

JOINT RESEARCH CENTRE  
Institute for Reference Materials and Measurements

# CERTIFICATE OF ANALYSIS

ERM<sup>®</sup> - EC680m

LOW-DENSITY POLYETHYLENE		
	Mass Fraction	
	Certified value <sup>1)</sup> [mg/kg]	Uncertainty <sup>2)</sup> [mg/kg]
As	4.7	0.4
Br	181	9
Cd	20.8	0.9
Cr	9.6	0.5
Hg	2.56	0.16
Pb	11.3	0.4
S	86	9
Sb	9.6	0.7
Sn	20.7	1.6
Zn	194	12

1) Certified values are values that fulfil the highest standards of accuracy. The given values represent the unweighted mean values of the means of accepted sets of data, each set being obtained in a different laboratory and/or with a different method of determination. The certified value and its uncertainty are traceable to the International System of units (SI).

2) The uncertainty is the expanded uncertainty of the certified value with a coverage factor  $k = 2$  corresponding to a level of confidence of about 95 % estimated in accordance with ISO/IEC Guide 98-3, Guide to the Expression of Uncertainty in Measurement (GUM:1995), ISO, 2008.

This certificate is valid for one year after purchase.

Sales date:

The minimum amount of sample to be used is 150 mg for Cl and 90 mg for all other elements.

Accepted as an ERM<sup>®</sup>, Geel, December 2015

Signed:



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Joint Research Centre  
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## NOTE

European Reference Material ERM<sup>®</sup>-EC680m was produced and certified under the responsibility of the Institute for Reference Materials and Measurements of the European Commission's Joint Research Centre according to the principles laid down in the technical guidelines of the European Reference Materials<sup>®</sup> co-operation agreement between BAM-IRMM-LGC. Information on these guidelines is available on the internet (<http://www.erm-crm.org>).

Indicative Values		
	Mass Fraction	
	Indicative value <sup>1)</sup> [mg/kg]	Uncertainty <sup>2)</sup> [mg/kg]
Cl	84	11
<p>2) Indicative values are values where either the uncertainty is deemed too large or where too few independent datasets are available to allow certification and are therefore less reliable than certified values. Great caution should be used when using these values. The given value is an unweighted mean value of the means of accepted sets of data, each set being obtained in a different laboratory and/or with a different method of determination. The indicative value and its uncertainty are traceable to the International System of units (SI).</p> <p>3) The uncertainty is the expanded uncertainty of the indicative with a coverage factor <math>k = 2</math> corresponding to a level of confidence of about 95 % estimated in accordance with ISO/IEC Guide 98-3, Guide to the Expression of Uncertainty in Measurement (GUM:1995), ISO, 2008.</p>		

## DESCRIPTION OF THE MATERIAL

The sample consists of approximately 100 g granulate of low-density polyethylene (LDPE) spiked with various pigments to obtain the desired element contents.

## ANALYTICAL METHODS USED FOR CERTIFICATION

Cold vapour atomic absorption spectrometry (CV-AAS)

Cold vapour atomic fluorescence spectrometry (CV-AFS)

Electrothermal atomic absorption spectrometry (ETAAS)

Inductively coupled plasma mass spectrometry (both quadrupole and sectorfield) with external and with isotopically labelled standards (ICP-QMS, ICP-SFMS, ICP-IDMS)

Inductively coupled plasma atomic emission spectrometry (ICP-AES)

Isotope dilution thermal ionisation mass spectrometry (ID-TIMS)

Neutron activation analysis with  $k_0$ -standardisation ( $k_0$ NAA)

Combustion with subsequent ion chromatographic detection (combustion-IC)

Combustion with subsequent infrared spectrometry (combustion-IR)

## PARTICIPANTS

ALS Scandinavia AB, Luleå, Sweden

(measurements for one method under the scope of ISO/IEC 17025 accreditation SWEDAC 2030)

Australian Nuclear Science and Technology Organization, Lucas Heights, Australia

AIMPLAS-Instituto Tecnológico del Plástico, Valencia, Spain

Bundesanstalt für Materialforschung und Prüfung, Berlin, Germany

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(measurements under the scope of ISO/IEC 17025 accreditation SLOVENSKA AKREDITACIJA LP090)

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Technische Universität Bergakademie Freiberg, Freiberg, Germany

Umweltbundesamt GmbH, Wien, Austria

(measurements under the scope of ISO/IEC 17025 accreditation Akkreditierung Austria ID 200)

Università Degli Studi di Ferrara, Ferrara, Italy

Vlaamse Instelling voor Technologisch Onderzoek (VITO), Mol, Belgium

## SAFETY INFORMATION

The usual laboratory safety precautions apply.

## INSTRUCTIONS FOR USE AND INTENDED USE

The main purpose of this material is to assess method performance, i.e. for checking the accuracy of analytical results. Note that if the tested material contains insoluble pigments, results obtained on this CRM may not be representative for the tested sample for wet digestion methods. It can also be used for control charts, validation studies or for calibration.

### Comparing an analytical result with the certified value

A result is unbiased if the combined standard uncertainty of measurement and certified value covers the difference between the certified value and the measurement result (see also ERM Application Note 1, [www.erm-crm.org](http://www.erm-crm.org)).

For assessing the method performance, the measured values of the CRMs are compared with the certified values. The procedure is described here in brief:

- Calculate the absolute difference between mean measured value and the certified value ( $\Delta_{\text{meas}}$ ).
- Combine measurement uncertainty ( $u_{\text{meas}}$ ) with the uncertainty of the certified value ( $u_{\text{CRM}}$ ):  $u_{\Delta} = \sqrt{u_{\text{meas}}^2 + u_{\text{CRM}}^2}$
- Calculate the expanded uncertainty ( $U_{\Delta}$ ) from the combined uncertainty ( $u_{\Delta}$ ) using an appropriate coverage factor, corresponding to a level of confidence of approximately 95 %.
- If  $\Delta_{\text{meas}} \leq U_{\Delta}$  no significant difference between the measurement result and the certified value, at a confidence level of about 95 % exists.

### Use in quality control charts

The materials can be used for quality control charts. Different CRM-units will, within the uncertainty, give the same result as inhomogeneity was included in the uncertainties of the certified values.

### Use as a calibrant

It is not recommended to use this matrix material as calibrant for the final instrumental quantification step, because the certified values have higher uncertainties than pure standards. If this CRM is used as a calibrant, the uncertainty of the certified value must, as always, be taken into account in the estimation of the measurement uncertainty.

## **STORAGE**

The materials shall be stored at  $(18 \pm 5)$  °C in a dry environment in the dark.

However, the European Commission cannot be held responsible for changes that happen during storage of the material at the customer's premises, especially of opened samples.

## **LEGAL NOTICE**

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## **NOTE**

A detailed technical report is available at [www.irmm.jrc.be](http://www.irmm.jrc.be). A paper copy is obtainable from the Joint Research Centre, Institute for Reference Materials and Measurements on request.

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