IRMM
Institute for Reference Materials and Measurements

CERTIFICATE
ISOTOPIC REFERENCE MATERIAL IRMM-651

$77.506\ (30) \cdot 10^{-9}$ mol (^{64}Zn) · g^{-1} (solution)

The Isotopic Reference Material is supplied with an isotope amount content of ^{64}Zn certified as above.

The amount of Zinc isotopes present are related to the ^{64}Zn content through the following certified amount ratios:

$n(^{66}Zn)/n(^{64}Zn)$:	0.557 17 (30)
$n(^{67}Zn)/n(^{64}Zn)$:	0.080 702 (34)
$n(^{68}Zn)/n(^{64}Zn)$:	0.366 27 (12)
$n(^{70}Zn)/n(^{64}Zn)$:	0.011 981 (22)

This corresponds to an isotopic composition with the following abundances:

amount fraction (·100)		mass fraction (·100)	
$n(^{64}Zn)/n(Zn)$	49.600 2 (84)	$m(^{64}Zn)/m(Zn)$	48.511 9 (82)
$n(^{66}Zn)/n(Zn)$	27.636 (11)	$m(^{66}Zn)/m(Zn)$	27.875 (11)
$n(^{67}Zn)/n(Zn)$	4.002 8 (10)	$m(^{67}Zn)/m(Zn)$	4.098 8 (11)
$n(^{68}Zn)/n(Zn)$	18.167 0 (58)	$m(^{68}Zn)/m(Zn)$	18.879 0 (59)
$n(^{70}Zn)/n(Zn)$	0.594 3 (12)	$m(^{70}Zn)/m(Zn)$	0.635 8 (12)

The molar mass of the Zinc in this sample is 65.362 54 (21) g·mol^{-1}

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

156.263 (55) $\cdot 10^{-9}$	mol (Zn) · g^{-1} (solution)
5.066 0 (20) $\cdot 10^{-6}$	g (^{64}Zn) · g^{-1} (solution)
10.213 7 (36) $\cdot 10^{-6}$	g (Zn) · g^{-1} (solution)

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NOTES

1. The isotope amount content value and the isotopic ratios of this Isotopic Reference Material are traceable to the SI in the shortest possible way via metrological weighings and via IRMM-007/3, IRMM-007/4, IRMM-007/5 and IRMM-007/6. Measurements calibrated by this Isotopic Reference Material have therefore the potential of being traceable to the SI (mole).

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

3. The IRMM-651 has been prepared from diluting a vacuum distilled zinc shot. The IRMM-651 comes in a flame sealed quartz ampoule containing about 0.78 µmol Zinc in 5 mL of a chemically stable nitric acid solution. The molarity is about 0.5M. Details of the preparation and certification procedure can be found in[2].

4. The atomic masses used in the calculations are[3]:

^{64}Zn:	63.929 142 2 (14)
^{66}Zn:	65.926 033 4 (20)
^{67}Zn:	66.927 127 3 (20)
^{68}Zn:	67.924 844 2 (20)
^{70}Zn:	69.925 319 3 (42)

5. All metrological weighings required in the preparation and certification were done by F. Hendrickx. The isotope abundance ratio measurements of the IRMM-651 were done by E. Ponzevera, using Multiple Collector Inductively Coupled Plasma Mass Spectrometry (MC-ICPMS). M. Berglund and C. Hennessy co-ordinated the preparation of this Isotopic Reference Material and G. Van Baelen was responsible for ampouling. C. Quétel co-ordinated the work leading to the certification of this Isotopic Reference Material and A. Verbruggen was responsible for issuance of the certificate.

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Dr P. Taylor
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IRMM Isotope Measurements

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[1] International Organisation for Standardisation, Guide to the Expression of Uncertainty in Measurements, Geneva, Switzerland 1995.
[2] Mass discrimination during MC-ICPMS isotopic ratio measurements: investigation by means of synthetic isotopic mixtures (IRMM-007 series) and application to the calibration of natural-like zinc materials (including IRMM-3702 and IRMM-651). , Ponzevera *et al*., Journal of the American Society for Mass Spectrometry, 2006. 17: p. 1412-1427.
[3] The 2003 atomic mass evaluation: (II). Tables, graphs and references. Audi *et al*., Nuclear Physics A, 2003. 729(1): p. 337-676. Atomic masses used in [2] above come from an older reference (Isotope abundance variations of selected elements, Coplen *et al*. Pure Appl. Chem., Vol. 74, 10, pp1987-2017, 2002). This difference has impact only on last decimal of the calculated molar mass and no impact on Zn isotope ratios, amount and mass fractions.