



# Certificate of Analysis

Certified Reference Material

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## ORMS-6

Water Certified Reference Material for Mercury

ORMS-6 is a water spiked with inorganic mercury Certified Reference Material (CRM) from the National Research Council Canada (NRC). The material is packaged in a 50 mL glass ampoule stabilized with 0.5% BrCl.

Table 1 shows the certified value established for ORMS-6. The expanded uncertainty associated with the certified value was calculated according to the JCGM Guide [1] and corresponds to approx. 95 % confidence ( $k = 2$ ).

**Table 1: Certified value and expanded uncertainty ( $k = 2$ ) for ORMS-6**

Element	Mass fraction pg/g
Hg (a,b,c)	$26.18 \pm 1.10$

Refer to the sections below for additional explanations

Period of validity: until April 2035

Storage conditions: please store at room temperature in dark

## **Intended use**

ORMS-6 is intended for use in the method development, validation, and quality control for the analysis of mercury in natural waters.

## **Preparation of material**

This reference material was prepared at the NRC facility. An appropriate volume of concentrated BrCl, prepared according to EPA Method 245.7 [2], was added to a certain amount of deionized water, along with a spike of high purity inorganic mercury standard. The material was then thoroughly blended and aliquoted into 50 mL pre-cleaned glass ampoules, which were flame-sealed. The ampoules were subject to gamma irradiation with a minimum dose of 25 kGy to inhibit bacterial action.

## **Characterization of material**

The explanatory list of letters next to the element (Table 1) refers to the instrumental method used for measurements:

- a) isotope dilution cold vapour inductively coupled plasma sector field mass spectrometry (ID-CV-ICP-SFMS)
- b) isotope dilution cold vapour triple quadrupole inductively coupled plasma mass spectrometry (ID-CV-ICP-MS/MS)
- c) flow injection cold vapour atomic fluorescence spectrometry (CV-AFS)

## **Metrological traceability**

Results presented in this certificate are traceable to the International System of Units (SI) through gravimetrically prepared standards of established purity and international measurement intercomparisons. As such, ORMS-6 serves as suitable reference material for laboratory quality assurance programs, as outlined in ISO/IEC 17025.

## **Homogeneity**

The material was tested for homogeneity at NRC using both ID-CV-ICP-MS and CV-AFS. Results from sub-samples (ca. 10 mL) were evaluated using Bayesian analysis of variance (ANOVA) to determine both within-unit and between-unit heterogeneity components [3].

## **Stability**

Studies of similar waters indicate that the material is stable with respect to the total Hg mass fraction for more than ten years.

## **Uncertainty**

The expanded uncertainty ( $U$ ) for the certified value is equal to  $U = ku_c$ , where  $u_c$  is the combined standard uncertainty calculated according to the Joint Committee for Guides in Metrology (JCGM) [3] and  $k$  is the coverage factor. A coverage factor of  $k = 2$  was applied which corresponds to a level of confidence of approximately 95 %.

All reasonable sources of uncertainty related to the certified value in Table 1 were considered. Included in the combined uncertainty estimate are uncertainties in the batch characterization, uncertainties related to possible between-unit variation, and uncertainties related to inconsistency between the various measurement methods [4].

## **Storage**

The material shall be stored closed and kept in the dark at room temperature.

## **Instructions for handling and use**

PLEASE USE APPROPRIATE CAUTION WHEN OPENING THE VIALS AS SHARP GLASS EDGES MAY CAUSE INJURY.

The ampoule should be opened immediately prior to use. Prior to opening, the contents of the ampoule should be thoroughly mixed by inverting the ampoule. The ampoule should be opened at the pre-scored mark immediately before use and exclusively in a clean area, with precautions taken against contamination during sampling. A piece of tubing is provided to ensure protection when snapping open the pre-scored vial. To open an ampoule, place the plastic tubing over the stem, grasp the tubing in one hand and the body in the other, and position your thumb tip-to-tip near the constriction. Use your thumb tip as a hinge to bend the stem and the body to break the ampoule open. It is preferable to sample directly from the vial as contamination may occur if the liquid comes in contact with freshly exposed surfaces of the vial.

The certified value is only guaranteed if the ampoule is sampled immediately after opening in order to limit solvent evaporation. It is important to note that the volume of the solution is not certified; only the concentration is certified. Therefore, the entire contents of the vial should not be diluted to volume.

Repeated sub-sampling and storage of the CRM solution after initial opening may impact certified values, especially due to the volatility of mercury. Users shall take responsibility for demonstrating that their sub-sampling and storage procedures do not impact the certified value.

## **Health and safety information**

Only qualified personnel should handle the material and appropriate disposal methods should be used. A Safety Data Sheet (SDS) is available at [doi.org/10.4224/crm.2025.orms-6](https://doi.org/10.4224/crm.2025.orms-6). For laboratory use only; not for human consumption, therapeutic, drug, household, or any other uses.

## **Period of validity**

The certified value is valid until April 2035, provided the storage and instructions for handling and use specified in this certificate are followed.

## **Quality management system**

The NRC is Canada's national metrology institute (NMI) and is a signatory of the International Committee for Weights and Measures Mutual Recognition Arrangement (CIPM MRA). The CIPM MRA was developed in a response to a growing need for an open, transparent, and comprehensive scheme to give users reliable quantitative information on the comparability of national metrology services and to provide the technical basis for wider agreements negotiated for international trade, commerce, and regulatory affairs. Our Quality Management System for measurement services and certified reference materials conforms to the requirements of ISO/IEC 17025 and ISO 17034.

The Calibration and Measurement Capabilities (CMC) supporting the result in Table 1 is listed in the International Bureau of Weights and Measures (BIPM) Key Comparison Database (<https://www.bipm.org/kcdb/>) which recognizes the validity of the measurements performed by NMIs participating in the CIPM MRA. The NRC has the following CMC relevant for this material: measurements applied for determining certified values of mercury in water (TEW31).

## **Description of terms**

Certified values are those for which the NRC has the highest confidence and that all known and suspected sources of bias have been considered by the NRC and are reflected in the stated expanded uncertainties.

## Supplemental information

Bibliographic information and any additional technical supplemental information are available at [doi.org/10.4224/crm.2025.orms-6](https://doi.org/10.4224/crm.2025.orms-6).

## References

1. JCGM-100:2008 (2008) Evaluation of measurement data – Guide to the expression of uncertainty in measurement. Joint Committee for Guides in Metrology (JCGM). [doi.org/10.59161/JCGM100-2008E](https://doi.org/10.59161/JCGM100-2008E)
2. EPA Method 245.7 (2005) Mercury in Water by Cold Vapor Atomic Fluorescence Spectrometry, Revision 2.0, United States Environmental Protection Agency (US EPA), EPA-821-R-05-001. <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P1008IY8.txt>
3. van der Veen A.M.H. (2017) Bayesian analysis of homogeneity studies in the production of reference materials. *Accred. Qual. Assur.* 22: 307-319. [doi.org/10.1007/s00769-017-1292-6](https://doi.org/10.1007/s00769-017-1292-6)
4. Possolo A, Meija J. (2022) Measurement uncertainty: A Reintroduction, 2nd edition. Sistema Interamericano de Metrologia. [doi.org/10.4224/1tqz-b038](https://doi.org/10.4224/1tqz-b038)

## Authorship

Kenny Nadeau<sup>1</sup>, Indumathi Gedara Pihillagawa<sup>1</sup>, Kelly L. LeBlanc<sup>1</sup>, Christine Brophy<sup>1</sup>, Calvin Palmer<sup>1</sup>, Mitchell Bordash<sup>1</sup>, Lu Yang<sup>1</sup>, Juris Meija<sup>1</sup>, and Patricia Grinberg<sup>1</sup>

<sup>1</sup> Metrology Research Centre, National Research Council Canada, 1200 Montreal Road, Ottawa, Ontario, K1A 0R6, Canada

## Acknowledgements

The following staff members at the NRC contributed to the production and certification of ORMS-6: Michelle Chartrand, Liam Salsman, Gustavo Bittencourt, Mai Le Phuong and Enea Pagliano.

Date of issue: July 2025

Document version: 20250708

**Approved by:** \_\_\_\_\_

Patricia Grinberg, Ph. D.  
Team Leader, Inorganic Chemical Metrology

This certificate is only valid if the corresponding material was obtained directly from the NRC or an authorized reseller. Users should ensure that the certificate they have is current. For updates, please refer to [doi.org/10.4224/crm.2025.orms-6](https://doi.org/10.4224/crm.2025.orms-6).

## Comments, information, and inquiries should be addressed to:

National Research Council Canada  
Metrology Research Centre  
1200 Montreal Road  
Building M-36, Room 1029  
Ottawa, Ontario K1A 0R6

**Telephone:** 613-993-2359

**Fax:** 613-993-8915

**Email:** [CRM.sales-ventes.MRC@nrc-cnrc.gc.ca](mailto:CRM.sales-ventes.MRC@nrc-cnrc.gc.ca)

**Canada** 