JOINT RESEARCH CENTRE
Institute for Reference Materials and Measurements

CERTIFICATE OF ANALYSIS

ERM®- AE639

Hg in a solution of 0.5 M HCl + 0.05 % (m/v) $K_2Cr_2O_7$			
		Certified value [1]	*Uncertainty* [2]
amount content	mol (^{202}Hg) · g^{-1} (solution)	1.189 1 · 10^{-8}	0.005 0 · 10^{-8}
amount ratios	$n(^{196}Hg)/n(^{202}Hg)$	0.004 972	0.000 046
	$n(^{198}Hg)/n(^{202}Hg)$	0.330 6	0.002 1
	$n(^{199}Hg)/n(^{202}Hg)$	0.561 9	0.002 8
	$n(^{200}Hg)/n(^{202}Hg)$	0.770 5	0.002 8
	$n(^{201}Hg)/n(^{202}Hg)$	0.441 26	0.000 88
	$n(^{204}Hg)/n(^{202}Hg)$	0.230 27	0.000 75

1) The values of the Hg isotope ratios are traceable to the SI via the values of the Tl isotope ratios of the isotopic reference material NIST SRM 997. The Hg content of this natural isotopic spike is traceable to Hg amount content measurements based on gravimetry, whereby a mass of pure substance (Hg_2Cl_2) was weighed and corrections were made for impurities.

2) Estimated expanded uncertainty U with a coverage factor k=2, corresponding to a level of confidence of about 95 %, as defined in the Guide to the Expression of Uncertainty in Measurement (GUM), ISO, 1995.

This certificate is valid for three years after purchase.

Sales date:

The material can be regarded as a homogenous solution.

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Signed:

Dr. Philip Taylor
Unit for Isotope Measurements
EC-DG JRC-IRMM
Retieseweg 111
B-2440 Geel, Belgium

Signed:

Prof. Dr. Hendrik Emons
European Commission
Joint Research Centre
Institute for Reference Materials and Measurements
Retieseweg 111
B-2440 Geel, Belgium

NOTE

European Reference Material **ERM®-AE639** was originally certified as **IRMM-639**. It was produced and certified under the responsibility of the IRMM according to the principles laid down in the technical guidelines of the European Reference Materials® co-operation agreement between BAM-IRMM-LGC. Information on these guidelines is available on the Internet (http://www.erm-crm.org). A detailed technical report on the certification procedure can be found in IRMM Internal Report GE/R/IM/40/99, available from IRMM on explicit request.

DESCRIPTION OF THE SAMPLE

The Spike Isotopic Reference Material ERM®-AE639 is supplied with a certified isotope amount content of ^{202}Hg. The samples are supplied in flame-sealed glass ampoules and contain about 0.2 µmol of mercury in 5 mL of a hydrochloric acid solution. The matrix is 0.5 M sub-boiling distilled hydrochloric acid + 0.05 % (m/v) potassium dichromate.

From the certified values, the following amount and mass contents, the isotopic composition of Hg and the molar mass are derived:

		Certified value	U (k=2) [1]
amount content	mol (Hg) · g^{-1} (solution)	3.971 · 10^{-8}	0.015 · 10^{-8}
mass content	g (^{202}Hg) · g^{-1} (solution)	2.402 · 10^{-6}	0.010 · 10^{-6}
	g (Hg) · g^{-1} (solution)	7.966 · 10^{-6}	0.030 · 10^{-6}
isotope amount fractions of Hg (·100)	n(^{196}Hg)/n(Hg)	0.148 9	0.001 3
	n(^{198}Hg)/n(Hg)	9.900	0.052
	n(^{199}Hg)/n(Hg)	16.826	0.064
	n(^{200}Hg)/n(Hg)	23.073	0.058
	n(^{201}Hg)/n(Hg)	13.213	0.025
	n(^{202}Hg)/n(Hg)	29.944	0.053
	n(^{204}Hg)/n(Hg)	6.895	0.030
isotope mass fractions of Hg (·100)	m(^{196}Hg)/m(Hg)	0.145 4	0.001 2
	m(^{198}Hg)/m(Hg)	9.769	0.052
	m(^{199}Hg)/m(Hg)	16.689	0.064
	m(^{200}Hg)/m(Hg)	23.000	0.058
	m(^{201}Hg)/m(Hg)	13.237	0.025
	m(^{202}Hg)/m(Hg)	30.148	0.053
	m(^{204}Hg)/m(Hg)	7.011	0.030
molar mass of Hg	g·mol^{-1}	200.604 1	0.003 2

[1] All uncertainties indicated are expanded uncertainties $U = k \cdot u_c$ where u_c is the combined standard uncertainty estimated following the ISO/BIPM Guide to the Expression of Uncertainty in Measurement.

Atomic masses used for calculation of the derived values:*

* G. Audi and A.H. Wapstra, The 1993 atomic mass evaluation, *Nucl Phys* A565 (1993) 1-65.

Isotope	g · mol^{-1}	*U* (*k*=2)
^{196}Hg	195.965 814	0.000 008
^{198}Hg	197.966 752	0.000 006
^{199}Hg	198.968 262	0.000 006
^{200}Hg	199.968 309	0.000 006
^{201}Hg	200.970 285	0.000 006
^{202}Hg	201.970 625	0.000 006
^{204}Hg	203.973 475	0.000 006

ANALYTICAL METHOD USED FOR CERTIFICATION

The mercury mass fraction was calculated from gravimetric data, taking results from impurity measurements and uncertainties into account. The isotopic composition was determined by ICP-MS.

PARTICIPANTS

EC-DG-JRC, Institute for Reference Materials and Measurements, Isotope Materials Unit, Retieseweg 111, 2440 Geel, Belgium

SAFETY INFORMATION

The usual laboratory safety precautions apply

INSTRUCTIONS FOR USE

Using this spike isotopic reference material, the Hg content in an unknown sample can be determined by Isotope Dilution, through a measurement of the mercury isotope amount ratio $R(B)$ = n(^{200}Hg)/n(^{202}Hg), in a blend. It should be calculated with the aid of the following equation, which enables an easy quantification of the uncertainty sources in the procedure:

$$c(Hg,X) = \frac{R(Y)-R(B)}{R(B)-R(X)} \cdot \frac{\sum R_i(X)}{\sum R_i(Y)} \cdot \frac{m(Y)}{m(X)} \cdot c(Hg,Y)$$

where:

$R(X)$	=	amount ratio n(^{200}Hg)/n(^{202}Hg) in the unknown sample material X
$R(Y)$	=	amount ratio n(^{200}Hg)/n(^{202}Hg) in the spike material Y
$\sum R_i(X)$	=	sum of all amount ratios in the unknown sample material X
$\sum R_i(Y)$	=	sum of all amount ratios in the spike material Y
$m(X)$	=	mass of unknown sample used in the measurement
$m(Y)$	=	mass of the sample of spike solution used in the measurement
$c(Hg,X)$	=	amount content of Hg · g^{-1} sample material
$c(Hg,Y)$	=	amount content of Hg · g^{-1} spike solution

STORAGE

The material may be stored at 18 °C in the dark.

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European Commission - Joint Research Centre
Institute for Reference Materials and Measurements (IRMM)
Retieseweg 111, B - 2440 Geel (Belgium)
Telephone: +32-14-571.722 - Telefax: +32-14-590.4