

## Certified Reference Material

## Certificate of Analysis

ISO  
17034:2016

ISO/IEC  
17025:2017

ISO  
9001:2015

**Product ID:** IARM-CU464-21

**Product Description:** Copper Alloy, CDA 464 / C46400

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>0.0040</b>	$\pm 0.0006$	<b>Al</b>	<b>0.0006</b>	$\pm 0.0003$	<b>As</b>	<b>0.0011</b>	$\pm 0.0004$	<b>Bi</b>	<b>0.0010</b>	$\pm 0.0005$
<b>Cu</b>	<b>60.7</b>	$\pm 0.3$	<b>Fe</b>	<b>0.096</b>	$\pm 0.002$	<b>Mn</b>	<b>0.0115</b>	$\pm 0.0003$	<b>Ni</b>	<b>0.0084</b>	$\pm 0.0006$
<b>P</b>	<b>0.0012</b>	$\pm 0.0004$	<b>Pb</b>	<b>0.066</b>	$\pm 0.001$	<b>Sb</b>	<b>0.0016</b>	$\pm 0.0006$	<b>Sn</b>	<b>0.751</b>	$\pm 0.009$
<b>Zn</b>	<b>38.5</b>	$\pm 0.3$									

**Indicative Values listed in ppm**

Cd (7)	Cr (5)	O (20)	S (20)	Se (7)	Si (40)	Ti (5)
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**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.

$$1. N_{MIN} = \max(10, \sqrt[3]{N_{PROD}})$$

$$2. U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$$

**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.

- Massachusetts Materials Research - West Boylston, MA
- New Hampshire Materials Laboratory - Somersworth, NH
- Scrooby's Laboratory Service - Benoni, South Africa
- LGC Standards - Manchester, NH
- IMR Test Labs - Louisville, KY
- Lucid Laboratories Pvt. Ltd. - Hyderabad, India
- AnchorCert Analytical - Birmingham, England
- TCR Engineering Pvt. Ltd - Mumbai, India
- TecEurolab - Campogallino, Italy
- Luvak Inc - Boylston, MA
- Analyticka Laborator Lithea S.R.O - Brno, Czech Republic
- 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.

  
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 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	Cd	Cr	Cu	Fe	Mn	Ni	O	P	Pb
1	0.0019	0.0001	0.0003	0.0003	0.0003	0.0001	60.000	0.0918	0.0109	0.0065	0.0007	0.0004	0.0608
2	0.0030	0.0003	0.0005	0.0003	0.0004	0.0005	60.170	0.0930	0.0110	0.0070	0.0015	0.0007	0.0622
3	0.0035	0.0003	0.0007	0.0004	0.0007	0.0008	60.210	0.0930	0.0110	0.0075	0.0031	0.0010	0.0642
4	0.0038	0.0004	0.0007	0.0008	0.0015	<0.001	60.405	0.0940	0.0110	0.0080	<0.001	0.0010	0.0650
5	0.0039	0.0005	0.0009	0.0008	<0.001	<0.001	60.600	0.0950	0.0111	0.0080		0.0010	0.0652
6	0.0040	0.0005	0.0010	0.0012	<0.001	<0.005	60.616	0.0951	0.0114	0.0080		0.0011	0.0652
7	0.0040	0.0009	0.0012	0.0014	<0.005		60.690	0.0955	0.0115	0.0080		0.0013	0.0654
8	0.0043	0.0010	0.0013	0.0020			60.941	0.0955	0.0115	0.0085		0.0020	0.0657
9	0.0045	0.0010	0.0015	0.0020			61.028	0.0960	0.0117	0.0086		0.0021	0.0660
10	0.0045	0.0012	0.0015	<0.001			61.060	0.0960	0.0120	0.0090		<0.0005	0.0660
11	0.0050	<0.0005	0.0019	<0.002			61.110	0.0965	0.0120	0.0090		<0.0005	0.0660
12	0.0050	<0.0005	0.0022	<0.002			61.129	0.1000	0.0120	0.0100		<0.0005	0.0670
13	<0.001	<0.0005	<0.0003	<0.002			61.460	0.1000	0.0120	0.0100		<0.0005	0.0670
14	<0.005	<0.001	<0.001	<0.002				0.1005	0.0120	0.0101		<0.001	0.0675
15		<0.001	<0.005	<0.005				0.1010				<0.005	0.0700
16													
17													
Mean	0.0040	0.0006	0.0011	0.0010	0.0007	0.0005	60.724	0.0962	0.0115	0.0084	0.0018	0.0012	0.0655
STDV	0.0009	0.0004	0.0006	0.0007	0.0006	0.0004	0.4409	0.0029	0.0004	0.0011	0.0012	0.0006	0.0021
<b>Certified</b>	<b>0.0040</b>	<b>0.0006</b>	<b>0.0011</b>	<b>0.0010</b>	<b>(0.0007)</b>	<b>(0.0005)</b>	<b>60.7</b>	<b>0.096</b>	<b>0.0115</b>	<b>0.0084</b>	<b>(0.002)</b>	<b>0.0012</b>	<b>0.066</b>
U <sub>CRM</sub>	0.0006	0.0003	0.0004	0.0005			0.3	0.002	0.0003	0.0006		0.0004	0.001
Methods	I,O,G,X,A	O,I,G,X	I,O,X,A	I,O,G,X,A	O,I	O,I	W,I,G,X,O	I,O,X,A	I,O,X,A	I,O,G,A	F	I,O,G,X,W	I,O,X,A

	S	Sb	Se	Si	Sn	Ti	Zn
1	0.0010	0.0003	0.0001	0.0009	0.7200	0.00001	37.480
2	0.0027	0.0010	0.0003	0.0030	0.7200	0.0010	37.922
3	<0.001	0.0011	0.0004	0.0030	0.7270	<0.001	37.957
4	<0.001	0.0020	0.0006	0.0040	0.7400	<0.005	38.000
5	<0.001	0.0020	0.0010	0.0040	0.7413		38.032
6		0.0020	0.0020	0.0046	0.7440		38.100
7		0.0021	<0.0005	0.0050	0.7480		38.360
8		0.0021	<0.0005	0.0070	0.7500		38.430
9		<0.001	<0.001	<0.001	0.7500		38.439
10		<0.001	<0.001	<0.001	0.7500		38.520
11		<0.002	<0.001	<0.002	0.7553		38.651
12		<0.005	<0.002	<0.002	0.7655		38.760
13		<0.005		<0.002	0.7666		39.000
14				<0.005	0.7672		39.021
15				<0.01	0.7680		39.090
16					0.7736		39.459
17					0.7830		39.500
Mean	0.0019	0.0016	0.0007	0.0039	0.7511	0.0005	38.513
STDV	0.0012	0.0007	0.0007	0.0018	0.0183	0.0007	0.5703
<b>Certified</b>	<b>(0.002)</b>	<b>0.0016</b>	<b>(0.0007)</b>	<b>(0.004)</b>	<b>0.751</b>	<b>(0.0005)</b>	<b>38.5</b>
U <sub>CRM</sub>		0.0006			0.009		0.3
Methods	C,O	I,O,X,A	I,O,G,X	I,O,G,X,W	I,O,G,X	I	I,O,G,X,W

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