AcOH

Acetic acid is most often used for the extraction of metallic impurities together with sodium acetate.

HBr

Hydrobromic acid is a non-oxidizing acid. It is used in some special applications because it yields better reductive selectivity in the determination of SeVT by Hydride Generation-Laser Induced Fluorescence (HG-LIF) than HCl.

H₃PO₄

Phosphoric acid is commonly used in the semiconductor industry to both clean and etch metal surfaces. The concentration of the phosphoric acid is critical to optimizing these processes.

H₂O

Water ensures the highest accuracy in trace analysis of ppt range by minimizing blank values.

Table 1: High Purity Acids and Bases

Product No.	Acid Name and Concentration	Purity Grade
1.00066	Acetic acid (glacial) 100%	Suprapur®
1.00306	Hydrobromic acid 47%	Suprapur®
1.00318	Hydrochloric acid 30%	Suprapur®
1.00335	Hydrofluoric acid 40%	Suprapur®
1.00441	Nitric acid 65%	Suprapur®
1.00473	Water	Suprapur®
1.00517	Perchloric acid 70%	Suprapur®
1.00552	ortho-Phosphoric acid 85%	Suprapur®
1.00714	Sulfuric acid 96%	Suprapur®
1.05428	Ammonia solution 25 %	Suprapur®
1.05589	Sodium hydroxide solution 30%	Suprapur®
1.07298	Hydrogen peroxide 30%	Suprapur®
1.11670	Formic acid 98-100%	Suprapur®
1.15186	Hydrochloric acid 36%	Suprapur®
1.15187	Nitric acid 69%	Suprapur®
16911	Hydrogen Peroxide 30%	for ultratrace analysis
1.01514	Hydrochloric acid 30%	Ultrapur
1.01518	Nitric acid 60%	Ultrapur
1.01262	Water	Ultrapur
1.01513	Hydrofluoric acid 48%	Ultrapur
1.01516	Sulfuric acid 96%	Ultrapur

B. Matrix Modifier

In graphite furnace AAS, element determinations are increasingly carried out with matrix modifiers. Chemical modification should be considered if an analyte is highly volatile, or if the analyte and the matrix volatilize at similar temperatures. Such modification would allow ashing at higher (or atomization at lower) furnace temperatures, resulting in elimination of the matrix with no loss of the analyte (or atomization of the analyte, but not the matrix). Depending on the element to be determined, various substances are used; however, palladium nitrate has become one of the most popular among them. A primary criterion for such substances is the absence of the element to be analyzed. For this reason, the recommended reagents indicated below have been specially tested for their suitability as matrix modifiers.

Table 2: Matrix Modifiers

Product No.	Matrix Modifier	Application
1.07289	Palladium matrix modifier	for graphite furnace AAS $c(\text{Pd}) = 10.0 \pm 0.2 \text{ g/l}$ ($\text{Pd}(\text{NO}_3)_2 / \text{HNO}_3$ ca. 15%)
1.05813	Magnesium matrix modifier	for graphite furnace AAS $c(\text{Mg}) = 10.0 \pm 0.2 \text{ g/l}$ ($\text{Mg}(\text{NO}_3)_2 \cdot 6 \text{ H}_2\text{O}$ in HNO_3 ca. 17%)
1.07290	Phosphate modifier	for graphite furnace AAS $\text{NH}_4\text{H}_2\text{PO}_4$ $100 \pm 2 \text{ g/l}$ in H_2O
76040	Palladium Matrix Modifier	for graphite furnace-AAS
63043	Magnesium matrix modifier	for graphite furnace-AAS

C. Reducing Agents for Hydride AAS

Hydride AAS is used for the analysis (especially traces) of arsenic, antimony, tin, selenium, bismuth, and mercury. It is used to separate and preconcentrate analytes from sample matrices by a reaction that turns them into their hydride vapors. Sodium borohydride is the common reagent of choice for the reduction. Our reagents are specifically analyzed to ensure that they are free from hydride generating metals.

Table 3: Reducing Agents for Hydride AAS

Product No.	Reducing Agent	Application
1.06371	Sodium borohydride	for analysis

D. Spectroscopic Buffers for Flame AAS

To avoid interferences in the flame-AAS in the determination of Na, Li and K, the sample and standard solution are modified with a spectroscopic buffer. Cesium chloride is the main substance added to the matrices.

Table 4: Spectroscopic Buffers

Product No.	Spectroscopic Buffer	Application
1.02037	Cesium chloride-aluminium nitrate buffer solution	acc. to Schuhknecht and Schinkel for the determination of sodium, potassium and lithium by flame spectrometry (enth./cont. $50 \text{ g/l CsCl} + 250 \text{ g/l Al}(\text{NO}_3)_3 \cdot 9 \text{ H}_2\text{O}$)
1.02039	Cesium chloride	99.995 Suprapur®
1.16755	Cesium chloride-lanthanum chloride buffersolution	acc. to Schinkel for atomic absorption spectroscopy $10 \text{ g/l CsCl} + 100 \text{ g/l La}$

Analysis

The quality of a CRM strongly depends on the quality of the starting materials, therefore, only materials of highest purity are used to produce *TraceCERT*® and *Certipur*® standards.

TraceCERT® and *Certipur*® certified reference materials (CRMs) are produced under ISO 17034 and analyzed in our ISO/IEC 17025 accredited labs. Our certificate of analysis includes the certification report and is issued according to the ISO Guide 31 guidelines.

Table 5: Overview of AAS & ICP Single Solutions Portfolio

	AAS Single Solutions		ICP Single Solutions	
	<i>TraceCERT</i> ®	<i>Certipur</i> ®	<i>TraceCERT</i> ®	<i>Certipur</i> ®
Certification	ISO 17034			
Metal Concentrations (mg/L)	1,000	1,000	10,000, 1,000, 10 & 1	10,000, 1,000 & 10
Matrix	Aqueous + Different Acid Concentrations			
Packaging	HD-PE Bottle	HD-PE Bottle	HD-PE Bottle sealed in an Aluminum foil bag	HD-PE Bottle
Package Size	250 mL ^{1,2}	100 mL, 500 mL	100 mL ^{1,3}	
Indicative Values	Upto 70 impurities are tested whose concentrations are stated in the certificate			

¹Hg (*TraceCERT*®) bottled in 100 mL borosilicate white glass bottle

²The following AAS (*TraceCERT*®) standards come in a 100 mL package size: Pd, Au, Pt, Sc, Tl
The following AAS (*Certipur*®) standards come only in a 100 mL package size: Cs, In, Te, Zr

³All 1 mg/L ICP solutions as well as some special mixtures come in FEP bottles

Table 6: Overview of Multi-element Mixes Portfolio

	Multi-element Standard Solutions	
	<i>TraceCERT</i> ®	<i>Certipur</i> ®
Certification	ISO 17034	
Matrix	Aqueous + various acid concentrations	
Packaging	HD-PE Bottle sealed in an Aluminum foil bag	HD-PE bottle
Package Size	100 mL	100 mL, 500 mL

1. AAS and ICP Single Element Standards (TraceCERT® and Certipur®)

We offer a large range of single element certified reference standard solutions in various concentrations (1 mg/L, 10 mg/L, 1,000 mg/L, 10,000 mg/L) suitable for AAS, ICP-OES or ICP-MS application.

For our TraceCERT® line the certified values are given as m/m and m/V values. On the certificates more information is given about the certification process, stability and homogeneity assessments, uncertainty evaluation and for the ICP product range the measured trace impurities.


Key Features of Single element Standard Solutions:

- Produced in accordance with ISO 17034 and characterized in an ISO/IEC 17025 accredited laboratory.
- Traceable to SI unit via primary reference materials (NIST, BAM)
- Comprehensive documentation according to ISO Guide 31, including proper uncertainty calculation
- Offered as TraceCERT® and Certipur® ICP and AAS single-element certified reference material standard solutions accredited by Swiss Accreditation Service (SAS) & Deutsche Akkreditierungsstelle (DAkkS), respectively.

The certificate of a Certified Reference Material Grade TraceCERT® AAS single-element Standard:


Our certificates for Certified Reference Materials meet all requirements as recommended by ISO Guide 31:

ISO Guide 31 Certificate Content	
1	Document title
2	Unique identifier of the RM
3	Name of the RM
4	Name & contact details of the RM producer
5	Intended use
6	Period of validity
7	Storage information
8	Instructions for handling and use
9	Page number/total pages
10	Document version
11	Material description
12	Property value & associated uncertainty; property of Interest
13	Metrological traceability
14	Name, function of the RM producer's approving officer


www.sigmaaldrich.com

1 Certified Reference Material
Reference material certificate


3 Aluminum Standard for AAS





2 Product no.: 39435
Lot no.: BCCJ8872
11 Description of CRM: Aluminum nitrate nonahydrate (pure material) in 2% HNO₃ (prepared with HNO₃ suitable for trace analysis and high-purity water, 18.2 MΩ·cm, 0.22 μm filtered).
6 Expiry date: DEC 2025
7 Storage: Store at 5°C-25°C
Density (certified) at 20°C: 1015.2 kg m⁻³ ± 0.5 kg m⁻³

Constituent	Certified values at 20°C and expanded uncertainties, $U = k \cdot u$ ($k = 2$) ^{[1][2]}
Aluminum	985 mg kg⁻¹ ± 6 mg kg⁻¹ 1000 mg L⁻¹ ± 7 mg L⁻¹


13 Metrological traceability: Directly traceable to NIST SRM 3101a.^[3]
Measurement method: The certified value is established by inductively coupled plasma optical emission spectrometry ICP-OES in accordance with ISO/IEC 17025.^[4]
5 Intended use: Calibration of AAS, ICP, spectrophotometry or any other analytical technique.
8 Instructions for handling and correct use: The bottle's temperature must be 20°C. Shake well before every use. If storage of a partially used bottle is necessary (at the user's risk), the cap should be tightly sealed and the bottle should be stored at reduced temperature (e.g. refrigerator) to minimize transpiration rate.
Health and safety information: Please refer to the Safety Data Sheet for detailed information about the nature of any hazard and appropriate precautions to be taken.
Packaging: 250 mL HDPE bottle
Accreditation: Sigma-Aldrich Production GmbH is accredited by the Swiss Accreditation Service SAS as reference material producer under no. SRMS 0001 in accordance with international standard ISO 17034^[5]
Certificate issue date: 30 JAN 2023


ISO 17034
SRMS 0001


S. Matt - CRM Operations


Dr. P. Zell - Approving Officer

4 Sigma-Aldrich Production GmbH, Industriestrasse 25, 9471 Buchs, Switzerland; Tel +41-81-755-2511; Fax +41-81-756-5449; www.sigmaaldrich.com
Sigma-Aldrich Production GmbH is a subsidiary of Merck KGaA, Darmstadt, Germany.




9 Certificate Page 1 of 3

10 Certificate version 01

Certificate of a Certified Reference Material Grade Certipur® AAS Single-element Standard

ISO Guide 31 Certificate Content	
1	Document title
2	Unique identifier of the RM
3	Name of the RM
4	Name & contact details of producer
5	Intended use
6	Period of validity
7	Storage information
8	Instructions for handling and use
9	Page number/total pages
10	Document version
11	Material description
12	Property value & associated uncertainty; property of Interest
13	Metrological traceability
14	Name, function of the RM producer's approving officer


www.sigmaaldrich.com


1 Certificate of Analysis – Certified Reference Material


3 Certipur® Aluminium standard solution 1000 mg/l Al

2 Product no.: 1.19770.0100
Lot no.: HC28811270
11 Description of CRM: Aluminium standard solution 1000 mg/l Al
6 Expiry date: 2026/05/31
7 Storage: +15°C to +25°C tightly closed in the original container
12 Composition: Al(NO₃)₃ in HNO₃ 0.5 mol/l


Analyte	Certified value as mass fraction	Associated uncertainty, $U = k \cdot u$ ($k = 2$) as mass fraction
Al	981 mg/kg	± 5 mg/kg

13 Metrological traceability: Directly traceable to NIST SRM 3101a, lot 140903
Measurement method: Inductively coupled plasma optical emission spectrometry ICP-OES
5 Intended use: This reference material is intended for use as a calibration standard in element analysis.
8 Instructions for handling and correct use: Shake well before use and never pipet directly from the original container. See Details for correct use on page 2.
Health and safety information: Please refer to the Safety Data Sheet for detailed information about the nature of any hazard and appropriate precautions to be taken.
Accreditation: Merck KGaA, Darmstadt, Germany is accredited by the German accreditation authority DAkkS as registered reference material producer D-RM-15185-01-00 in accordance with ISO 17034.
Certificate issue date: 2022/06/07



ILAC-MRA
ISO 17034


Deutsche
Akkreditierungsstelle
D-RM-15185-01-00

CRM released by Approving Officer
or delegate of Quality Control


Dipl.-Ing. Ayfer Yildirim
Responsible Laboratory Manager

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EMD Millipore Corporation, 400 Summit Drive, Burlington MA 01803, USA, Tel. +1-978-715-4321
Sigma-Aldrich Canada Co. or Millipore (Canada) Ltd. 2149 Winston Park, Dr. Oakville, Ontario, L6H 6J8, Phone: +1 800-565-1400

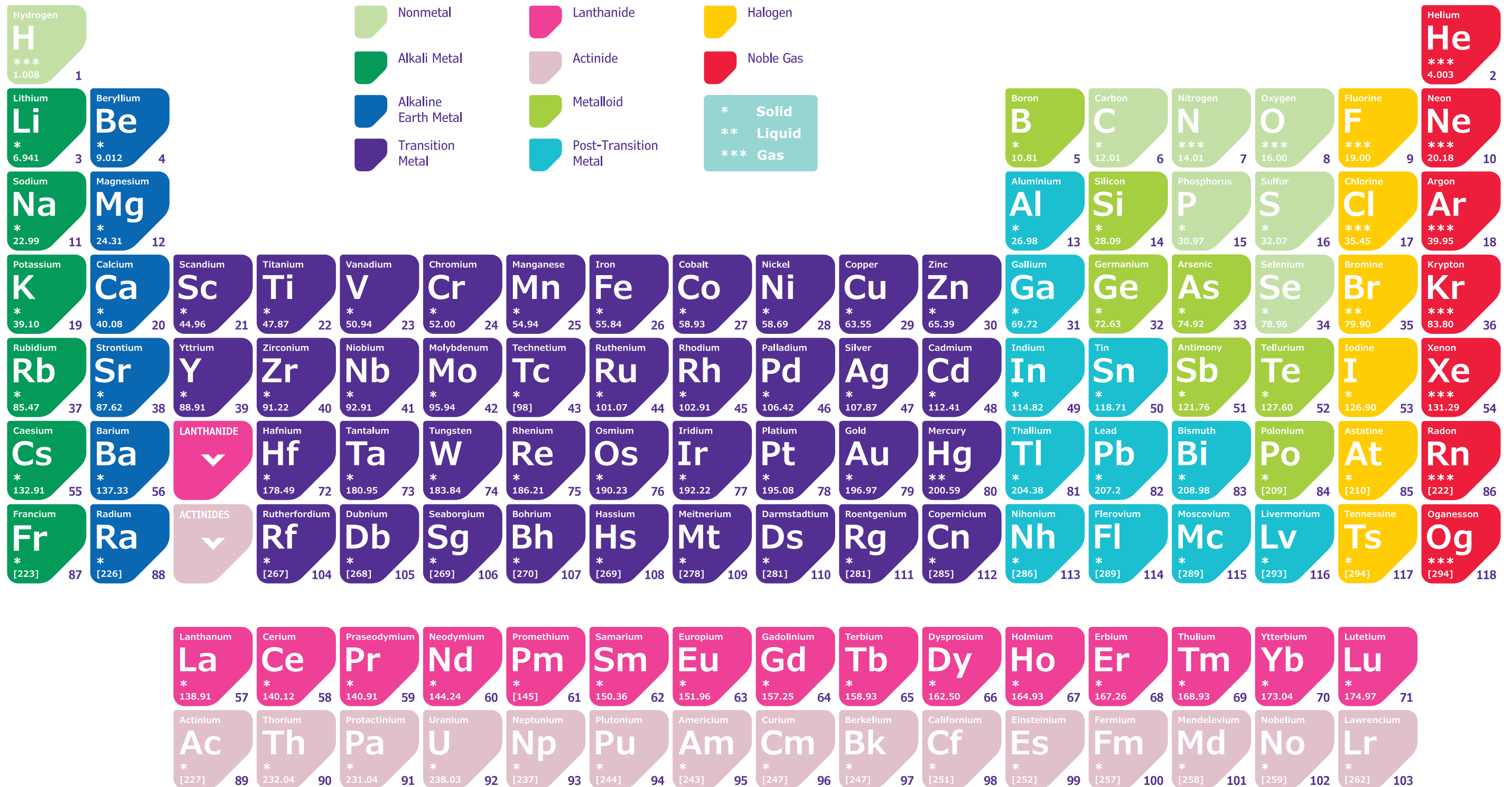


9 Certificate Page 1 of 2

10 Certificate version 01

Interactive Periodic Table for Single Element Standards: Click & Explore!

Navigate our interactive periodic table to explore your chosen element and access a complete list of its associated standards and information on our website.



A. AAS Single Element Standard Solutions (1000 mg/L)

1	H																	He
2	Li	Be										B	C	N	O	F	Ne	
3	Na	Mg										Al	Si	P	S	Cl	Ar	
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba	57-71	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra	89-103	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og

57-71	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
89-103	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

All green elements: Certipur® & TraceCERT®

All yellow elements: Certipur® & TraceCERT® products with different solvent matrices

All red/blue elements: either TraceCERT® or Certipur® product



Figure 1. AAS Single Element Standards

Table 7: AAS Single Element Standards, 1000 mg/L

Element	Matrix TraceCERT®	Cat No TraceCERT®	Pck TraceCERT®	Matrix Certipur®	Cat No Certipur®	Pck Certipur®
Aluminum	HNO ₃	39435	250 mL	HNO ₃	1.19770	100 mL, 500 mL
Antimony	HNO ₃	94117	250 mL	HCl	1.70204	100 mL, 500 mL
Arsenic	HNO ₃	39436	250 mL	HNO ₃	1.19773	100 mL, 500 mL
Barium	HNO ₃	90092	250 mL	HNO ₃	1.19774	100 mL, 500 mL
Beryllium				HNO ₃	1.70207	100 mL, 500 mL
Bismuth				HNO ₃	1.19804	100 mL, 500 mL
Boron	H ₂ O	40591	250 mL	H ₂ O	1.19500	100 mL, 500 mL
Cadmium	HNO ₃	51994	250 mL	HNO ₃	1.19777	100 mL, 500 mL
Calcium	HNO ₃	69349	250 mL	HNO ₃	1.19778	100 mL, 500 mL
Cesium				HNO ₃	1.70212	100 mL, 500 mL
Chromium	HNO ₃	02733	250 mL	HNO ₃	1.19779	100 mL, 500 mL
Cobalt	HNO ₃	05202	250 mL	HNO ₃	1.19785	100 mL, 500 mL
Copper	HNO ₃	38996	250 mL	HNO ₃	1.19786	100 mL, 500 mL
Gold	HCl	08269	100 mL	HCl	1.70216	100 mL, 500 mL
Indium				HNO ₃	1.19504	100 mL, 500 mL
Iron	HNO ₃	16596	250 mL	HNO ₃	1.19781	100 mL, 500 mL
Lead	HNO ₃	16595	250 mL	HNO ₃	1.19776	100 mL, 500 mL
Lithium	HNO ₃	59916	250 mL	HNO ₃	1.70223	100 mL, 500 mL
Magnesium	HNO ₃	42992	250 mL	HNO ₃	1.19788	100 mL, 500 mL
Manganese	HNO ₃	77036	250 mL	HNO ₃	1.19789	100 mL, 500 mL
Mercury	HNO ₃	16482	250 mL	HNO ₃	1.70226	100 mL, 500 mL
Molybdenum	HCl	67210	250 mL	H ₂ O	1.70227	100 mL, 500 mL
Nickel	HNO ₃	42242	250 mL	HNO ₃	1.19792	100 mL, 500 mL
Palladium	HCl	78437	100 mL	HNO ₃	1.14282	100 mL, 500 mL
Phosphorous	H ₂ O	51474	250 mL			100 mL, 500 mL
Platinum	HCl	47037	100 mL	HCl	1.70219	100 mL, 500 mL
Potassium	HNO ₃	96665	250 mL	HNO ₃	1.70230	100 mL, 500 mL
Rhodium	HCl	11561	100 mL			
Ruthenium	HCl	84033	100 mL			
Scandium				HNO ₃	1.19513	100 mL, 500 mL
Selenium	HNO ₃	89498	250 mL	HNO ₃	1.19796	100 mL, 500 mL
Silicon	NaOH	16259	250 mL	NaOH	1.70236	100 mL, 500 mL
Silver	HNO ₃	39361	250 mL	HNO ₃	1.19797	100 mL, 500 mL
Sodium	HNO ₃	05201	250 mL	HNO ₃	1.70238	100 mL, 500 mL
Strontium				HNO ₃	1.19799	100 mL, 500 mL
Sulfur	H ₂ O	18020	250 mL			
Tellurium				HNO ₃	1.19514	100 mL
Thalium				HNO ₃	1.19801	100 mL, 500 mL
Tin	HCl	74244	250 mL	HCl	1.70242	100 mL, 500 mL
Titanium	HNO ₃	04689	100 mL	H ₂ O	1.70243	100 mL, 500 mL
Tungsten				H ₂ O	1.70244	100 mL, 500 mL
Vanadium	HNO ₃	02334	250 mL		1.70245	100 mL, 500 mL
Yttrium	HNO ₃	40423	250 mL	HNO ₃	1.19809	100 mL, 500 mL
Zinc	HNO ₃	18827	250 mL	HNO ₃	1.19806	100 mL, 500 mL
Zirconium				HCl	1.70234	100 mL

B. ICP Single Element Standard Solutions (1 mg/L & 10 mg/L)

ICP-MS Portfolio, single element solutions, 1 mg/L & 10 mg/L

1	H																	He	
2	Li	Be												B	C	N	O	F	Ne
3	Na	Mg												Al	Si	P	S	Cl	Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
6	Cs	Ba	57-71	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
7	Fr	Ra	89-103	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og	
			57-71	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	
			89-103	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	

All yellow elements: 1 mg/L solutions *TraceCERT*[®] elements, Hg: 10 mg/L

All blue elements: 10 mg/L solutions *Certipur*[®]



Figure 2. ICP Single Element Standard

Table 8: ICP Single Element Standards, 1mg/L & 10 mg/L

Element	Matrix <i>TraceCERT</i> [®]	Cat No <i>TraceCERT</i> [®]	Pck <i>TraceCERT</i> [®]	Matrix <i>Certipur</i> [®]	Cat No <i>Certipur</i> [®]	Pck <i>Certipur</i> [®]	Conc. (mg/L)
Rhodium				HNO ₃	108525	100 mL	10
Thorium				HNO ₃	170391	100 mL	10
Uranium				HNO ₃	170360	100 mL	10
Mercury	HNO ₃	89459	100 mL				10
Arsenic	HNO ₃	75016	100 mL				1
Aluminum	HNO ₃	05674	100 mL				1
Cadmium	HNO ₃	12313	100 mL				1
Chromium (III)	HNO ₃	72995	100 mL				1
Cobalt	HNO ₃	41798	100 mL				1
Copper	HNO ₃	41621	100 mL				1
Gold	HCl	67363	100 mL				1
Iron	HNO ₃	68436	100 mL				1
Lead	HNO ₃	75015	100 mL				1
Nickel	HNO ₃	72631	100 mL				1
Palladium	HNO ₃	42396	100 mL				1
Iron	HNO ₃	69389	100 mL				1
Tin	HNO ₃ & HF	63564	100 mL				1

C. ICP Single Element Standards (1000 mg/L)

ICP-OES Portfolio, Single element solutions, 1000 mg/L

1	H																	He	
2	Li	Be												B	C	N	O	F	Ne
3	Na	Mg												Al	Si	P	S	Cl	Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
6	Cs	Ba	57-71	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
7	Fr	Ra	89-103	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og	
			57-71	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	
			89-103	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	

All green elements: *Certipur*[®] & *TraceCERT*[®]

All yellow elements: *Certipur*[®] & *TraceCERT*[®] products with different solvent matrices or oxidation states

All blue elements: *Certipur*[®] (Ru, Os, Ir) solution, no primary reference material available worldwide; uncertainties given from the ICP-OES method & by comparison with competitor solutions)



Figure 3. ICP Single Element Standard, 1000 mg/L

Table 9: ICP Single Element Standards, 1000 mg/L

Element	Matrix TraceCERT®	Cat No TraceCERT®	Pck TraceCERT®	Matrix Certipur®	Cat No Certipur®	Pck Certipur®
Aluminum	HNO ₃	61935	100 mL	HNO ₃	1.70301	100 mL
Antimony	HNO ₃ + HF traces	73495	100 mL	HCl	1.70302	100 mL
Arsenic (III)	HCl	72718	100 mL	HNO ₃	1.70303	100 mL
Arsenic (V)	H ₂ O	76686	100 mL			
Arsenic	HNO ₃	01969	100 mL			
Barium	HNO ₃	59943	100 mL	HNO ₃	1.70304	100 mL
Beryllium	HNO ₃	51985	100 mL	HNO ₃	1.70305	100 mL
Bismuth	HNO ₃	05719	100 mL	HNO ₃	1.70306	100 mL
Boron	H ₂ O	01932	100 mL	H ₂ O	1.70307	100 mL
Cadmium	HNO ₃	36379	100 mL	HNO ₃	1.70309	100 mL
Calcium	HNO ₃	19051	100 mL	HNO ₃	1.70308	100 mL
Cerium	HNO ₃	16734	100 mL	HNO ₃	1.70311	100 mL
Cesium	HNO ₃	96664	100 mL	HNO ₃	1.70310	100 mL
Chromium (III)	HNO ₃	74582	100 mL	HNO ₃	1.70312	100 mL
Chromium (III)	HNO ₃	92966	100 mL			
Chromium (VI)	H ₂ O	19036	100 mL			
Chromium (VI)	HNO ₃	68131	100 mL			
Cobalt	HNO ₃	30329	100 mL	HNO ₃	1.70313	100 mL
Copper	HNO ₃	68921	100 mL	HNO ₃	1.70314	100 mL
Dysprosium			100 mL	HNO ₃	1.70315	100 mL
Europium	HNO ₃	05779	100 mL	HNO ₃	1.70317	100 mL
Gadolinium	HNO ₃	05660	100 mL	HNO ₃	1.70318	100 mL
Gallium	HNO ₃	16639	100 mL	HNO ₃	1.70319	100 mL
Erbium	HNO ₃	05693	100 mL	HNO ₃		100 mL
Germanium	HNO ₃	05419	100 mL	H ₂ O	1.70320	100 mL
Gold	HCl	38168	100 mL	HCl	1.70321	100 mL
Hafnium	HNO ₃ + HF	04617	100 mL	HCl	1.70322	100 mL
Holmium	HNO ₃	01541	100 mL	HNO ₃	1.70323	100 mL
Indium	HNO ₃	00734	100 mL	HNO ₃	1.70324	100 mL
Iridium				HCl	1.70325	100 mL
Iron	HNO ₃	43149	100 mL	HNO ₃	1.70326	100 mL
Lanthanum	HNO ₃	11523	100 mL	HNO ₃	1.70327	100 mL
Lead	HNO ₃	41318	100 mL	HNO ₃	1.70328	100 mL
Lithium	HNO ₃	12292	100 mL	HNO ₃	1.70329	100 mL
Lutetium	HNO ₃	03909	100 mL	HNO ₃	1.70330	100 mL
Magnesium	HNO ₃	30083	100 mL	HNO ₃	1.70331	100 mL
Manganese	HNO ₃	74128	100 mL	HNO ₃	1.70332	100 mL
Mercury	HNO ₃	28941	100 mL	HNO ₃	1.70333	100 mL
Molybdenum	HCl	68780	100 mL	H ₂ O	1.70334	100 mL
Rubidium	HNO ₃	01444	100 mL			
Neodym	HNO ₃	04730	100 mL	HNO ₃	1.70335	100 mL
Nickel	HNO ₃	28944	100 mL	HNO ₃	1.70336	100 mL
Niobium	HNO ₃	67913	100 mL	H ₂ O	1.70337	100 mL
Osmium				HCl	1.70338	100 mL
Palladium	HCl	77091	100 mL	HNO ₃	1.70339	100 mL
Phosphorus	H ₂ O	38338	100 mL	H ₂ O	1.70340	100 mL
Platinum	HCl	19078	100 mL	HCl	1.70341	100 mL
Potassium	HNO ₃	06335	100 mL	HNO ₃	1.70342	100 mL

Element	Matrix TraceCERT®	Cat No TraceCERT®	Pck TraceCERT®	Matrix Certipur®	Cat No Certipur®	Pck Certipur®
Praseodymium				HNO ₃	1.70343	100 mL
Rhenium	HNO ₃	39957	100 mL	H ₂ O	1.70344	100 mL
Rhodium	HCl	04736	100 mL	HNO ₃	1.70345	100 mL
Rubidium				HNO ₃	1.70346	100 mL
Ruthenium				HCl	1.70347	100 mL
Samarium				HNO ₃	1.70348	100 mL
Scandium	HNO ₃	92279	100 mL	HNO ₃	1.70349	100 mL
Selenium	HNO ₃	50002	100 mL	HNO ₃	1.70350	100 mL
Silicium	HNO ₃	08729	100 mL	NaOH	1.70365	100 mL
Silicium	NaOH	15747	100 mL			
Silver	HNO ₃	12818	100 mL	HNO ₃	1.70352	100 mL
Sodium	HNO ₃	00462	100 mL	HNO ₃	1.70353	100 mL
Strontium	H ₂ O	75267	100 mL	HNO ₃	1.70354	100 mL
Sulfur	H ₂ O	18021	100 mL	H ₂ O	1.70355	100 mL
Tantalum	HNO ₃ + HF	16641	100 mL	H ₂ O	1.70356	100 mL
Tellurium	HNO ₃ + HF	78358	100 mL	HNO ₃	1.70357	100 mL
Terbium	HNO ₃	44881	100 mL	HNO ₃	1.70358	100 mL
Thallium	HNO ₃	51873	100 mL	HNO ₃	1.70359	100 mL
Tin	HCl	92615	100 mL	HCl	1.70362	100 mL
Thulium			100 mL	HNO ₃	1.70361	100 mL
Titanium	HNO ₃	12237	100 mL	H ₂ O	1.70363	100 mL
Tungsten	HNO ₃ + HF	50334	100 mL	H ₂ O	1.70364	100 mL
Vanadium	HNO ₃	18399	100 mL	HNO ₃	1.70366	100 mL
Ytterbium				HNO ₃	1.70367	100 mL
Yttrium	HNO ₃	01357	100 mL	HNO ₃	1.70368	100 mL
Zinc	HNO ₃	18562	100 mL	HNO ₃	1.70369	100 mL
Zirconium	HNO ₃ + HF	51244	100 mL	HCl	1.70370	100 mL

D. ICP Single Element Standards (10,000 mg/L)

ICP-OES Portfolio, Single element solutions, 10,000 mg/L

1	H																			He
2	Li	Be											B	C	N	O	F			Ne
3	Na	Mg											Al	Si	P	S	Cl			Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br			Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I			Xe
6	Cs	Ba	57-71	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At			Rn
7	Fr	Ra	89-103	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts			Og

57-71	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
89-103	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

All green elements: overlapping products (Certipur® - TraceCERT®): 14 elements

All yellow elements: double products but with different solvent matrices: 2 elements

All red/blue elements: only one solution (13 TraceCERT® element, 3 Certipur® element)



Figure 4. ICP Single Element Standard, 10,000 mg/L

Table 10: ICP Single Element Standards, 10,000 mg/L

Element	Matrix TraceCERT®	Cat No TraceCERT®	Pck TraceCERT®	Matrix Certipur®	Cat No Certipur®	Pck Certipur®
Aluminum	HNO ₃	41377	100 mL	HNO ₃	1.70371	100 mL
Barium	HNO ₃	75187	100 mL			
Boron	diluted ammonium hydroxide solution	18822	100 mL			
Calcium	HNO ₃	94458	100 mL	HNO ₃	1.70373	100 mL
Cesium	HNO ₃	79261	100 mL			
Chromium (III)	HNO ₃	93104	100 mL	HNO ₃	1.70374	100 mL
Cobalt	HNO ₃	01488	100 mL	HNO ₃	1.70375	100 mL
Copper	HNO ₃	94459	100 mL	HNO ₃	1.70378	100 mL
Iron	HNO ₃	56209	100 mL	HNO ₃	1.70376	100 mL
Lead	HNO ₃	39082	100 mL	HNO ₃	1.70372	100 mL
Lithium	HNO ₃	90766	100 mL			
Magnesium	HNO ₃	80759	100 mL	HNO ₃	1.70379	100 mL
Manganese	HNO ₃	42071	100 mL	HNO ₃	1.70380	100 mL
Molybdenum	HNO ₃ + HF	39891	100 mL			
Mercury				HNO ₃	1.70384	100 mL
Nickel	HNO ₃	19013	100 mL	HNO ₃	1.70382	100 mL
Phosphorus	H ₂ O	19916	100 mL	H ₂ O	1.70383	100 mL
Potassium	HNO ₃	68371	100 mL	HNO ₃	1.70377	100 mL
Scandium	HNO ₃	92504	100 mL			
Silicium				HNO ₃	1.70386	100 mL
Selenium	HNO ₃	98838	100 mL			
Sodium	HNO ₃	39924	100 mL	HNO ₃	1.70381	100 mL
Sulfur	H ₂ O	94430	100 mL	H ₂ O	1.70385	100 mL
Thallium	HNO ₃	05295	100 mL			
Vanadium				HNO ₃	1.70388	100 mL
Tin	HNO ₃ + HF	42991	100 mL			
Titanium	HNO ₃ + HF	44973	100 mL			
Yttrium	HNO ₃	02312	100 mL			
Zinc	HNO ₃	68961	100 mL	HNO ₃	1.70389	100 mL
Zirconium	HNO ₃ + HF	51971	100 mL	HCl	1.70390	100 mL

D. ICP Calibration Multielement Solutions: Certipur® Portfolio

Our Certipur® multielement calibration solutions are traceable to standard reference material from NIST. A certificate of analysis is enclosed in each package. It includes data on content, composition, traceability, date of release and expiry date.

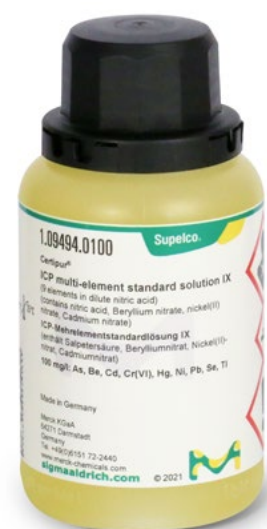


Figure 8. ICP calibration multielement solutions Certipur® Standard

Table 15: ICP calibration multielement solutions Certipur® Portfolio

Cat No	Description	No. of Elements	Elements	Concentration	Matrix	Pck	Applications
1.15474	ICP multi-element standard solution I	19	Be, Sr	1 mg/mL	dil. HNO ₃	100 mL	
			Ba, Mn	5 mg/mL			
			B, Fe	15 mg/mL			
			Cd, Co, Cu, Zn	20 mg/mL			
			Cr	25 mg/mL			
			Ag	50 mg/mL			
			Al	100 mg/mL			
			Ga	150 mg/mL			
			Bi, In, Pb	200 mg/mL			
1.11355	ICP multi-element standard solution IV	23	Ag, Al, B, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, In, K, Li, Mg, Mn, Na, Ni, Pb, Sr, Tl, Zn	100 mg/L	dil. HNO ₃	100 mL	
1.09492	ICP multi-element standard solution VIII	24	Al, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, K, Li, Mg, Mn, Na, Ni, Pb, Se, Sr, Te, Tl, Zn	100 mg/L	dil. HNO ₃	100 mL	
1.09494	ICP multi-element standard solution IX	9	As, Be, Cd, Cr(VI), Hg, Ni, Pb, Se, Tl	100 mg/L	dil. HNO ₃	100 mL	
1.09493	ICP multi-element standard solution X	23	Tl, Se, Bi	10 µg/L	dil. HNO ₃	100 mL	For surface water
			Be, Cu, Cr, Cd	20 µg/L			
			Pb, Co	25 µg/L			
			Mn	30 µg/L			
			As, Ba, Ni, V, Zn	50 µg/L			
			B, Fe, Mo, Sr	100 µg/L			
			K	3000 µg/L			
			Na	8000 µg/L			
			Mg	15000 µg/L			
Ca	35000 µg/L						

Cat No	Description	No. of Elements	Elements	Concentration	Matrix	Pck	Applications
1.09491	ICP multi-element standard solution XI	7	Hg	8 mg/L	dil. HNO ₃	100 mL	For Sewage Sludge
			Cd	10 mg/L			
			Ni	200 mg/L			
			Cu	800 mg/L			
			Cr, Pb	900 mg/L			
Zn	2500 mg/L						
1.09480	ICP multi-element standard solution XIII	15	Hg	5.0 mg/L	dil. HNO ₃	100 mL	
			Cd, Se	25.0 mg/L			
			As, Be, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn	100 mg/L			
			V	250 mg/L			
Al	500 mg/L						
1.09487	ICP multi-element standard solution XVI	21	Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Li, Mg, Mn, Mo, Ni, Se, Sr, Tl, Ti, V, Zn	100 mg/L	dil. HNO ₃	100 mL	
1.09495	ICP multi-element standard solution XVII	7	Hf, Ir, Sb, Sn, Ta, Ti, Zr	100 mg/L	15% HCl	100 mL	
1.10580	ICP multi-element standard solution VI	30	Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, K, Li, Mg, Mn, Mo, Na, Ni, Pb, Rb, Se, Sr, Te, Tl, U, V, Zn	10 mg/L	dil. HNO ₃	100 mL	calibration in ICP-MS
1.09411	ICP Multi element standard solution XXIV	15	As, Cd, Co, Mo, Ni, Sr, Al, Ba, Cu, Zn, Cr, Pb, Se, Mn	50 mg/L	dil. HNO ₃	500 mL	
			K	500 mg/L			
1.09410	ICP Multi element standard solution XXIII	15	Ba, B, Co, Fe, Ga, In, K, Li, Lu, Na, Rh, Sc, Tl, U, Y	0.5-2.0 ng/ml	5% HNO ₃	500 mL	For mass calibration
1.09500	GF AAS Multi element standard XXVIII	16	Be, Cd	5 mg/mL	dil. HNO ₃	100 mL	For Calibration
			Ag	10 mg/L			
			Cr, Fe, Mn,	20 mg/mL			
			Ba, Co, Cu, Ni	50 mg/mL			
			Al, As, Pb, Sb, Se, Tl	100 mg/mL			
1.10714	ICP multielement standard V	26	Be, Mg, Mn, Sc, Sr, Y	1 mg/L	dil. HNO ₃	500 mL	HCl soluble elements
			B, Ba, Cd, Cr, Cu, Fe, Li, Ti, Zn	2 mg/L			
			Hg, Ni	5 mg/L			
			Ca, P	10 mg/L			
			Al, As, Na, Pb, Se, Te	20 mg/L			
			K	100 mg/L			
1.09481	ICP multi-element standard solution XIV	11	P, S, K	20 mg/L	dil. HCl	500 mL	HCl soluble elements
			As, La, Li, Mo, Mn, Ni, Sc, Na	100 mg/L			
1.17283	ICP Multi element standard solution XXI	29	Al, As, Ba, Be, Bi, Cd, Ca, Cs, Cr, Co, Cu, Ga, In, Fe, Pb, Li, Mg, Mn, Ni, K, Rb, Se, Ag, Na, Sr, Tl, U, V, Zn	10 mg/L	dil. HNO ₃	100 mL	

4. TraceCERT® mixes for special applications

A. Mixes acc. to ICH Q3D Guidelines (Pharma Testing)

We offer different inorganic elemental impurity mixes as certified reference material standard mixes with element ratios corresponding to the oral, parenteral and inhalation, and cutaneous/transcutaneous elemental concentrations limits of the ICH Q3D guideline.

You can find more information about this specific product group on our webpage:
Inorganic Elemental Impurity Mix Standards



Figure 9. ICH Q3D mix

Table 16: Mixes acc. to ICH Q3D guidelines

Class	Cat No/ SKU	19041-100ml	73108-100ml	75463-100ml	69729-100ml	89118-100ml	77184-100ml	89922-100ml
product		Elemental Impurities according to ICH Q3D oral, Standard 1	Elemental Impurities according to ICH Q3D oral, Standard 2	Elemental Impurities according to ICH Q3D oral, Standard 4*	Elemental Impurities according to ICH Q3D oral, Standard 3	Elemental Impurities according to ICH Q3D parenteral, Standard 1	Elemental Impurities according to ICH Q3D parenteral, Standard 5**	Elemental Impurities according to ICH Q3D parenteral, Standard 2
	matrix	in 12% nitric acid	in 10% hydrochlorid acid	in 10% hydrochlorid acid	in 5% nitric acid and <0.5% hydrofluoric acid	in 12% nitric acid	in 12% nitric acid	in 10% hydrochlorid acid
		elements in mg/L	elements in mg/L	elements in mg/L	elements in mg/L	elements in mg/L	elements in mg/L	elements in mg/L
1	As	15				15	15	
	Cd	5				2	2	
	Hg	30				3	3	
	Pb	5				5	5	
2a	Ni	200				20	20	
	V	100				10	10	
	Co	50				5	5	
2b	Se	150				80	80	
	Ag	150				10	15	
	Au		100	300				100
	Ir		100	100				10
	Os		100	100				10
	Pd		100	100				10
	Pt		100	100				10
	Rh		100	100				10
	Ru		100	100				10
	Tl	8				8	8	
3	Cr (III)				1100			
	Cu				300			
	Mo				300			
	Ba				140			
	Sb				120			
	Li				55			
	Sn				600			
				*75463 replaces 73108			**77184 replaces 89118	

Table 16: Mixes acc. to ICH Q3D guidelines

Class	Cat No/ SKU	90088-100ml	07368-100ml	91496-100ml	78525-100ml	93696-100ml	95419-100ml	78524-100ml	96396-100ml
product		Elemental Impurities according to ICH Q3D parenteral, cutaneous and transcutaneous, Standard 6***	Elemental Impurities according to ICH Q3D parenteral, Standard 3	Elemental Impurities according to ICH Q3D inhalational, Standard 4	Elemental Impurities according to ICH Q3D inhalational, Standard 6****	Elemental Impurities according to ICH Q3D inhalational, Standard 2	Elemental Impurities according to ICH Q3D inhalational, Standard 5*****	Elemental impurities according to ICH Q3D cutaneous and transcutaneous, Standard 1	Elemental impurities according to ICH Q3D cutaneous and transcutaneous, Standard 2
	matrix	in 10% hydrochlorid acid	in 5% nitric acid and <0.5% hydrofluoric acid	in 12% nitric acid	in 12% nitric acid	in 10% hydrochlorid acid	in 10% hydrochlorid acid	in 12% nitric acid	in 10% hydrochlorid acid
		elements in mg/L	elements in mg/L	elements in mg/L	elements in mg/L	elements in mg/L	elements in mg/L	elements in mg/L	elements in mg/L
1	As			2	2			30	
	Cd			3	3			20	
	Hg			1	1			30	
	Pb			5	5			50	
2a	Ni			5	6			200	
	V			1	1			100	
	Co			3	3			50	
2b	Se			130	130			800	
	Ag			7	7			150	
	Au	300				10	3		
	Ir	10				10	1		
	Os	10				10	1		
	Pd	10				10	1		
	Pt	10				10	1		
	Rh	10				10	1		
	Ru	10				10	1		
	Tl			8	8			8	
3	Cr (III)		110						1100
	Cu		30						300
	Mo		150						1500
	Ba		70						700
	Sb		9						90
	Li		25						250
	Sn		60						600
		90088 replaces 89922			*78525 replaces 91496		*****95419 replaces 93696	new product	new product

All replacement products will be available in 2024.

B. Mixes for Cannabis Testing

It is critical to accurately monitor levels of elemental impurities in cannabis products, both to ensure regulatory compliance – and more importantly – consumer and patient safety. Trace levels of heavy metals such as arsenic, cadmium, mercury and lead may accumulate in plant materials through uptake from soil and, more commonly, may be introduced through the use of certain fertilizers.

All **TraceCERT®** mixes are certified reference materials and are produced in accordance with ISO 17034. They are characterized in accordance with ISO/IEC 17025 specifications.

You can find more information about this specific product group on our webpage: [Cannabis Standards](#)



Figure 10. Mixes for Cannabis Testing

Table 17: Mixes for cannabis testing

Cat No	Product	Specifications	Pack size
89471	Heavy metal mix IX	In 12% nitric acid; As, Cd, Pb, Hg: each 100 mg/L	100 mL
18208	Heavy metal mix according to USP 561 articles of botanical origin	In 12% nitric acid; As: 20 mg/L Cd: 5 mg/L Hg: 10 mg/L Pb: 50 mg/L	100 mL
91539	Metal mix I for cannabis testing	In 8% nitric acid and 0.05% HF As, Hg, Cd, Pb, Cr, Ba, Ag, Se, Sb, Cu, Ni, Zn: each 100mg/L	100 mL

Quality Assurance

Matrix CRMs Spiked with Metals

Organic and inorganic compound matrix certified reference materials (CRMs) are extremely valuable for validating analytical methods and calibration of mass-transfer processes. However, their usage extends beyond simply calibrating mass-transfer processes. CRMs can also serve as quality control tools to ensure the ongoing performance and accuracy of test methods while validating the accompanying test results. They can further set a benchmark for comparison between different laboratories, adding a layer of reliability across the entire analytical process.

We offer a comprehensive selection of CRMs spiked with various metals for clinical, food, and soil matrices. These matrices include both non-fortified “real-world” samples and natural matrices in which certain analytes have been fortified to match and fulfill the analytical profiles required by analysts. Most of our CRMs are method-specific and are accompanied by certificates displaying essential information such as:

- Measured value plus uncertainty
- Expanded uncertainty confidence level
- Prediction value, in addition to the mean value and standard deviation from the mean

Table 18: Matrix CRMs spiked with metals

Cat No	Product	Matrix	Analytes
CRM041	Chromium VI - Soil	Environment	Cr VI
CRM050	Lead Free Paint	Paint	Cd, Cr, Pb
QC1088	Chromium VI - WP	Environment	Cr (VI)
CLNSOIL3	Clean Sandy Loam Soil No. 3	Environment	Al, Sb, As, Ba, Be, Ce, Ca, Cr (total), Co, Cu, Fe, Pb, Mn, Mg, Hg, Ni, K, Se, Ag, Na, Ti, V, Zn
ERMBB184	Bovine muscle (trace elements)	Food and Feed	As, Cd, Cu, Fe, Mn, Se, Zn
FAP80469	Metals in rice	Food and Feed	As, As (inorganic), Cd, Pb, Hg (total)
FAP80466	Metals in seafood	Food and Feed	As, Cd, Hg
FAP80561	Metals in wine	Food and Feed	Cd, Cu, Pb
FAP79875	Metals in spices	Food and Feed	As, Cd, Pb
FAP80467	Metals in wheat	Food and Feed	Al, As (total), Cd, Cu, Fe, Pb, Hg (total), Ni, Zn
FAP80553	Metals in fruit products	Food and Feed	Cd, Cu, Fe, Pb, Sn
FAP80551	Metals in infant cereal	Food and Feed	As, As (inorganic), Cd, Cr, Pb, Hg (total), Se
FAP80562	Metals in soft drink	Food and Feed	As (inorganic), Cd, Fe, Pb, Sn
FAP80527	Metals in milk powder	Food and Feed	As, Cd, Pb, Hg (total)
FAP80554	Metals in vegetable puree	Food and Feed	Cd, Fe, Pb, Sn
NIST1570A	Trace elements in spinach leaves	Food and Feed	Al, As, B, Cd, Ca, Co, Cu, Eu, Pb, Mg, Mn, Hg, Ni, K, Rb, Sc, Se, Na, Sr, S, Th, U, V, Zn
ERMBB185	Bovine Liver (trace elements)	Food and Feed	As, Cd, Cu, Pb, Mn, Se, Zn
ERMBB186	Pig kidney (trace elements)	Food and Feed	Cd, Cu, Mn, Pb, Se, Zn, As, Hg, Ca, Chloride, K, Mg, Co, Na
ERMBB422	Fish muscle (trace elements)	Food and Feed	As, Cd, Cu, Fe, Hg, Iodide, Mn, Se, Zn
BCR668	Mussel tissue (trace elements)	Food and Feed	Cd, Dy, Er, Eu, Gd, La, Lu, Nd, Pr, Sm, Tb, Tm, Y
ERMBD150	Skimmed milk powder (major and trace elements)	Food and Feed	Cd, Ca, Chloride, Cu, Iodide, Fe, Pb, Mg, Mn, Hg, K, Se, Na, Zn
BCR402	White clover (trace elements)	Environment	As, Co, Mo, Se
ERMBD151	Skimmed milk powder (major and trace elements)	Food and Feed	Ca, Cd, Chloride, Cu, Iodide, Fe, Pb, Mg, Mn, Hg, K, Se, Na, Zn
BCR679	White cabbage (trace elements)	Food and Feed	Sb, As, Ba, B, Cd, Ca, Cr, Cu, Fe, Mg, Mn, Hg, Mo, Ni, Sr, Ti, Zn
ERMBD512	Dark chocolate (Cd, Mn, Cu, Ni)	Food and Feed	Cd, Cu, Mn, Ni
ERMCA615	Ground water (trace elements)	Environment	As, Cd, Fe, Hg, Mn, Ni, Pb

Cat No	Product	Matrix	Analytes
NIST1643F	Trace Elements in Water	Environment	Al, Sb, Ba, Be, Bi, B, Ce, Ca, Cr, Co, Cu, Fe, Pb, Li, Mg, Mn, Mo, Ni, K, Rb, Se, Ag, Na, Sr, Te, Tl, V, Zn
NIST606	Trace Elements in Basalt Glass	Environment	Ba, Co, Cr, Cu, La, Pb, Sc, Sr, V, Y, Zn
NIST1634C	Trace elements in fuel oil	Environment	Co, Ni, V
NIST2584	Trace elements in indoor dust	Environment	As, Cd, Cr, Pb, Hg
NIST2583	Trace elements in indoor dust	Environment	As, Cd, Cr, Pb, Hg
NIST1575A	Trace elements in pine needles	Environment	P, K, Ca
NIST695	Trace elements in multi-nutrient fertilizer	Fertilizer	As, Cd, Cr, Co, Cu
NIST1633C	Trace elements in coal fly ash	Environment	Al, As, Ba, Cd, Ca, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Rb, Sb, Sr, Ti, V
NIST1635A	Trace elements in coal (sub-bituminous)	Environment	Sb, As, Cr, Co, Cu, Pb, Mn, Hg, Ni, Rb, Se, Th, U, V
NIST2586	Trace elements in soil containing lead from paint	Environment	As, Cd, Cr, Pb
NIST2587	Trace elements in soil containing lead from paint	Environment	As, Cd, Cr, Pb
NIST1566b	Oyster Tissue	Food and Feed	Ca, Chlorine, Mg, K, Na, S, Al, As, Cd, Co, Cu, Fe, Pb, Mn, Hg (total), methylmercury (as Hg), Ni, Rb, Se, Ag, Th, V, Zn
NIST955D	Toxic Metals and Metabolites in Frozen Human Blood	Human Fluid	Pb, As, Cd, Cr, Co, Mn, Hg (total), Se, U, Ethylmercury (as Hg), inorganic Mercury (as Hg), Methylmercury (as Hg)
ERMCA713	Waste water (trace elements)	Environment	As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se
ERMCC141	Loam soil (trace elements)	Environment	Ce, Dy, Gd, La, Nd, Sc, Sm, Tb, Tm, Yb, Th, U
BCR142R	Light and sandy soil (trace elements)	Environment	Cd, Co, Cu, Pb, Mn, Hg, Ni
BCR483	Sewage sludge amended soil (trace elements)	Environment	Cd, Cr, Cu, Ni, Pb, Zn (EDTA-extractable); Cd, Cr, Cu, Ni, Pb Zn (acetic acid-extractable)
BCR484	Sewage sludge amended (terra rossa) soil (trace elements)	Environment	Cd, Cr, Cu, Ni, Pb, Zn (EDTA-extractable); Cd, Cr, Cu, Ni, Pb Zn (acetic acid-extractable)
BCR700	Organic-rich soil following harmonised EDTA and acetic acid extraction (extractable trace elements)	Environment	Cd, Cr, Cu, Ni, Pb, Zn (EDTA-extractable); Cd, Cr, Cu, Ni, Pb Zn (acetic acid-extractable)
ERMCC690	Calcareous soil (trace elements)	Environment	Ce, Dy, Gd, La, Nd, Sc, Sm, Tb, Tm, Yb, Th, U
ERMCD200	Bladderwrack, Fucus vesiculosus (trace metals), ERM	Food and Feed	As, Cd, Cu, Hg, Pb, Se, Zn
BCR505	Estuarine water (trace elements)	Environment	Cd, Cu, Ni, Zn
BCR579	Coastal seawater	Environment	Hg
BCR129	Hay powder	Food and Feed	Ca, Iodide, K, Kjeldahl-N, Mg, N, P, S, Zn
BCR176R	Fly ash (trace elements)	Environment	As, Cd, Co, Cr, Cu, Fe, Ni, Pb, Sb, Se, Tl, Zn
BCR185R	Bovine Liver (trace elements)	Meat	As, Cd, Cu, Mn, Pb, Se, Zn
BCR191	Brown bread (trace elements)	Food and Feed	Cd, Pb, Cu, Zn, Fe, Mn
BCR274	Single cell protein (trace elements)	Protein	As, Cd, Co, Cu, Mn, Pb, Se, Zn
BCR277R	Estuarine sediment (trace elements)	Environment	As, Cd, Co, Cr, Cu, Hg, Ni, Zn
BCR280R	Lake sediment (trace elements)	Environment	As, Cd, Co, Cr, Cu, Hg, Ni, Zn
BCR304	Human serum (Ca, Mg, Li)	Human Fluid	Ca, Mg, Li
BCR414	Plankton (trace elements)	Environment	As, Cd, Cr, Cu, Hg, Mn, Ni, Pb, Se, V, Zn
BCR596	Aquatic Plant (Cr)	Environment	Cr
BCR634	Human Blood (Pb, Cd)	Human Fluid	Pb, Cd
BCR635	Human Blood (Pb, Cd)	Human Fluid	Pb, Cd
BCR635	Human Blood (Pb, Cd)	Human Fluid	Pb, Cd
BCR637	Human Serum (Al, Se, Zn)	Human Fluid	Al, Se, Zn
BCR638	Human Serum (Al, Se, Zn)	Human Fluid	Al, Se, Zn
BCR639	Human Serum (Al, Se, Zn)	Human Fluid	Al, Se, Zn

Cat No	Product	Matrix	Analytes
BCR664	Glass (trace elements)	Environment	As, Ba, Cd, Chloride, Co, Cr, Pb, Sb, Se
BCR668	Mussel tissue (rare elements)	Food and Feed	Ce, Dy, Er, Eu, Gd, La, Lu, Nd, Pr, Sm, Tb, Tm, Y, Th, U
BCR723	Road dust (Pd, Pt, Rh)	Environment	Pt, Rh, Pd)
ERMCE101	Trout Muscle (trace elements)	Food and Feed	As, Fe, Mn, Hg, Se, Zn
ERMCC144	Sewaged sludge (trace elements)	Environment	As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Zn
ERMCD281	Rye Grass (trace elements)	Environment	Sb, As, B, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Hg, Mo, Ni, K, Se, Si, Na, S, Sn, Zn
ERMCE196	Bovine blood (Pb, Cd)	Food and Feed	Pb, Cd
ERMCE278K	Mussel tissue (elements)	Food and Feed	As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Rb, Se, Sr, Zn
ERMDB001	Human hair (trace elements)	Hair	As, Cd, Cu, Hg, Pb, Se, Zn

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