JOINT RESEARCH CENTRE
Institute for Reference Materials and Measurements

CERTIFICATE OF ANALYSIS

ERM®- AE649

Tl in 1 M nitric acid			
		Certified value (1)	Uncertainty (2)
amount content	mol ^{205}Tl · g^{-1} (solution)	8.368 8 · 10^{-7}	0.002 7 · 10^{-7}
amount ratio	$n(^{203}\mathrm{Tl})/n(^{205}\mathrm{Tl})$	0.418 91	0.000 18

1) The values reported in this certificate result from measurements performed at IRMM, and are traceable to the SI via the values of the Tl isotope ratios of the isotopic reference material NIST SRM 997.

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.

Accepted as CRM, Geel, March 2001

Signed:

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

Accepted as an ERM®, Geel, June 2004
Latest revision: November 2013

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®-AE649 was originally certified as IRMM-649. 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/19/00, available from IRMM on explicit request.

DESCRIPTION OF THE SAMPLE

The spike isotopic reference material ERM®-AE649 is supplied with a certified amount content of ^{205}Tl and certified isotopic composition of Tl. The samples are supplied in flame-sealed glass ampoules, and contain about 5.9 µmol of thallium in 5 mL of 1 M nitric acid solution.

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

		Certified value	Uncertainty [(1)]
amount content	mol (Tl) · g^{-1} (solution)	1.187 46 · 10^{-6}	0.000 36 · 10^{-6}
mass content	g (^{205}Tl) · g^{-1} (solution)	1.715 39 · 10^{-4}	0.000 56 · 10^{-4}
	g (Tl) · g^{-1} (solution)	2.426 97 · 10^{-4}	0.000 74 · 10^{-4}
isotope amount fraction of Tl (· 100)	n(^{203}Tl) / n(Tl) n(^{205}Tl) / n(Tl)	29.523 4 70.476 6	0.008 8 0.008 8
isotope mass fraction of Tl (· 100)	m(^{203}Tl) / m(Tl) m(^{205}Tl) / m(Tl)	29.319 6 70.680 4	0.008 8 0.008 8
molar mass of Tl in this sample		204.383 33 g·mol^{-1}	0.000 18

[1] 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.

Atomic masses used for calculation of the derived values[1]:

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

Isotope	g · mol^{-1}	U (k=2)
^{203}Tl	202.972 329	0.000 006
^{205}Tl	204.974 412	0.000 006

ANALYTICAL METHOD USED FOR CERTIFICATION

The thallium mass fraction was determined by gravimetric preparation.

PARTICIPANTS

Not applicable

SAFETY INFORMATION

Not applicable

INSTRUCTIONS FOR USE

Using this Spike Isotopic Reference Material, the ^{203}Tl (also applies for ^{205}Tl) content in an unknown sample can be determined by Isotope Dilution, through a measurement of the isotope amount ratio $R(B)$ = $n(^{203}\text{Tl})/n(^{205}\text{Tl})$ 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 **:**

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

where:

$R(X)$	=	amount ratio $n(^{203}\text{Tl})/n(^{205}\text{Tl})$ in the unknown sample material X
$R(Y)$	=	amount ratio $n(^{203}\text{Tl})/n(^{205}\text{Tl})$ 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
$c(Tl, X)$	=	amount content of Tl · g^{-1} sample material
$c(Tl, Y)$	=	amount content of Tl · g^{-1} spike solution

STORAGE

Not applicable

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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: +32-14-590.406