



National Institute of Standards & Technology

Certificate

Standard Reference Material 1643c

Trace Elements in Water

This Standard Reference Material (SRM) is intended primarily for use in evaluating the accuracy of trace element determinations in filtered and acidified fresh water and for calibrating instruments used in these determinations. SRM 1643c consists of approximately 500 mL of water in a polyethylene bottle, which is sealed in an aluminized plastic bag to maintain stability. SRM 1643c simulates the elemental composition of fresh water. Nitric acid is present at a concentration of 0.5 moles per liter to stabilize the trace elements.

Concentrations of Constituent Elements: The certified concentration values of the trace elements that were determined are given in Table 1. Noncertified values, which are to be used for information only are provided in Table 2.

Notice and Warnings to Users

Expiration of Certification: This certification is valid for two years from the date of purchase and shipment from the NIST. Should any of the certified values change before the expiration of the certification, purchasers will be notified by the NIST. Please return the attached registration form to facilitate notification.

Precautions: The SRM should be shaken before use because of possible water condensation. To prevent possible contamination of the SRM, do not insert pipets into the bottle. Samples should be decanted or taken at 22 ± 5 °C. After use, the bottle should be capped tightly and placed inside the aluminized plastic bag, which should be folded and sealed with sealing tape. This safeguard will protect the SRM from possible environmental contamination and long-term loss of water.

Trace element determinations, especially at ng/mL levels, are limited by contamination. Apparatus should be scrupulously cleaned and only the purest reagents employed. Sampling and manipulations, such as evaporations, should be done in a clean environment, for example, a Class 100 clean hood.

Coordination of the NIST technical measurements was performed by J.R. Moody of the NIST Inorganic Analytical Research Division.

The overall coordination of measurements at the U.S. Geological Survey, National Water Quality Laboratory and Laboratories that participate in the Standard Reference Water Program was under the direction of K. Long.

Statistical analysis of the experimental data was performed by R.C. Paule of the NIST Center for Computing and Applied Mathematics, Statistical Engineering Division.

The technical and support aspects involved in the certification and issuance of this SRM were coordinated through the Standard Reference Materials Program by R. Alvarez.

Gaithersburg, MD 20899
June 24, 1991

William P. Reed, Chief
Standard Reference Materials Program

(over)

Table 1. Certified Concentrations of Constituent Elements.

<u>Element</u>	<u>Concentration, $\mu\text{g/mL}$</u>	<u>Element</u>	<u>Concentration, $\mu\text{g/mL}$</u>
Calcium	36.8 \pm 1.4	Lithium	16.5 \pm 1.0
Magnesium	9.45 \pm 0.27	Manganese	35.1 \pm 2.2
Sodium	12.19 \pm 0.36	Molybdenum	104.3 \pm 1.9
		Nickel	60.6 \pm 7.3
		Rubidium	11.4 \pm 0.2
		Selenium	12.7 \pm 0.7
		Silver	2.21 \pm 0.30
		Strontium	263.6 \pm 2.6
		Vanadium	31.4 \pm 2.8
		Zinc	73.9 \pm 0.9

The certified value for each element is based on at least two independent methods of analysis. No statistically significant bottle-to bottle variability in the analytical results was observed. Except for strontium, the uncertainties are listed as \pm two standard deviations. The uncertainty for strontium would have been too small considering other possible sources of error. Accordingly, this uncertainty has been expanded to provide a more realistic value.

The density of SRM 1643c at 22 °C is 1.016 gm/mL.

Table 2. Noncertified Concentrations of Constituent Elements.

Elements other than those certified are present in this SRM. Those that were determined by only a single analytical method and therefore not certified are listed below for information only.

<u>Element</u>	<u>Concentration,</u>
Potassium	(2.3) $\mu\text{g/mL}$
Bismuth	(12) ng/mL
Tellurium	(2.7) ng/mL
Thallium	(7.9) ng/mL

Source and Preparation of Material SRM 1643c was prepared at the facilities of the U.S. Geological Survey, Branch of Quality Assurance, Golden, Colorado, under the direction of D. Erdmann of that Branch and J.R. Moody of the NIST Inorganic Analytical Research Division. Only high purity reagents were used; the containers were acid cleaned before use. In the preparation, a polyethylene cylindrical tank was filled with distilled water and sufficient nitric acid to make the solution approximately 0.5 moles HNO_3 per liter. Solutions containing known amounts of elements to be determined were added to the acidified water solution. After mixing thoroughly, the solution was filtered through 0.2 μm filters, sterilized by flowing through an ultra violet light sterilizer, and then transferred to cleaned 500-mL polyethylene bottles.

Table 3. Methods and Analysts for Elemental Determinations.

<u>Element</u>	<u>Method Code</u>	<u>Analyst Code</u>	<u>Element</u>	<u>Method Code</u>	<u>Analyst Code</u>
Aluminum	DCP	3	Lithium	FAES	3,7
Arsenic	ETAAS INAA RNAA	3,7 2,12 5,8,13	Magnesium	IDTIMS	1,6
Barium	ICP	3,11	Manganese	ETAAS	3,7
Beryllium	ETAAS	3,7	Molybdenum	ICP INAA RNAA	3,11 2,12 5,8,13
Boron	ICP IDTIMS	3,11 14	Nickel	ETAAS	3,7
Cadmium	ETAAS RNAA	3,7 5,8,13	Rubidium	ETAAS IDTIMS	3,7 14
Calcium	FAES IDTIMS	3,7 1,6	Selenium	ETAAS INAA RNAA	3,7 2,12 5,8,13
Chromium	ETAAS RNAA	3,7 5,8,13	Silver	ETAAS INAA RNAA	3,7 2,12 5,8
Cobalt	ETAAS INAA	3,7 2,12	Sodium	FAES	3,7
Copper	IDTIMS RNAA	13 5,8,13	Strontium	ICP IDTIMS	3,11 1,4,6
Iron	LEAFS	9	Vanadium	DCP	3
Lead	IDTIMS	1,10	Zinc	FAAS	3,7

Methods Used for Analysis of SRM 1643c:

DCP = Direct Current Plasma Spectrometry
ETAAS = Electrothermal Atomic Absorption Spectrometry
FAAS = Flame Atomic Absorption Spectrometry
FAES = Flame Atomic Emission Spectrometry
ICP = Inductively-Coupled Plasma Emission Spectrometry
IDTIMS = Isotope Dilution, Thermal Ionization Mass Spectrometry
INAA = Instrumental Neutron Activation Analysis
LEAFS = Laser-Excited Atomic Fluorescence Spectrometry, Flame
RNAA = Radiochemical Neutron Activation Analysis

Note: Methods used at the U.S. Geological Survey, National Water Quality in Arvada, Colorado and approximately 80 other cooperating laboratories are not listed. However, the results together with those from NIST were used to arrive at the certified values.

Analysts, National Institute of Standards and Technology

- | | |
|-------------------|----------------|
| 1. D.S. Braverman | 7. T.A. Rush |
| 2. R. Demiralp* | 8. S.F. Stone |
| 3. M.S. Epstein | 9. G.C. Turk |
| 4. J.D. Fassett | 10. R.D. Vocke |
| 5. R.R. Greenberg | 11. L.J. Wood |
| 6. J.R. Moody | 12. R. Zeisler |
| | 13. K. Garrity |

*Guest Scientist.

Cooperating Analysts

14. A. Götz, G. Lapitajs, L. Van Nevel, A. Lamberty, CEC-JRC Central Bureau for Nuclear Measurements, Geel, Belgium.