IRMM

Institute for Reference Materials and Measurements

CERTIFICATE
SPIKE ISOTOPIC REFERENCE MATERIAL IRMM-619

$8.500(24) \cdot 10^{-5}$ mol (^{85}Rb) · kg^{-1} (solution)

The Spike Isotopic Reference Material is supplied with an isotope amount content of ^{85}Rb certified as above.

The amount content of other rubidium isotopes present are related to the ^{85}Rb content through the following certified amount ratios**:**

$n(^{85}Rb)/n(^{87}Rb)$:	**2.593 0(20)**

This corresponds to an isotopic composition with the following abundances **:**

amount fraction (·100)		mass fraction (·100)	
$n(^{85}Rb)/n(Rb)$	72.168(15)	$m(^{85}Rb)/m(Rb)$	71.699(16)
$n(^{87}Rb)/n(Rb)$	27.832(15)	$m(^{87}Rb)/m(Rb)$	28.301(16)

The molar mass of the rubidium in this sample is 85.467 70(30) g·mol^{-1}

From the certified values, the following amount content and mass fractions are derived:

$1.177\ 8(34) \cdot 10^{-4}$	mol (Rb) · kg^{-1} (solution)
$7.217\ 5(20) \cdot 10^{-6}$	kg (^{85}Rb) · kg^{-1} (solution)
$1.006\ 6(28) \cdot 10^{-5}$	kg (Rb) · kg^{-1} (solution)

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NOTES

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. They are given in parentheses and include a coverage factor k=2. They apply to the last two digits of the value. The values certified are traceable to the SI.

2. The Spike Isotopic Reference Material IRMM-619 comes in a flame-sealed quartz ampoule containing about 0.5 µmol rubidium in 4 mL of a chemically stable nitric acid solution. The molarity is about 0.5 M HNO_3 (i.e. 0.5 mol HNO_3 per Liter of solution).

3. The atomic masses, used in the calculations, are[1]

^{85}Rb : 84.911 792 4 (54) g·mol^{-1}
^{87}Rb : 86.909 185 8 (56) g·mol^{-1}

4. Full details of the preparation and certification procedure can be found in IRMM certification Report GE/IM/R/34/99[2].

5. Using this Spike Isotopic Reference Material, the ^{87}Rb content in an unknown sample can be determined by Isotope Dilution, through a measurement of the isotope amount ratio $R(B) = n(^{85}\text{Rb})/n(^{87}\text{Rb})$ in a blend. It should be computed with the aid of the following equation which enables an easy quantification of the uncertainty sources in the procedure:

$$c\left(^{87}Rb, X\right) = \frac{R(Y) - R(B)}{R(B) - R(X)} \cdot \frac{1}{R(Y)} \cdot \frac{m(Y)}{m(X)} \cdot c\left(^{85}Rb, Y\right)$$

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

[1] G Audi and A H Wapstra, The 1993 atomic mass evaluation, Nucl Phys A565 (1993) 1-65.
[2] M Ostermann, M Berglund and A Verbruggen, Certification of the rubidium isotope amount content in the isotopic reference material IRMM-619

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where:

$R(X)$	=	amount ratio $n(^{85}Rb)/n(^{87}Rb)$ in the sample material X
$R(Y)$	=	amount ratio $n(^{85}Rb)/n(^{87}Rb)$ in the spike material Y
$c(^{87}Rb, X)$	=	amount content of $^{87}Rb \cdot kg^{-1}$ sample material
$c(^{85}Rb, Y)$	=	amount content of $^{85}Rb \cdot kg^{-1}$ spike solution
$\sum R_i(X)$	=	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
$c(Rb, X)$	=	amount content of $Rb \cdot kg^{-1}$ sample material
$c(Rb, Y)$	=	amount content of $Rb \cdot kg^{-1}$ spike solution.

6. This Spike Isotopic Reference Material is traceable to the SI in the shortest possible way. Measurements calibrated against these Isotopic Reference Materials have therefore the potential of being traceable to the SI.

The preparation of this Spike Isotopic Reference Material was performed by U Örnemark. The isotopic measurements were performed by M Ostermann and M Berglund by Thermal Ionisation Mass Spectrometry. Chemical preparation of the samples for isotopic measurements was performed by M Ostermann.

Metrological weighings required in the preparation and certification were performed by B Dyckmans - Van Hout and F Hendrickx. The ampoulation of this Spike Isotopic Reference Material was accomplished by G Van Baelen, U Örnemark and J C Wolff.

The overall co-ordination leading to the establishment, certification and issuance of this Spike Isotopic Reference Material was performed by A Verbruggen.

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October 1999

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IRMM Isotope Measurements