

## Certified Reference Material

## Certificate of Analysis

ISO  
17034:2016

ISO/IEC  
17025:2017

ISO  
9001:2015

**Product ID:** IARM-CU182-18

**Product Description:** Copper Alloy, CDA 182 / C18200

Revision No.: 000  
 Revision Date: 07/25/2022

**Description and Intended Use:** This **Certified Reference Material** is covered under the scope of accreditation to **ISO 17034** by LGC Standards - Manchester, NH. As an ISO 17034 certified reference material, appropriate use of this material will fulfill the certified reference material and traceability requirements for use in **ISO 17025** accredited laboratories. This CRM may come in the form of a solid disk, or chips. The intended use of this CRM may include, but is not limited to, the calibration of instruments and the validation of analytical methods.

**Certified Values listed in wt.% with associated uncertainties**

<b>Ag</b>	<b>0.0008</b> ± 0.0002	<b>Al</b>	<b>0.0031</b> ± 0.007	<b>Co</b>	<b>0.00013</b> ± 0.00005	<b>Cr</b>	<b>1.09</b> ± 0.05
<b>Cu</b>	<b>98.8</b> ± 0.3	<b>Fe</b>	<b>0.041</b> ± 0.003	<b>Mg</b>	<b>0.0019</b> ± 0.0004	<b>Mn</b>	<b>0.0007</b> ± 0.0002
<b>Ni</b>	<b>0.0007</b> ± 0.0002	<b>P</b>	<b>0.0012</b> ± 0.0004	<b>Pb</b>	<b>0.0019</b> ± 0.0005	<b>S</b>	<b>0.0018</b> ± 0.0004
<b>Si</b>	<b>0.09</b> ± 0.02	<b>Sn</b>	<b>0.002</b> ± 0.001	<b>Zn</b>	<b>0.010</b> ± 0.001	<b>Zr</b>	<b>0.063</b> ± 0.008

**Indicative Values listed in ppm**

As (7)    Bi (4)    C (50)    Ca (15)    O (11)    Sb (50)    Ti (4)

**Homogeneity and Uncertainty:** "Uncertainty" values, as reported adjacent to certified concentration values, are based on a 95% Confidence Interval. These estimated uncertainties include the combined effects of method imprecision, material inhomogeneity, and any bias between methods. Homogeneity data from experimental XRF results are reflected in both the overall statistics and certified data. Homogeneity samples are selected by a systematic sampling procedure. The number of samples may be determined by equation 1, where  $N_{prod}$  is the number of units produced and  $N_{min}$  is the number of samples used for homogeneity testing. These samples are arranged in a simple randomized design such that each sample is analyzed multiple times by XRF. Homogeneity may also be determined within sample using an applied version of ASTM E826. A single factor ANOVA is used to calculate uncertainty due to inhomogeneity ( $U_{hom}$ ). Uncertainty of the material is calculated by equation 2, where  $H=U_{hom}$ ,  $S$ = Standard deviation,  $t$ = t-value at 95% CI, and  $n$ = number of observations.

$$1. N_{MIN} = \max(10, \sqrt[3]{N_{PROD}}) \qquad 2. U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$$

**Certification Laboratories:** Much of the analytical work performed to assess this material has been carried out by laboratories with proven competence, as indicated by their accreditation to ISO 17025. It is an implicit requirement for this accreditation that analytical work should be performed with due traceability, via an unbroken chain of comparisons, each with stated uncertainty, to primary standards such as the mole, or to nationally- or internationally-recognized reference materials. Of the individual results herein, some have traceability (to the mole) via primary analytical methods. Some are traceable to substances of known stoichiometry. Most have traceability via commercial solutions. Furthermore, some results have additional traceability to NIST standards, as part of the analytical calibration or process control.

- AnchorCert Analytical- Birmingham, UK
- LGC Standards - Manchester, NH
- New Hampshire Materials Laboratory, Somersworth, NH
- IMR Test Labs - Lansing, NY
- Laboratory Testing, Inc. – Hatfield, PA
- SGS MSI - Melrose Park, IL
- Lucid Laboratories Pvt. Ltd - Hyderabad, India
- Analyticka Laborator Lithea S.R.O - Brno, Czech Republic
- Scrooby's Laboratory Service - Benoni, South Africa
- TCR Engineering Services Pvt. Ltd. - Mumbai, India
- TEC Eurolab - Campogalliano, Italy
- Applied Technical Services - Marietta, GA

**Instructions for Use:** The test surface is on the opposite side of the labeled surface, which includes the material identification. The entire thickness of the unit is certified. However, the user is cautioned not to measure disks less than 2 mm thick when using X-ray fluorescence spectrometry. Each packaged disk has been prepared by finishing the test surface using a lathe. The user must determine the correct surface preparation procedure for each analytical technique. The user is cautioned to use care when either resurfacing the disk or performing additional polishing, as these processes may contaminate the surface. The minimum sample size for chips should be individually evaluated based on the analytical technique used; this would typically be greater than 0.1 grams. The material should be stored in a cool, dry location when not in use.

Chips are not recommended for gas analysis.

**Period of Validity:** The certification of this material is valid indefinitely, within the uncertainty specified, provided the material is handled and stored in accordance with the instructions stated on this certificate. The certification is nullified if the material is damaged, contaminated, otherwise modified, or used in a manner for which it was not intended.



**Chuck Goudreau, Certifying Officer**

July 25, 2022  
**Certification Date**



ISO 17034 Accredited: Reference Materials  
 Producer, Certificate # 2848.02  
 ISO/IEC 17025 Accredited: Chemical  
 Testing, Certificate # 2848.01

**Conditions of Sale and Supply:** All CRMs & RMs sold are subject to applicable LGC Standard Terms and Conditions of Sale.

The following data represents all pertinent information reported as it applies to the chemical characterization of this material.

	Ag	Al	As	Bi	C	Ca	Co	Cr	Cu	Fe	Mg	Mn
1	0.0004	0.0020	0.0001	0.0001	0.0010	0.0010	0.0001	0.9060	98.580	0.0310	0.0010	0.0003
2	0.0005	0.0020	0.0004	0.0001	0.0012	0.0020	0.0001	0.9794	98.640	0.0350	0.0010	0.0004
3	0.0005	0.0021	0.0006	0.0003	0.0016		0.0001	0.9889	98.700	0.0350	0.0016	0.0006
4	0.0006	0.0023	0.0006	0.0005	0.0024		0.0001	1.0022	98.700	0.0354	0.0019	0.0006
5	0.0006	0.0027	0.0010	0.0005	0.0030		0.0002	1.0300	98.764	0.0366	0.0019	0.0007
6	0.0007	0.0029	0.0010	0.0007	0.0070		0.0002	1.0800	98.780	0.0374	0.0020	0.0007
7	0.0007	0.0029	0.0015	<0.0005	0.0090		<0.0001	1.1012	98.840	0.0390	0.0020	0.0008
8	0.0008	0.0030	<0.001	<0.0005	0.0151		<0.0001	1.1200	99.700	0.0400	0.0020	0.0009
9	0.0008	0.0030	<0.001	<0.0005			<0.0002	1.1240		0.0400	0.0022	0.0010
10	0.0009	0.0030	<0.001	<0.001			<0.0005	1.1240		0.0414	0.0025	0.0011
11	0.0011	0.0042	<0.002	<0.001			<0.0005	1.1300		0.0420	0.0032	0.0011
12	0.0012	0.0050	<0.002	<0.001			<0.001	1.1300		0.0430	<0.002	<0.001
13	0.0017	0.0055	<0.002	<0.002			<0.001	1.1310		0.0430	<0.002	<0.001
14	<0.001	<0.002					<0.005	1.1910		0.0454	<0.010	<0.002
15		<0.002					<0.01	1.3000		0.0455		<0.002
16		<0.005								0.0465		<0.002
17										0.0483		<0.005
18										0.0490		
Mean	0.0008	0.0031	0.0007	0.0004	0.0050	0.0015	0.0001	1.0892	98.838	0.0408	0.0019	0.0007
STDV	0.0004	0.0011	0.0005	0.0002	0.0050	0.0007	0.0000	0.0964	0.3577	0.0051	0.0006	0.0003
<b>Certified</b>	<b>0.0008</b>	<b>0.0031</b>	<b>(0.0007)</b>	<b>(0.0004)</b>	<b>(0.005)</b>	<b>(0.0015)</b>	<b>0.00013</b>	<b>1.09</b>	<b>98.8</b>	<b>0.041</b>	<b>0.0019</b>	<b>0.0007</b>
Uncertainty	0.0002	0.0007					0.00005	0.05	0.3	0.003	0.0004	0.0002
Methods	I,IM,X,O,G,A	I,IM,X,O,G	I,IM,O,G,X	I,IM,O,X	C,G,I	I	I,IM,G,X,A,O	I,W,X,O,G	I,X,O,W	I,X,G,O,A	I,IM,G,O,X,A	I,IM,X,G,O,A

	Ni	O	P	Pb	S	Sb	Si	Sn	Ti	Zn	Zr
1	0.0004	0.0003	0.0005	0.0010	0.0010	0.0003	0.0460	0.0005	0.0001	0.0060	0.0410
2	0.0004	0.0008	0.0006	0.0014	0.0010	0.0015	0.0542	0.0007	0.0001	0.0070	0.0495
3	0.0007	0.0010	0.0010	0.0014	0.0010	0.0039	0.0610	0.0007	0.0001	0.0086	0.0510
4	0.0008	0.0012	0.0010	0.0015	0.0014	0.0045	0.0698	0.0018	0.0002	0.0090	0.0566
5	0.0009	0.0014	0.0011	0.0019	0.0015	0.0045	0.0830	0.0020	0.0006	0.0090	0.0570
6	0.0010	0.0021	0.0012	0.0019	0.0017	0.0051	0.0879	0.0020	0.0010	0.0099	0.0573
7	0.0010		0.0012	0.0020	0.0020	0.0051	0.0930	0.0032	0.0010	0.0100	0.0600
8	<0.001		0.0020	0.0020	0.0020	0.0120	0.0950	0.0046	<0.001	0.0100	0.0600
9	<0.001		0.0021	0.0026	0.0020	<0.001	0.0980	<0.001	<0.002	0.0100	0.0612
10	<0.001		<0.001	0.0035	0.0023	<0.001	0.1034	<0.001	<0.002	0.0105	0.0674
11	<0.002		<0.001	<0.001	0.0024	<0.001	0.1135	<0.002	<0.005	0.0110	0.0696
12	<0.002		<0.001	<0.002	0.0024	<0.002	0.1260	<0.002		0.0112	0.0697
13	<0.002		<0.002	<0.002	0.0029	<0.002	0.1270	<0.002		0.0130	0.0853
14	<0.005		<0.002	<0.002	<0.002	<0.002	0.1430	<0.005		0.0130	0.0980
15			<0.002	<0.005	<0.002	<0.005					
16			<0.005		<0.002						
17											
18											
Mean	0.0007	0.0011	0.0012	0.0019	0.0018	0.0046	0.0929	0.0019	0.0004	0.0099	0.0631
STDV	0.0002	0.0006	0.0005	0.0007	0.0006	0.0035	0.0287	0.0014	0.0004	0.0020	0.0146
<b>Certified</b>	<b>0.0007</b>	<b>(0.0011)</b>	<b>0.0012</b>	<b>0.0019</b>	<b>0.0018</b>	<b>(0.005)</b>	<b>0.09</b>	<b>0.002</b>	<b>(0.0004)</b>	<b>0.010</b>	<b>0.063</b>
U <sub>CRM</sub>	0.0002		0.0004	0.0005	0.0004		0.02	0.001		0.001	0.008
Methods	I,O,X,A	F	I,X,G,O,W	I,F,IM,O,X	C,I,G,O,X	I,IM,G,O,X,A	I,G,W,O	I,IM,G,O,X	I,G,X	I,IM,X,O,A	I,X,O

Legend: W = Classical, C = Combustion, F = Fusion, A = AA or GFAA, I = ICP or DCP, IM=ICP-MS, D = DC Arc, O = AES, X = XRF, G = GDAES or GDMS, H = Hollow Cathode AES