

## Certificate of Analysis

### IARM Cu485-18

Naval Brass / CDA 485 / UNS C48500

## Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

<b>Al</b>	<b>0.002 ± 0.001</b>	<b>As</b>	<b>0.055 ± 0.010</b>	<b>C</b>	<b>0.002 ± 0.001</b>	<b>Cd</b>	<b>0.0005 ± 0.0002</b>
<b>Cu</b>	<b>60.8 ± 0.2</b>	<b>Fe</b>	<b>0.062 ± 0.003</b>	<b>Mn</b>	<b>0.0013 ± 0.0002</b>	<b>Ni</b>	<b>0.013 ± 0.001</b>
<b>Pb</b>	<b>1.76 ± 0.06</b>	<b>Sb</b>	<b>0.0018 ± 0.0007</b>	<b>Si</b>	<b>0.003 ± 0.001</b>	<b>Sn</b>	<b>0.759 ± 0.008</b>
<b>Zn</b>	<b>36.5 ± 0.2</b>						

### Indicative Values listed in ppm

Ag (31)	B (<50)	Be (<50)	Bi (10)	Ca (<50)	Co (5)	Cr (<10)
H (<10)	Hf (<10)	Mg (1)	Mo (<50)	N (10)	Nb (<50)	O (20)
P (20)	Pd (<10)	S (19)	Se (30)	Ta (<10)	Ti (10)	V (<50)
W (<10)	Y (<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 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.

### 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.

	Al	As	C	Cd	Cu	Fe	Mn	Ni	Pb	Sb	Si	Sn	Zn	Ag	B	Be
1	0.0003	0.0316	0.0010	0.0003	60.120	0.0543	0.0009	0.0090	1.654	0.0010	0.0010	0.7423	35.960	0.0029	0.0010	<0.0001
2	0.0010	0.0458	0.0014	0.0004	60.450	0.0550	0.0010	0.0120	1.660	0.0013	0.0011	0.7450	36.106	0.0030	<0.0001	<0.001
3	0.0014	0.0584	0.0017	0.0005	60.470	0.0566	0.0010	0.0124	1.676	0.0016	0.0020	0.7457	36.130	0.0030	<0.001	<0.005
4	0.0020	0.0590	0.0020	0.0005	60.490	0.0570	0.0011	0.0126	1.685	0.0020	0.0030	0.7500	36.130	0.0035	<0.005	
5	0.0030	0.0660	0.0031	0.0006	60.653	0.0589	0.0014	0.0126	1.700	0.0020	0.0040	0.7500	36.180			
6	0.0038	0.0660	0.0042	0.0008	60.730	0.0593	0.0014	0.0130	1.700	0.0030	0.0040	0.7519	36.470			
7					60.770	0.0598	0.0014	0.0130	1.703			0.7560	36.524			
8					60.849	0.0600	0.0015	0.0132	1.715			0.7600	36.537			
9					60.880	0.0602	0.0016	0.0140	1.720			0.7668	36.543			
10					60.905	0.0611		0.0140	1.724			0.7670	36.567			
11					61.257	0.0649		0.0150	1.760			0.7747	36.570			
12					61.277	0.0660		0.0154	1.770			0.7787	36.620			
13					61.360	0.0660		0.0175	1.822			0.7800	36.787			
14						0.0690			1.890				36.960			
15						0.0700			2.002				36.970			
16						0.0700			2.047							
17						0.0710										
Mean	0.0019	0.0545	0.0022	0.0005	60.79	0.0623	0.0013	0.0134	1.764	0.0018	0.0025	0.7591	36.470	0.0031		
STDV.	0.0013	0.0134	0.0012	0.0002	0.36	0.0055	0.0002	0.0020	0.119	0.0007	0.0014	0.0131	0.311	0.0003		
<b>Certified</b>	<b>0.002</b>	<b>0.055</b>	<b>0.002</b>	<b>0.0005</b>	<b>60.8</b>	<b>0.062</b>	<b>0.0013</b>	<b>0.013</b>	<b>1.76</b>	<b>0.0018</b>	<b>0.003</b>	<b>0.759</b>	<b>36.5</b>	<b>(0.0031)</b>	<b>(&lt;0.005)</b>	<b>(&lt;0.005)</b>
U <sub>CRM</sub>	0.001	0.010	0.001	0.0002	0.2	0.003	0.0002	0.001	0.06	0.0007	0.001	0.008	0.2			
Methods	O,I,IM	O,I,IM	O,C	O,I,IM	I,O,X,W	O,I,X,IM	O,I,IM	O,X,I,IM	O,I,X	O,I,IM	O,X,I,IM	O,I,X	O,I,X	O,I	I,IM	I

	Bi	Ca	Co	Cr	H	Mg	Mo	N	Nb	O	P	S	Se	Ta	Ti	Zr
1	0.0005	<0.001	0.0001	0.0010	0.0003	0.0001	0.0040	0.0002	<0.0001	0.0006	0.0000	0.0012	0.0004	<0.001	0.0002	0.0002
2	0.0005	<0.005	0.0001	0.0010	<0.001	0.0001	<0.001	0.0007	<0.001	0.0010	0.0016	0.0013	0.0020	<0.001	0.0003	<0.001
3	0.0006		0.0002	<0.0001		<0.001	<0.005	0.0010	<0.001	0.0035	0.0030	0.0020	0.0027		0.0020	<0.001
4	0.0020		0.0002	<0.001		<0.001		<0.0005	<0.005	<0.0005	0.0050	0.0024	0.0050		<0.001	<0.005
5	<0.0001		0.0010	<0.001		<0.005		<0.001		<0.001	<0.0001	0.0027	<0.0001		<0.005	
6	<0.0001		0.0012					<0.001		<0.001	<0.0001	<0.0001	<0.001		<0.005	
7	<0.001		<0.0001								<0.0001	<0.0005	<0.005			
8	<0.001		<0.001								<0.005	<0.001	<0.005			
9	<0.005		<0.001								<0.005	<0.01				
10			<0.005								<0.01					
11			<0.01													
12			<0.01													
13																
14																
15																
Mean	0.0009		0.0005	0.0010		0.0001	0.0040	0.0006		0.0017	0.0024	0.0019	0.0025		0.0008	0.0002
STDV.	0.0007		0.0005	0.0000		0.0000		0.0004		0.0016	0.0021	0.0007	0.0019		0.0010	
<b>Reference</b>	<b>(0.001)</b>	<b>(&lt;0.005)</b>	<b>(0.0005)</b>	<b>(&lt;0.001)</b>	<b>(&lt;0.001)</b>	<b>(0.0001)</b>	<b>(&lt;0.005)</b>	<b>(0.001)</b>	<b>(&lt;0.005)</b>	<b>(0.002)</b>	<b>(0.002)</b>	<b>(0.0019)</b>	<b>(0.003)</b>	<b>(&lt;0.001)</b>	<b>(0.001)</b>	<b>(&lt;0.005)</b>
Methods	O,I,IM	IM	O,I,IM	O,I,IM	F	I,IM	IM	F	I,IM	F	O,X,I,IM	O,C,I	O,I,IM	IM	IM	IM

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

LGC Standards	Manchester, NH	Laboratorio Prove Materiali S. Marco srl	Schio, Italy
Laboratory Testing, Inc.	Hatfield, PA	AY Mc Donald Mfg. Co.	Dubuque, IA
Anderson Laboratories, Inc.	Greendale, WI	California Metal-X	Los Angeles, CA
Sipi-Metals Corp	Chicago, IL	NSL Analytical Services	Cleveland, OH
IMR Test Labs	Lansing, NY	Dirats Laboratories	Westfield, MA
Applied Technical Services	Marietta, GA	EAG Laboratories	Liverpool, NY

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

NIST 37D NIST 1103 NIST 1121 LECO 502-102 IARM 73A IARM 76A IARM 87A

### Homogeneity and Uncertainty

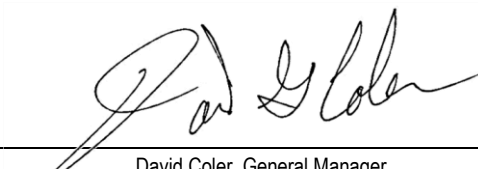
"Uncertainty" values, as reported adjacent to certified concentration values, are based on a 95% Confidence Interval. These estimated uncertainties include the combined effects of method imprecision, material inhomogeneity, and any bias between methods. Homogeneity data from experimental XRF results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

