

# CERTIFICATE OF REFERENCE MATERIAL

RM 006

BR1  
Copper alloy  
Bronze B555

The assigned certified values<sup>1</sup> and uncertainties<sup>2</sup>

|     | Zn           | Sn          | Pb           | Fe            | P            | As            | Sb            | Mn            | Ni           | Al           | S             |
|-----|--------------|-------------|--------------|---------------|--------------|---------------|---------------|---------------|--------------|--------------|---------------|
|     | %            | %           | %            | %             | mg/kg        | mg/kg         | %             | %             | %            |              | %             |
| BR1 | <b>5.079</b> | <b>4.95</b> | <b>5.037</b> | <b>0.0852</b> | <b>97.00</b> | <b>102.00</b> | <b>0.0903</b> | <b>0.0801</b> | <b>0.481</b> | <b>74.50</b> | <b>0.0143</b> |
|     | ±0.063       | ±0.11       | ±0.0.097     | ±0.0078       | ±21.71       | ±8.24         | ±0.0037       | ±0.0033       | ±0.017       | ±3.06        | ±0.0025       |

<sup>1</sup> 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.

<sup>2</sup> The certified uncertainty is the expanded uncertainty with a coverage factor k=2, corresponding to a level of confidence of about 95 %.

### Not certified values

|     | Si          | Cu              |
|-----|-------------|-----------------|
|     | mg/kg       |                 |
| BR1 | <b>77.1</b> | <b>The rest</b> |

Value for Si is presented as an informative because it was obtained only by two laboratories (unweighted mean value of the means)

Certified on October 2019

Last revision on November 2023

Signature

SIEĆ BADAWCZA ŁUKASIEWICZ  
INSTYTUT METALI NIEŻELAZNYCH  
DYREKTOR

dr inż. Barbara Juszczyk

#### Description of the material:

The certified reference material is available in the form of discs (40 mm diameter and ~25 mm height).

#### Traceability:

The certified values are traceable to the SI via calibration using pure metals, certified monoelement standard solutions and certified reference materials i.e. MI5, BL2, BL3, BL4, WD1, WD2, WD3, WD4, WR1, WR5, MA1, WB7, MO4, BI3 produced by The Institute of Non-Ferrous Metals. All values were confirmed in an inter-laboratory comparison using independent analytical methods.

#### Analytical methods applied for characterization:

Inductively coupled plasma optical emission spectrometry (ICP-OES)  
X-ray Fluorescence spectrometry with wavelength dispersion (WDXRF)  
Flame atomic absorption spectrometry (FAAS)  
Volumetric method  
Complexometric titration with potentiometric end-point detection  
Colourmetric method  
Combustion method with IR detection

#### Participating laboratories:

|                          | Zn         | Sn         | Pb         | Fe         | P    | As      | Sb         | Mn         | Ni         | Al      | S    | Si   |
|--------------------------|------------|------------|------------|------------|------|---------|------------|------------|------------|---------|------|------|
| ICP-OES                  | 1, 2, 6, 7 | 1, 2, 6, 7 | 1, 2, 6, 7 | 1, 2, 6, 7 | 1, 7 | 1, 2, 6 | 1, 2, 6, 7 | 1, 2, 6, 7 | 1, 2, 6, 7 | 1, 2, 7 | 1, 7 | 2, 6 |
| WDXRF                    | 1          | 1          | 1          | 1          | 1    | 1       | 1          | 1          | 1          | 1       | 1    |      |
| FAAS                     | 2, 4, 5    | 2, 4       | 2, 4, 5    | 2, 4, 5    |      |         | 2, 4       | 2, 4, 5    | 2, 4       | 4       | 5    |      |
| Volumetric method        |            | 3          |            |            |      |         |            |            |            |         |      |      |
| Complexometric titration |            |            | 3          |            |      |         |            |            |            |         |      |      |
| Colourmetric method      |            |            |            |            | 6    |         |            |            |            |         |      |      |
| IR                       |            |            |            |            |      |         |            |            |            |         | 1, 6 |      |

1. Łukasiewicz Research Network-Institute of Non-Ferrous Metals, Analytical Chemistry Department, Emission Spectrometry Laboratory, Gliwice, Poland
2. Łukasiewicz Research Network-Institute of Non-Ferrous Metals, Analytical Chemistry Department, Atomic Spectrometry Laboratory, Gliwice, Poland
3. Łukasiewicz Research Network-Institute of Non-Ferrous Metals, Analytical Chemistry Department, Laboratory of Classical Analyses, Gliwice, Poland
4. Walcowania Metali „Dziedzice” S.A., Czechowice – Dziedzice, Poland
5. Łukasiewicz Research Network-Foundry Research Institute
6. Universal Scientific Laboratory Pty Ltd, Milperra, Australia
7. AIM, Montreal, Kanada

Intended use:

The CRM is intended for establishing or checking the calibration of optical emission and X-ray spectrometers for analysis of samples of similar matrix composition (for micro-analysis is not verified).

Minimum sample size:

Materials designed for spark-OES spectrometry, XRF spectrometry (>1 mm spot size). For other analytical techniques minimum 0.5 g of the CRM is required.

Instructions for storage and use:

Storage the material in a dry and clean environment at room temperature.

Transport under normal conditions.

Before every use, the surface of CRM must be prepared by milling or turning on a lathe. Overheating of the material during preparation should be avoided. Samples should be prepared in the same way as the CRM. Such preparation does not result in change of certified values.

Brief description of the production and certification process:

was made by melting of all components in the inductive, of crucible furnace and by casting into special moulds protecting elimination of segregation of the components during solidification. Homogeneity testing were made taking into account over 30% of the material produced. Investigations were carried out using atomic emission spectrometry method with low voltage spark. Homogeneity was estimated statistically with application of the ANOVA.

The certification of BR1 is valid 50 years, within the measurement uncertainties specified, provided the CRM is handled in accordance with the instructions given in this certificate.

Expired date:

50 years

Certificate Revision History: 31st of October 2019 (original certificate date); 27th of February 2021 (additional information about traceability, methods used for certification and minimum sample size was added; uncertainties were recalculated); 30th of March (edition and supplementation of: title section, the tables, traceability section, instruction for storage and use section and expired date); 19th of October (edition and supplementation of: validity, information about accreditation); 29th of June 2022 (additional information about traceability and methods use for certification); 30<sup>th</sup> of November 2023 (change of graphic design)

Since 2018 our production of the certified reference materials is carried out in accordance with requirements of the ISO 17034 standard.

The Łukasiewicz Research Network —Institute of Non-Ferrous Metals holds an accreditation of the Polish Centre for Accreditation as a reference material producer according to ISO/IEC 17034 with certificate number RM 006.

**Contact:**

**Łukasiewicz Research Network —Institute of Non-Ferrous Metals  
Centre of Analytical Chemistry  
Sowińskiego 5 Street  
44-100 Gliwice, Poland  
e-mail: [crm@imn.lukasiewicz.gov.pl](mailto:crm@imn.lukasiewicz.gov.pl)  
phone: +48 32 23 80 408**

[www.reference-materials.com](http://www.reference-materials.com)

