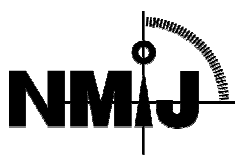


National Institute of Advanced Industrial Science and Technology

## National Metrology Institute of Japan



## Reference Material Certificate

NMIJ CRM 7202-b  
No. +++

## Trace Elements in River Water (Elevated Level)

This certified reference material (CRM) is produced in accordance with the NMIJ's management system and is in compliance with ISO 17034 and ISO/IEC 17025. This CRM is intended for use in the calibration of instruments, and validation of analytical methods and instruments used for the analysis of trace elements in river water, drinking water and other freshwater sample.

**Certified Values**

The certified values for the elements in this CRM are given in the table below. This CRM should be used without drying. The uncertainty of the certified value is the half-width of the expanded uncertainty interval calculated using a coverage factor ( $k$ ) of 2, which gives a level of confidence of approximately 95 %.

Element	Certified value, Mass fraction ( $\mu\text{g}/\text{kg}$ )	Expanded uncertainty, Mass fraction ( $\mu\text{g}/\text{kg}$ )	Analytical method (see below*)
B	47.8	0.9	1,2
Al	17.0	0.5	2,3,5
Cr	4.65	0.06	1,2,3
Mn	4.93	0.13	2,3,5
Fe	29.8	0.4	1,2,3,
Ni	1.05	0.03	1,2,3
Cu	9.88	0.13	1,2
Zn	9.83	0.20	1,2
As	1.10	0.05	2,3,5
Se	1.00	0.06	1,2
Rb	0.651	0.018	1,2
Sr	32.7	0.6	1,2
Mo	0.184	0.006	1,2,3
Cd	0.98	0.03	1,2
Sb	0.0103	0.0004	1,3
Ba	5.69	0.11	1,2
Pb	1.002	0.018	1,2

Element	Certified value, Mass fraction ( $\text{mg}/\text{kg}$ )	Expanded uncertainty, Mass fraction ( $\text{mg}/\text{kg}$ )	Analytical method (see below*)
Na	3.64	0.06	2,4,6
Mg	1.23	0.04	2,4,6
K	0.833	0.023	2,4,6
Ca	4.51	0.15	2,4,6

\*Analytical methods:

- 1) Isotope dilution-inductively coupled plasma mass spectrometry (ID-ICP-MS)
- 2) ICP-MS
- 3) High-resolution ICP-MS
- 4) ICP optical emission spectrometry (ICP-OES)
- 5) Graphite furnace atomic absorption spectrometry
- 6) Flame atomic absorption spectrometry

### Analysis

These certified values of this CRM were the weighted means of the results from two or more analytical methods conducted at NMIJ. The quantitative analysis of elements was made by the aforementioned analytical methods of 1) to 6), and combinations of these are based on: (1) a single primary method (ID-ICP-MS) with one or more reference methods or (2) three or more reference methods.

The expanded uncertainty in each certified value is equal to  $U = k u_c$ , where  $u_c$  is the combined standard uncertainty derived from: (a) the analytical results, (b) the method-to-method variance, (c) the concentration of a standard solution, and (d) the sample homogeneity.

### Metrological Traceability

Each certified value was determined by multiple methods with standard solutions guaranteed by JCSS (Japanese Calibration Service System), and is traceable to the International System of Units (SI). All the working standard and sample solutions were prepared by a gravimetric method, using a balance calibrated by JCSS.

### Indicative Values

The concentrations of P and U in this CRM are given in the table below as indicative values.

Element	Reference value, Mass fraction (mg/kg)	Expanded uncertainty, Mass fraction (mg/kg)	Analytical method (see above*)
P	8.1	0.3	3
U	0.0076	0.0005	2

The indicative values were determined with a JCSS standard solution for P and a standard solution (TraceCERT, Sigma-Aldrich, prod. No. 61344, traceable to NIST) for U. The expanded uncertainty in each indicative value is equal to  $U = k u_c$ , where  $u_c$  is the combined standard uncertainty derived from (a) the analytical results, (b) the sample homogeneity, and (c) the standard solution, with coverage factor ( $k=2$ ) corresponding to an interval of 95 % confidence.

### Mutual Recognition Arrangement under Meter Convention

This certificate is consistent with the calibration and measurement capabilities (CMCs) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures (CIPM). Under the MRA, all participating institutes recognize the validity of each other's calibration and measurement certificates for the quantities, ranges and measurement uncertainties specified in Appendix C (as for Appendix C of MRA, see <http://kcdb.bipm.org/AppendixC/default.asp>).

### Expiration of Certification

This certificate is valid for one year from the date of shipment, provided that the material remains unopened and is stored in accordance with the instructions given in this certificate.

### Sample Form

This CRM is in the form of a clear liquid, prepared from natural river water. This CRM of ca. 100 mL in net volume is kept in a high-density polyethylene bottle.

**Homogeneity**

The homogeneity of this CRM was determined by analyzing 11 bottles hierarchical-randomly sampled from 1,100 bottles. The elements were determined by ICP-MS and ICP-OES. The homogeneity of each element is reflected in the uncertainty of the certified value.

**Instructions for Storage**

This CRM should be stored at a temperature about 5 °C and shielded from light.

**Instructions for Use**

(1) The unit of the certified values is mass fraction (g/kg). The unit can be converted to volume concentration (g/L) by multiplying the density of this CRM at the room temperature when used. The density of this CRM at 25 °C is shown as an information in this certificate.

(2) Before opening, the bottle is kept standing at a room temperature until the temperature of the CRM reaches to an equilibrium, then the bottle is gently shaken with a hand. Care should be taken to prevent any contamination from pipettes, vessels, and working environment, because the mass fractions of the trace elements in the CRM are extremely low. A pipet tip should not be dipped into the CRM bottle to avoid contaminating this CRM. The CRM is readily used up after opening the bottle.

**Precautions for Handling**

Wear a mask, gloves, and other protective equipment during handling. Entrust disposal of this reference material to a professional waste disposal company licensed by prefectural governor. Refer to the safety data sheet (SDS) on this CRM before use.

**Preparation**

This CRM was prepared from NMIJ CRM 7202-a. Approximately 150 L of NMIJ CRM 7202-a and ca. 5 L of 68 % nitric acid were mixed for one night, then bottled in high density polyethylene bottles of 100 mL volume.

NMIJ CRM 7202-a, the starting material, was prepared from natural river water. The river water was sampled using an inert pump and filtered with filter medias (pore size 1 µm and pore size 0.45 µm). After adding nitric acid and appropriate amounts of the Al, As, B, Cd, Cr, Cu, Fe, Pb, Mn, Ni, Se and Zn solutions into the river water, the mixture was bottled in high density polyethylene bottles.

**Technical Information****(1) Density**

The density of this CRM at 25 °C in March 2011 was 1.01087 g/cm<sup>3</sup>, determined by a resonant frequency oscillation method.

(2) The mass fractions of rare earth elements (REEs) in this CRM in March 2011 are given in the table below as information values.

Element	Information value Mass fraction (µg/kg)	Element	Information value Mass fraction (µg/kg)
La	0.0085	Tb	0.00016
Ce	0.0082	Dy	0.0010
Pr	0.0017	Ho	0.00024
Nd	0.0065	Er	0.00068
Sm	0.0012	Tm	0.00010
Eu	0.00036	Yb	0.00067
Gd	0.0012	Lu	0.00012

The information values were determined by ICP-MS after preconcentration using a chelating solid phase extraction cartridge ME-1 (GL science, Japan).

#### NMIJ Analysts

The technical managers for this CRMs are HIOKI A. and INAGAKI K., production managers are INAGAKI K. and ARIGA T., and analysts are INAGAKI K., NARUKAWA T., ZHU Y., KOGUCHI M., and KUDO I.

#### Information

If substantive technical changes occur that affect the certification before the expiration of this certificate, NMIJ will notify the registered customer. Customer registration on the NMIJ Website (given below) will facilitate notification. Technical reports regarding this CRM can be obtained from the contact details given below.

#### Reproduction of Certificate

In reproducing this certificate, it should be clearly indicated that the document is a copy.

April 1, 2020

ISHIMURA Kazuhiko  
President

National Institute of Advanced Industrial Science and Technology

If you have any questions about this CRM, please contact:

National Institute of Advanced Industrial Science and Technology,

National Metrology Institute of Japan,

Center for Quality Management of Metrology, Reference Materials Office,

1-1-1 Umezono, Tsukuba, Ibaraki 305-8563, Japan

Phone: +81-29-861-4059; Fax: +81-29-861-4009, <https://unit.aist.go.jp/nmij/english/refmate/>

#### Revision history

April 1, 2015: "Metrology Management Center" was renamed to "Center for Quality Management of Metrology."

March 14, 2008: The description in "Expiration of Certification" was changed to "one year from the date of shipment."