JOINT RESEARCH CENTRE
Institute for Reference Materials and Measurements

CERTIFICATE OF ANALYSIS

ERM®- AE642

Cl in water			
		Certified value (1)	Uncertainty (2)
amount content	mol (^{37}Cl) · g^{-1} (solution)	4.375 ·10^{-6}	0.026 ·10^{-6}
amount ratio	$n(^{35}Cl)/n(^{37}Cl)$	0.019 14	0.000 48

1) The values reported in this certificate result from measurements performed at IRMM, and are traceable to the SI. The values for the isotopic ratios are traceable to the values of NIST SRM-975 and those for the amount content are traceable to ERM®-AE641.

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, February 2002

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®-AE642 was originally certified as IRMM-642. 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/02/00, available from IRMM on explicit request.

DESCRIPTION OF THE SAMPLE

The spike isotopic reference material ERM®-AE642 is supplied with a certified amount content of ^{37}Cl and a certified isotopic compositon. The samples are supplied in flame-sealed quartz ampoules containing about 18 µmol chlorine in 4 mL of water.

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

		Certified value	Uncertainty (1)
amount content	mol (Cl) · g^{-1} (solution)	$4.458 \cdot 10^{-6}$	$0.027 \cdot 10^{-6}$
mass content	g ^{37}Cl · g^{-1} (solution)	$1.617\,1 \cdot 10^{-4}$	$0.009\,7 \cdot 10^{-4}$
	g (Cl) · g^{-1} (solution)	$1.646 \cdot 10^{-4}$	$0.010 \cdot 10^{-4}$
isotope amount fractions of Cl (·100)	$n(^{35}Cl)/n(Cl)$ $n(^{37}Cl)/n(Cl)$	1.878 98.122	0.046 0.046
isotope mass fractions of Cl (·100)	$m(^{35}Cl)/m(Cl)$ $m(^{37}Cl)/m(Cl)$	1.778 98.222	0.044 0.044
molar mass of Cl		36.928 40 g·mol^{-1}	0.000 93

[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:*

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

Isotope	g · mol^{-1}	U (k=2)
^{35}Cl	34.968 852 71	0.000 000 08
^{37}Cl	36.965 902 60	0.000 000 10

ANALYTICAL METHOD USED FOR CERTIFICATION

ERM®-AE642 was prepared by dissolution of ^{37}Cl-enriched NaCl in distilled and subboiled water. The chlorine amount content was determined by Isotope Dilution Mass Spectrometry, the isotopic composition was determined by negative thermal ionization mass spectrometry.

PARTICIPANTS

Not applicable

SAFETY INFORMATION

Not applicable

INSTRUCTIONS FOR USE

Using this spike isotopic reference material, the ^{35}Cl content in an unknown sample can be determined by Isotope Dilution, through a measurement of the isotope amount ratio $R(B) = n(^{35}Cl)/n(^{37}Cl)$ 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:

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

where:

$R(X)$	=	amount ratio $n(^{35}Cl)/n(^{37}Cl)$ in the sample material X
$R(Y)$	=	amount ratio $n(^{35}Cl)/n(^{37}Cl)$ 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 spike solution used in the measurement
$c(Cl,X)$	=	amount content of Cl · kg^{-1} sample material
$c(Cl,Y)$	=	amount content of Cl · kg^{-1} spike solution

STORAGE

Not applicable

LEGAL NOTICE

Neither the European Commission, its contractors nor any person acting on their behalf:

(a) make any warranty or representation, express or implied, that the use of any information, material, apparatus, method or process disclosed in this document does not infringe any privately owned intellectual property rights; or

(b) assume any liability with respect to, or for damages resulting from, the use of any information, material, apparatus, method or process disclosed in this document save for loss or damage arising solely and directly from the negligence of the Institute for Reference Materials and Measurements of the European Commission's Joint Research Centre.

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