National Institute of Advanced Industrial Science and Technology
National Metrology Institute of Japan

Reference Material Certificate
NMIJ CRM 7602-a
No. +++
Seawater for Nutrients - Middle Concentration

This certified reference material (CRM) was produced in accordance with the NMIJ’s management system and in compliance with ISO GUIDE 34:2009 and ISO/IEC 17025:2005. This CRM is intended for use in controlling the precision of analysis and for confirming the validity of analytical methods and instruments during analysis of nutrients in seawater.

Certified Values
The certified values for the nitrate ions, nitrite ions and dissolved silica in this CRM are given in the table below. 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 %.

<table>
<thead>
<tr>
<th></th>
<th>Certified value, *1 Mass fraction (mg/kg)</th>
<th>Expanded uncertainty, Mass fraction (mg/kg)</th>
<th>Analytical methods *2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate ions</td>
<td>0.942</td>
<td>0.027</td>
<td>1), 3), 4)</td>
</tr>
<tr>
<td>Nitrite ions</td>
<td>0.019</td>
<td>0.002</td>
<td>1), 3)</td>
</tr>
<tr>
<td>Dissolved silica</td>
<td>0.837</td>
<td>0.017</td>
<td>1), 2), 5)</td>
</tr>
</tbody>
</table>

*1 The certified value for dissolved silica is expressed as the mass fraction of silicon.

*2 Analytical methods: See the next section “Analysis”.

Analysis
The property values were arithmetic means of the results of the following analytical methods:
1) Colorimetric method (continuous flow mode and batch one) for nitrate ions, nitrite ions, phosphate ions and dissolved silica
2) Ion exclusion chromatography/isotope dilution-inductively coupled plasma mass spectrometry for dissolved silica
3) Ion chromatography by direct analysis for nitrate ions and nitrite ions
4) Ion chromatography after halogen-ion separation for nitrate ions
5) Ion exclusion chromatography with post-column detection for dissolved silica

Metrological Traceability
Each certified value was determined by more than one method with using one of NIST (National Institute of Standards and Technology) SRM of a silicon standard solution and the NMIJ primary standard solutions of nitrate ions and nitrite ions. Those values are traceable to the International System of Units (SI).

Indicative Value
The indicative value was determined with the NMIJ primary standard solution of phosphate ions. The indicative value for phosphate ions in this CRM is given in the table below.

<table>
<thead>
<tr>
<th></th>
<th>Indicative value, Mass fraction (mg/kg)</th>
<th>Analytical method (see the section “Analysis” (vide supra))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphate ions</td>
<td>0.101 ± 0.005</td>
<td>1)</td>
</tr>
</tbody>
</table>

The value following the ± in the column of the indicative 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 %.

1/3
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 of ca. 90 mL in net volume is kept in a polypropylene bottle which is sealed in an aluminum zip bag.

Homogeneity
The homogeneity of this CRM was determined by analyzing a set of 10 bottles several times by the colorimetric method. The homogeneity of each analyte is reflected in the uncertainty of the certified value or the indicative one.

Instructions for Storage
This CRM should be stored at a temperature between 5 °C and 30 °C in a clean place and shielded from light.

Instructions for Use
After this CRM was kept in a temperature different from the room temperature, the bottle should be opened after the temperature reaches the room temperature. Prior to use, the bottle should be shaken well. This CRM should be used promptly, once a bottle of CRM is opened. This CRM is for laboratory use only.

Precautions for Handling
Refer the safety data sheet (SDS) on this material before use.

Preparation
The raw material seawater of this CRM was a blend of the following seawaters: (1) Artic Sea, 690 m depth collected with the cooperation of the Meteorological Research Institute (MRI) and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), (2) Atlantic Ocean, 1500 m depth collected with the cooperation of MRI and the Plymouth Marine Laboratory, UK (PML), and (3) Suruga-wan Bay, 397 m depth collected with the cooperation of General Environmental Technos Co., Ltd. (KANSO Technos). The nutrient composition is similar to the original one of the 1500 m depth seawater of the Atlantic Ocean. The blended seawater was sterilized in an autoclave of stainless steel, followed by subdividing in polypropylene bottles and sealing by aluminum zip bags in a clean room. This bottling process was carried out with cooperation of KANSO Technos.

Technical Information
The value 1.023 g/cm³ (25 °C) can be used as the density of the seawater for the purpose of air-buoyancy correction. This CRM contains a silicon compound which cannot be detected by the colorimetric method using the molybdenum blue method or the molybdenum yellow method, but can be separated and detected by ion exclusion chromatography-inductively coupled plasma mass spectrometry.

NMIJ Analysts
The technical manager for this CRM is A. Hioki, the production manager is T. Miura and the analysts are C. Cheong, N. Nonose, T. Suzuki, T. Miura, Y. Yamauchi, and Y. Ishizawa.

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, 2015

Ryoji Chubachi
President
National Institute of Advanced Industrial Science and Technology

If you have any questions about this CRM, please contact:
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Revision history
April 1, 2015: “Metrology Management Center” was renamed to “Center for Quality Management of Metrology.”
September 24, 2015: The indicative value for phosphate ions was revised.
September 6, 2016: The description in “Expiration of Certification” was changed to “one year from the date of shipment.”
Certified values of nitrate ions, nitrite ions and dissolved silica were revised. Indicative value of phosphate ions was revised.