

Certificate of Analysis

IARM Cu954-18

Aluminum Bronze / CDA 954 / UNS C95400

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	10.36 ± 0.07	Bi	0.0011 ± 0.0004	C	0.007 ± 0.002	Co	0.017 ± 0.002
Cr	0.003 ± 0.001	Cu	84.7 ± 0.1	Fe	4.23 ± 0.03	Mn	0.29 ± 0.01
Ni	0.134 ± 0.004	P	0.016 ± 0.004	Pb	0.016 ± 0.002	Sb	0.0009 ± 0.0006
Si	0.025 ± 0.002	Sn	0.047 ± 0.004	Zn	0.141 ± 0.006		

Indicative Values listed in ppm

Ag (30)	As (30)	B (7)	Be (<50)	Ca (<50)	Cd (20)	H (<10)
Hf (<10)	Mg (13)	Mo (20)	N (6)	Nb (<50)	O (10)	Pd (<10)
S (20)	Se (<50)	Ta (<10)	Ti (<50)	V (<50)	W (<10)	Y (<10)
Zr (4)						

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	Bi	C	Co	Cr	Cu	Fe	Mn	Ni	P	Pb	Sb	Si	Sn	Zn	Ag
1	10.1631	0.00018	0.0046	0.0137	0.0017	84.37	4.14	0.262	0.1264	0.0024	0.011	0.0005	0.0183	0.0354	0.129	0.0023
2	10.18	0.001	0.00493	0.014	0.002	84.5679	4.148	0.2689	0.127	0.0131	0.0112	0.0006	0.02	0.042	0.13	0.003
3	10.20	0.001	0.0051	0.015	0.002	84.59	4.1692	0.27	0.1273	0.015	0.0124	0.0006	0.022	0.0424	0.134	0.004
4	10.26	0.001	0.0065	0.0154	0.002	84.6544	4.1798	0.271	0.13	0.015	0.0153	0.0007	0.023	0.047	0.136	
5	10.3033	0.001	0.007	0.0155	0.0023	84.7267	4.18	0.2745	0.13	0.0152	0.017	0.001	0.023	0.0471	0.14	
6	10.32	0.0013	0.0079	0.016	0.0024	84.778	4.21	0.278	0.131	0.0169	0.017	0.002	0.0231	0.048	0.14	
7	10.3692	0.0013	0.009	0.016	0.0036	84.8107	4.22	0.28	0.131	0.017	0.0175		0.0236	0.0495	0.14	
8	10.37	0.002	0.01	0.0178	0.005	84.9325	4.2278	0.2804	0.1322	0.017	0.018		0.024	0.05	0.1419	
9	10.41			0.018	0.00623		4.2453	0.281	0.1379	0.0181	0.019		0.025	0.0527	0.143	
10	10.4158			0.0186			4.248	0.2898	0.14	0.023	0.02		0.027	0.0535	0.1525	
11	10.419			0.0188			4.298	0.304	0.146	0.02668	0.0203		0.0292		0.1597	
12	10.4334			0.0215			4.306	0.306	0.148				0.03			
13	10.465			0.02246			4.31	0.315								
14	10.58						4.313	0.318								
15								0.344								
16								0.3491								
Mean	10.36	0.0011	0.007	0.017	0.003	84.7	4.23	0.29	0.134	0.016	0.016	0.0009	0.025	0.047	0.141	0.003
STDV.	0.10	0.0005	0.002	0.003	0.002	0.2	0.06	0.03	0.007	0.006	0.003	0.0006	0.004	0.005	0.009	0.0009
Certified	10.36	0.0011	0.007	0.017	0.003	84.7	4.23	0.29	0.134	0.016	0.016	0.0009	0.025	0.047	0.141	0.003
U _{CRM}	0.07	0.0004	0.002	0.002	0.001	0.1	0.03	0.01	0.004	0.004	0.002	0.0006	0.002	0.004	0.006	
Methods	O,X,I	O,I,IM	O,C	O,X,I,IM	O,I,IM	O,W,I,X	O,X,I	O,X,I,IM	O,X,I,IM	O,I,IM	O,I,IM	O,I,IM	O,I,IM,X	O,X,I,IM	O,X,I,IM	O,I

	As	B	Be	Ca	Cd	H	Hf	Mg	Mo	N	Nb	O	Pd	S	Se	Ta
1	0.0002	0.0005	0.0005	<0.001	0.0001	0.0001	<0.001	0.001	0.0003	0.0003	<0.001	0.0004	<0.001	0.0003	0.0001	<0.001
2	0.0002	0.0006	<0.001	<0.005	0.00011	0.0002		0.0012	0.0003	0.0005	<0.001	0.001		0.0012	0.002	<0.001
3	0.001	0.001	<0.005		0.001	<0.001		0.0013	0.005	0.001	<0.005	0.0015		0.0016	<0.001	
4	0.009	<0.001			0.006			0.0014	<0.001	<0.0005		<0.0005		0.002	<0.005	
5	<0.001	<0.005			<0.001			0.0015	<0.005	<0.001		<0.001		0.0024	<0.005	
6	<0.005				<0.001			<0.001	<0.001	<0.001		<0.001		0.00571		
7					<0.005			<0.005								
8																
Mean	0.003	0.0007			0.002			0.0013	0.002	0.0006		0.0010				
STDV.	0.004	0.0003			0.003			0.0002	0.003	0.0004		0.0006				
Reference	(0.003)	(0.0007)	(<0.005)	(<0.005)	(0.002)	(<0.001)	(<0.001)	(0.0013)	(0.002)	(0.0006)	(<0.005)	(0.001)	(<0.001)	(0.002)	(<0.005)	(<0.001)
Methods	O,I,IM	I,IM	I,IM	IM	O,I,IM	F	IM	I,IM	I,IM	F	I,IM	F	IM	O,C,I	O,I,IM	IM

	Ti	V	W	Y	Zr
1	0.0002	0.0004	<0.001	<0.001	0.00002
2	0.003	<0.001	<0.001		0.0003
3	<0.001	<0.001			0.0003
4	<0.005	<0.005			0.001
5					<0.001
6					<0.005
Mean					0.0004
STDV.					0.0004
Reference	(<0.005)	(<0.005)	(<0.001)	(<0.001)	(0.0004)
Methods	I,IM	I,IM	IM	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

ConCast Metal Products Co.
Laboratory Testing, Inc.
Anderson Laboratories, Inc.
Sipi-Metals Corp
NSL Analytical Services
Dirats Laboratories

Mars, PA
Hatfield, PA
Greendale, WI
Chicago, IL
Cleveland, OH
Westfield, MA

Laboratorio Prove Materiali S. Marco srl
AY Mc Donald Mfg. Co.
Colonial Metals Co.
EAG Laboratories
IMR Test Labs
Applied Technical Services

Schio, Italy
Dubuque, IA
Columbia, PA
Liverpool, NY
Lansing, NY
Marietta, GA

Certification laboratories have demonstrated performance and traceability by utilizing 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:

BCS304 BCS904 IARM 226A IARM 75B IARM 79A IARM 79C IARM 80C IARM 86A IARM 87B IARM 93A IARM 93B IARM 94A IARM 94C LECO 502-102
MBH 17869 MBH 32XALB2 K MBH 32XALB9 A MBH 39X17869 AE MBH 39XCT6 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.



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