

Certificate of Analysis

IARM Cu486-18

Naval Brass / CDA 486 / UNS C48600

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Ag	0.004 ± 0.002	As	0.025 ± 0.007	Cd	0.0009 ± 0.0002	Cu	61.2 ± 0.3
Fe	0.036 ± 0.003	Ni	0.032 ± 0.003	P	0.004 ± 0.002	Pb	1.31 ± 0.05
Sn	0.692 ± 0.008	Zn	36.5 ± 0.3				

Indicative Values listed in ppm

Al (30)	B (<50)	Bi (4)	C (16)	Co (6)	Cr (<50)	H (<10)
Hf (<10)	Mg (<50)	Mn (3)	Mo (<50)	N (<10)	Nb (<50)	O (7)
S (30)	Sb (50)	Se (40)	Si (20)	Ti (10)	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	As	Cd	Cu	Fe	Ni	P	Pb	Sn	Zn	Al	B	Bi	C	Co	Cr
1	0.001	0.003	0.00032	60.43	0.03	0.023	0.001	1.13	0.67279	35.63	0.00018	0.0001	0.0001	0.001	0.0002	0.001
2	0.003	0.01	0.0009	60.67	0.032	0.025	0.00119	1.23	0.673	35.811	0.0005	<0.001	0.00025	0.0012	0.0002	0.0014
3	0.004	0.0192	0.001	61.0945	0.0327	0.0298	0.0025	1.25	0.68	36.139	0.003	<0.001	0.00029	0.00159	0.00057	0.01003
4	0.0041	0.0251	0.001	61.12	0.0332	0.031	0.00258	1.274	0.6803	36.19	0.0051	<0.005	0.001	0.002	0.001	<0.0001
5	0.005	0.027	0.001	61.257	0.0334	0.031	0.004	1.276	0.685	36.41	0.007	<0.0001	<0.0001	0.00216	0.001	<0.001
6	0.0063	0.0278	0.00104	61.337	0.0341	0.0315	0.005	1.282	0.6885	36.56	<0.0001	<0.001	<0.001	<0.0001	<0.0001	<0.001
7		0.029	0.0011	61.514	0.0345	0.0316	0.006	1.292	0.69	36.585	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005
8		0.0305		61.62	0.035	0.032	0.006	1.303	0.697	36.72	<0.01	<0.005	<0.005	<0.001	<0.001	<0.005
9		0.033		61.73	0.035	0.034		1.326	0.6973	36.7535				<0.005	<0.005	<0.01
10		0.033			0.0367	0.0348		1.3516	0.703	36.798						
11		0.034			0.037	0.035		1.36	0.71	37.00						
12					0.04	0.035		1.3683	0.71	37.03						
13					0.042	0.0387		1.4237	0.7115							
14					0.0435			1.4687								
15					0.048											
Mean	0.004	0.025	0.0009	61.2	0.036	0.032	0.004	1.31	0.692	36.5	0.003		0.0004	0.0016	0.0006	
STDV.	0.002	0.01	0.0003	0.4	0.005	0.004	0.002	0.08	0.01	0.4	0.003		0.0004	0.0005	0.0004	
Certified	0.004	0.025	0.0009	61.2	0.036	0.032	0.004	1.31	0.692	36.5	(0.003)	(<0.005)	(0.0004)	(0.0016)	(0.0006)	(<0.005)
U _{CRM}	0.002	0.007	0.0002	0.3	0.003	0.003	0.002	0.05	0.008	0.3						
Methods	G,O,I	X,G,O,I,IM	O,I,IM	X,O,W,I	X,O,G,I,IM	X,O,G,I,IM	X,O,I,IM	X,O,G,I,IM	X,O,G,I,IM	X,O,G,I	X,O,I,IM	I,IM	O,I,IM	C,O	O,I,IM	O,I,IM

	H	Hf	Mg	Mn	Mo	N	Nb	O	S	Sb	Se	Si	Ti	V	W	Zr
1	0.0001	<0.001	0.00007	0.00004	0.004	0.0003	<0.0001	0.0004	0.0013	0.00073	0.001	0.00015	0.00007	<0.001	<0.001	<0.0001
2	0.0002		0.0003	0.000127	<0.001	0.001	<0.001	0.00083	0.002	0.002	0.002	0.0008	0.00033	<0.001		<0.001
3			<0.001	0.00018	<0.005	<0.0005	<0.001	0.001	0.00259	0.0035	0.00272	0.0018	0.002			<0.001
4			<0.001	0.0003		<0.001	<0.005	<0.0005	0.003	0.00696	0.0055	0.002	<0.001			<0.005
5			<0.005	0.001		<0.001		<0.001	0.0071	0.013	0.0079	0.004				
6				<0.0001		<0.001		<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001			
7				<0.001		<0.001		<0.0005	<0.0005	<0.005	<0.005	<0.005	<0.005			
8				<0.001		<0.001		<0.001	<0.001	<0.005	<0.005	<0.005	<0.005			
9				<0.005		<0.005		<0.01	<0.01	<0.005	<0.005	<0.005	<0.005			
10																
11																
12																
13																
14																
15																
Mean				0.0003				0.0007	0.003	0.005	0.004	0.002	0.001			
STDV.				0.0004				0.0003	0.002	0.005	0.003	0.001	0.001			
	(<0.001)	(<0.001)	(<0.005)	(0.0003)	(<0.005)	(<0.001)	(<0.005)	(0.0007)	(0.003)	(0.005)	(0.004)	(0.002)	(0.001)	(<0.005)	(<0.001)	(<0.005)
Methods	F	IM	I,IM	O,I,IM	IM,I	F	I	F	O,C,I	O,I,IM	G,O,I,IM	X,O,I,IM	IM,I	IM,I	IM	I,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

Revere Copper Products, Inc.	Rome, NY	Laboratorio Prove Materiali S. Marco srl	Schio, Italy
LECO Corporation	St. Joseph, MI	AY Mc Donald Mfg. Co.	Dubuque, IA
Anderson Laboratories, Inc.	Greendale, WI	California Metal-X	Los Angeles, CA
Sipi-Metals Corp	Chicago, IL	Laboratory Testing, Inc.	Hatfield, PA
NSL Analytical Services	Cleveland, OH	IMR Test Labs	Lansing, NY
Dirats Laboratories	Westfield, MA	Applied Technical Services	Marietta, GA

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 226A IARM 263A IARM 73C IARM 75B IARM 76D IARM 86D IARM 87B IARM 90A LECO 501-952 NIST 1103 NIST 37D 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.

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

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



Analytical Reference Materials International • 276 Abby Road • Manchester, NH 03103

Telephone (603) 935-4100 • www.ARMi.com • ARMI@LGCgroup.com

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