Łukasiewicz
Instytut Metali
Nieżelaznych

CERTIFICATE
OF REFERENCE MATERIAL

CS
Copper of high purity

The assigned certified values[1] and uncertainties[2]

	CS1	CS2	CS3	CS4	CS5
	mg/kg				
Ag	**53.0**	**45.6**	**38.9**	**237.0**	**320.0**
	±3.6	±4.8	±3.3	±36	±30
As	**2.3**	**7.9**	**13.8**	**42.2**	**70.5**
	±0.80	±0.98	±2.3	±4.5	±5.7
Bi	**1.1**	**6.2**	**12.2**	**39.6**	**59.7**
	±0.14	±0.93	±1.5	±3.1	±4.0
Cd	**1.0**	**7.4**	**13.4**	**35.5**	**66.1**
	±0.38	±2.0	±0.65	±2.1	±3.1
Fe	**18.4**	**30.5**	**28.3**	**82.0**	**90.9**
	±1.3	±3.4	±3.5	±5.4	±6.7
Ni	**46.8**	**26.6**	**11.1**	**7.1**	**4.4**
	±3.2	±3.9	±0.50	±0.67	±0.69
Pb	**60.5**	**38.6**	**13.3**	**7.6**	**5.0**
	±3.2	±1.3	±1.3	±0.67	±0.70
Sb	**3.0**	**7.5**	**13.0**	**36.8**	**63.9**
	±0.55	±1.5	±2.2	±4.2	±3.2
Se	**62**	**39.5**	**15.4**	**6.7**	**0.9**
	±11	±6.1	±3.7	±1.0	±0.18
Sn	**52.9**	**33.6**	**13.3**	**6.2**	**0.85**
	±3.7	±3.4	±1.2	±0.84	±0.26
Te	**2.1**	**5.6**	**10.6**	**32.9**	**49.9**
	±0.73	±0.67	±1.3	±3.5	±6.8
Zn	**24.1**	**8.9**	**31.3**	**44.0**	**101**
	±6.5	±2.1	±5.4	±3.6	±12
Co	**0.6**	**3.8**	**7.4**	**24.3**	**37.5**
	±0.25	±0.47	±0.67	±1.8	±2.6
Mn	**29.0**	**35.3**	**12.6**	**8.3**	**4.2**
	±3.4	±4.2	±1.2	±0.93	±1.0
S	**65.9**	**44.9**	**18.8**	**41.3**	**12.0**
	±3.0	±3.8	±2.5	±2.7	±1.7
Cr	-	**35.8**	**10.9**	**7.0**	**1.1**
	-	±1.8	±1.6	±1.1	±0.23
P	**57.7**	**33.8**	**12.1**	**6.3**	**2.0**
	±5.4	±4.4	±1.4	±0.35	±0.68

[1] 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.

[2] The certified uncertainty is the expanded uncertainty with a coverage factor k=2, corresponding to a level of confidence of about 95 %.

Version 2 from 30th of November 2023

Not certified values

	CS1	CS2	CS3	CS4	CS5
	mg/kg				
B	**1.6**	**3.1**	**4.2**	**21.7**	**35.2**
Cr	**0.3**	-	-	-	-
Si	**3.0**	**9.4**	**22.2**	**46.5**	**54.7**

Signature

SIEĆ BADAWCZA ŁUKASIEWICZ
INSTYTUT METALI NIEŻELAZNYCH
DYREKTOR
dr inż. Barbara Tuszczyk

Description of the material:

The certified reference materials are available in the form of 40 mm diameter and 25 mm height discs.

Traceability:

The certified values are traceable to the SI via calibration using pure metals, certified monoelement standard solutions and certified reference materials i.e. BAM-M365a produced by BAM Federal Institute for Materials Research and Testing, 39X17869 (AG) produced by MBH Analytical LTD. All values were confirmed in an inter-laboratory comparison using independent analytical methods.

Analytical methods applied for characterization:

Ag - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry directly on the background of matrix

As - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry after co-precipitation on Fe(OH)3 (pH=4)

Bi - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry after co-precipitation on Fe(OH)3 (pH=4)

Cd - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry directly on the background of matrix

Fe - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry after co-precipitation on La(OH)3 (pH=9)

Ni - atomic emission spectrometry with ICP and low voltage spark, spectrophotometric with dimethylgliyoxime after electrolytic copper separation and extraction of Ni with chloroform

Pb - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry after co-precipitation on $Fe(OH)_3$ (pH=9)

Sb - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry after co-precipitation on $Fe(OH)_3$ (pH=4)

Se - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry after co-precipitation on $Fe(OH)_3$ (pH=4)

Sn - atomic emission spectrometry with ICP and low voltage spark, spectrophotometric with phenylophluoran after separation on MnO_2

Te - atomic emission spectrometry with ICP, atomic absorption spectrometry after co-precipitation on $Fe(OH)_3$ (pH=4)

Zn - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry after electrolytic copper separation

Co - atomic emission spectrometry with ICP, atomic absorption spectrometry directly or after electrolytic copper separation

B - atomic emission spectrometry with ICP, spectrophotometric (directly) with azomethine H

Mn - atomic emission spectrometry with ICP and low voltage spark atomic absorption spectrometry directly on the background of matrix

S - atomic emission spectrometry with ICP and low voltage spark, method of combusting and infrared determination of SO_2

Cr - atomic emission spectrometry with ICP and low voltage spark atomic absorption spectrometry directly on the background of matrix

P - atomic emission spectrometry with ICP and low voltage spark spectrophotometric with blue-phosphoromolibdenate after extraction

Si - atomic emission spectrometry with ICP, spectrophotometric with amyl-alcohol

Participating laboratories:

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. Walcownia Metali Nieżelaznych "Łabędy" S.A., Gliwice, Poland
4. Zakłady Hutniczo-Przetwórcze Metali Nieżelaznych "HUTMEN", Wrocław, Poland
5. Walcownia Metali Dziedzice S.A., Czechowice-Dziedzice, Poland
6. Huta Metali Nieżelaznych Szopienice S.A., Katowice, Poland

Intended use:

The CRM is intended for establishing or checking the calibration of spark-OES and XRF for analysis of samples of similar matrix composition.

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.

The surface of CRM must be prepared by milling or turning on a lathe before every use. Samples should be prepared in the same way as the CRM.

Brief description of the production and certification process:

For the certification process random specimens were selected.

Homogeneity investigations were made taking into account 30 % of the material produced. Investigations were carried out the using atomic emission spectrometry method with low voltage spark. Homogeneity was estimated statistically with application of the test F.

The certification of CS 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 December 2002 (original certificate date); 30th of November 2023 (additional information about: expanded uncertainties, traceability, participating laboratories, methods used for certification, minimum sample size, instruction for storage and use and expire date was added 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
phone: +48 32 23 80 408
www.reference-materials.com