

## Certificate of Analysis

### IARM Cu642-18

Copper Alloy / CDA 642 / UNS C64200

## Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

<b>Al</b>	<b>6.5 ± 0.1</b>	<b>Cu</b>	<b>90.0 ± 1.0</b>	<b>Fe</b>	<b>0.039 ± 0.002</b>	<b>Mn</b>	<b>0.0024 ± 0.0005</b>
<b>Ni</b>	<b>0.014 ± 0.003</b>	<b>P</b>	<b>0.009 ± 0.004</b>	<b>Pb</b>	<b>0.019 ± 0.002</b>	<b>Si</b>	<b>1.96 ± 0.09</b>
<b>Sn</b>	<b>0.019 ± 0.002</b>	<b>Zn</b>	<b>1.19 ± 0.05</b>				

#### Indicative Values listed in ppm

Ag (150)	As (100)	B (<50)	Bi (10)	C (<50)	Cd (<50)	Co (<50)
Cr (<50)	H (<10)	Mg (<50)	Mo (<50)	N (10)	Nb (<50)	O (10)
S (20)	Sb (<50)	Se (20)	Ta (<10)	Ti (<50)	V (<50)	W (<10)
Zr (<50)						

#### 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** certified laboratories. This CRM may come in the form of a solid disk, chips, or powder. The intended use of this CRM may include, but is not limited to, the calibration of instruments and the validation of analytical methods.

#### Instructions for Use

1. 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.
2. 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.
3. The material should be stored in a cool, dry location when not in use.
4. Chips are not recommended for gas analysis.

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

	Ag	Al	As	B	Bi	C	Cd	Co	Cr	Cu	Fe	H	Mg	Mn	Mo	N
1	0.01	6.309	0.0004	0.00012	0.00015	0.00013	0.00004	0.0004	0.0009	88.89	0.0339	0.00013	0.0015	0.0013	0.005	0.00023
2	0.012	6.383	0.0006	<0.001	0.001	0.00164	0.00008	0.0004	0.001	89.71	0.034	0.001	0.0017	0.002	<0.001	0.001
3	0.0124	6.39	0.006	<0.001	<0.0001	0.002	0.0008	0.002	0.0015	90.12	0.0358	<0.0001	0.0018	0.002	<0.005	<0.0005
4	0.013	6.422	0.009	<0.005	<0.001	0.002	0.0008	<0.001	0.002	90.30	0.036		0.002	0.0024		<0.001
5	0.0262	6.452	<0.0001		<0.001	<0.005	<0.001	<0.001	<0.001	90.48	0.037		<0.001	0.0027		<0.001
6		6.52	<0.001		<0.005		<0.001	<0.005	<0.005	92.24	0.037		<0.005	0.0029		
7		6.553	<0.001				<0.005				0.0382			0.003		
8		6.64	<0.005								0.04			0.003		
9		6.719									0.042					
10		6.729									0.0426					
11											0.0431					
12											0.046					
13																
14																
15																
Mean	0.015	6.5	0.010		0.0010					90.0	0.039		0.0018	0.0024		0.0010
STDV.	0.007	0.1	0.009		0.0006					1.0	0.004		0.0002	0.0006		0.0005
<b>Certified</b>	<b>(0.015)</b>	<b>6.5</b>	<b>(0.01)</b>	<b>(&lt;0.005)</b>	<b>(0.001)</b>	<b>(&lt;0.005)</b>	<b>(&lt;0.005)</b>	<b>(&lt;0.005)</b>	<b>(&lt;0.005)</b>	<b>90.0</b>	<b>0.039</b>	<b>(&lt;0.001)</b>	<b>(&lt;0.005)</b>	<b>0.0024</b>	<b>(&lt;0.005)</b>	<b>(0.001)</b>
U <sub>CRM</sub>	0.1									1.0	0.002			0.0005		
Methods	X,O,I	X,O,I	X,O,I,IM	IM,I	O,IM,I	O,C	O,IM,I	O,I,IM	O,IM,I	X,I	X,O,I,IM	F	IM,I	X,O,I,IM	IM,I	F

	Nb	Ni	O	P	Pb	S	Sb	Se	Si	Sn	Ta	Ti	V	W	Zn	Zr
1	<0.001	0.006	0.0004	0.0015	0.016	0.0001	0.00022	0.0004	1.722	0.014	<0.001	0.00037	<0.001	<0.001	1.04	0.00003
2	<0.001	0.01	0.001	0.00397	0.016	0.002	0.0015	0.001	1.81	0.017	<0.001	0.003	<0.001	<0.001	1.109	<0.001
3	<0.005	0.0123	<0.0005	0.004	0.0167	0.003	<0.001	0.0035	1.827	0.0179		<0.001	<0.005		1.113	<0.001
4		0.014	<0.001	0.008	0.017	0.0045	<0.001	<0.005	1.885	0.0187		<0.005			1.17	<0.005
5		0.014	<0.001	0.01	0.017	<0.0005	<0.005	<0.005	1.89	0.019					1.175	
6		0.0142		0.01	0.0172	<0.001			1.91	0.02					1.18	
7		0.015		0.0111	0.0193				1.997	0.02					1.21	
8		0.015		0.012	0.02				2.017	0.0204					1.233	
9		0.016		0.0165	0.022				2.06	0.0209					1.26	
10		0.02			0.0238				2.11	0.021					1.27	
11		0.0202							2.141						1.274	
12									2.187						1.279	
13																
14																
15																
Mean		0.014	0.0010	0.009	0.019	0.002		0.002	1.96	0.019					1.19	
STDV.		0.004	0.0004	0.005	0.003	0.002		0.002	0.1	0.002					0.08	
<b>Certified</b>	<b>(&lt;0.005)</b>	<b>0.014</b>	<b>(0.001)</b>	<b>0.009</b>	<b>0.019</b>	<b>(0.002)</b>	<b>(&lt;0.005)</b>	<b>(0.002)</b>	<b>1.96</b>	<b>0.019</b>	<b>(&lt;0.001)</b>	<b>(&lt;0.005)</b>	<b>(&lt;0.005)</b>	<b>(&lt;0.001)</b>	<b>1.19</b>	<b>(&lt;0.005)</b>
U <sub>CRM</sub>		0.003		0.004	0.002			0.09	0.002	0.002					0.05	
Methods	IM,I	X,O,I,IM	F	X,O,IM,I	X,O,I,IM	X,O,C	O,IM,I	O,IM,I	X,O,I	X,O,I,IM	IM,I	IM,I	IM,I	IM,I	X,O,I	IM,I

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

### Certification Laboratories

Laboratorio Prove Materiali S. Marco srl  
 AY Mc Donald Mfg. Co.  
 California Metal-X  
 IMR Test Labs  
 Applied Technical Services  
 LGC Standards

Schio, Italy  
 Dubuque, IA  
 Los Angeles, CA  
 Lansing, NY  
 Marietta, GA  
 Manchester, NH

Laboratory Testing, Inc.  
 Anderson Laboratories, Inc.  
 NSL Analytical Services  
 Dirats Laboratories  
 EAG Laboratories

Hatfield, PA  
 Greendale, WI  
 Cleveland, OH  
 Westfield, MA  
 Liverpool, NY

Certification laboratories have demonstrated performance and traceability by utilizing a variety of test methods all under the scope of ISO 17025. Some of the specific CRMs and SRMs used in the analysis of the material covered by this certificate are:

IARM 80A IARM 81A IARM 81B IARM 87B IARM 226A IARM 267A IARM 75B IARM 150A NIST 3113 NIST 3151 NIST 150A NIST 157 NIST 400

### Homogeneity and Uncertainty

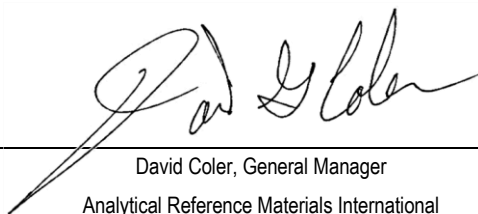
"Uncertainty" values, as reported adjacent to certified concentration values, are based on a 95% Confidence Interval. These estimated uncertainties include the combined effects of method imprecision, material inhomogeneity, and any bias between methods. Homogeneity data from experimental XRF results 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.

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

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

### Expiration

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.



David Coler, General Manager  
 Analytical Reference Materials International

