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ANALYTICAL LTD

ISO Certified · 9001:2015 · 17025:2017 · 17043:2010 · 17034:2016

Certificate of Analysis

IARM Cu955-18

Copper alloy, CDA 955 / UNS C95500

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Ag	**0.0019** ± 0.0005	**Al**	**10.37** ± 0.08	**Co**	**0.0027** ± 0.0003	**Cr**	**0.008** ± 0.001
Cu	**80.8** ± 0.5	**Fe**	**3.50** ± 0.07	**Mn**	**0.77** ± 0.03	**Ni**	**4.5** ± 0.2
P	**0.013** ± 0.003	**Pb**	**0.006** ± 0.001	**Si**	**0.022** ± 0.004	**Sn**	**0.0056** ± 0.0008
Zn	**0.038** ± 0.002						

Indicative Values listed in ppm

As (20)	B (30)	Bi (5)	C (80)	Ca (20)	Cd (3)	H (1)
Mg (<5)	Mo (<5)	N (<10)	O (10)	Pd (<1)	S (12)	Sb (20)
Se (<10)	Ti (<10)	V (<50)	Zr (<10)			

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	Ca	Cd	Co	Cr	Cu	Fe	H	Mg	Mn	Mo
1	0.0010	10.200	0.0004	0.0005	0.0001	0.0017	0.0020	0.0001	0.0021	0.0060	80.268	3.3470	0.0001	0.0003	0.7080	0.0004
2	0.0016	10.229	0.0005	0.0009	0.0004	0.0038	<0.001	0.0004	0.0023	0.0080	80.345	3.4270	<0.001	0.0004	0.7103	0.0005
3	0.0019	10.270	0.0005	0.0050	0.0005	0.0047		<0.0001	0.0026	0.0084	80.352	3.4340		0.0008	0.7505	<0.001
4	0.0020	10.358	0.0006	0.0070	0.0010	0.0056		<0.001	0.0026	0.0086	80.900	3.4520		<0.001	0.7562	<0.005
5	0.0021	10.370	0.0010	<0.005	<0.005	0.0070		<0.005	0.0030	0.0086	80.926	3.4867		<0.005	0.7810	<0.005
6	0.0024	10.394	0.0050			0.0080		<0.005	0.0030	0.0087	81.203	3.5025			0.7820	
7	0.0025	10.419	0.0056			0.0153			0.0030	0.0096	81.770	3.5100			0.7880	
8		10.420	<0.005			0.0210			0.0030	0.0097		3.5900			0.7895	
9		10.517	<0.005						0.0030	<0.005		3.6330			0.8040	
10		10.529							<0.005			3.6532			0.8410	
11																
12																
13																
14																
15																
Mean	0.0019	10.371	0.0019	0.0034	0.0005	0.0084	0.0020	0.0003	0.0027	0.0084	80.823	3.5035	0.0001	0.0005	0.7711	0.0005
STDV.	0.0005	0.1112	0.0023	0.0032	0.0004	0.0065		0.0002	0.0004	0.0011	0.5503	0.0971		0.0003	0.0410	0.0001
Certified	**0.0019**	**10.37**	**0.002**	**(0.003)**	**(0.0005)**	**0.008**	**(0.002)**	**(0.0003)**	**0.0027**	**0.008**	**80.8**	**3.50**	**(0.0001)**	**(0.0005)**	**0.77**	**(0.0005)**
U_{CRM}	0.0005	0.08	0.003			0.008			0.0003	0.001	0.5	0.07			0.03	
Methods	IM,A,I	I	IM,A,I	IM,I	IM,I	C	IM	IM,I	IM,I	IM,I	I	I	F	IM,I	I	IM,I

	N	Ni	O	P	Pb	Pd	S	Sb	Se	Si	Sn	Ti	V	Zn	Zr	
1	0.00001	4.0800	0.0003	0.0060	0.0050	0.00007	0.0005	0.0004	0.0004	0.0101	0.0043	0.0002	0.0003	0.0352	0.0002	
2	<0.001	4.2450	0.0005	0.0106	0.0053		0.0007	0.0004	<0.0001	0.0150	0.0049	0.0003	0.0030	0.0362	0.0002	
3	<0.001	4.3610	0.0009	0.0109	0.0057		0.0012	0.0005	<0.001	0.0190	0.0050	0.0010	<0.005	0.0370	<0.001	
4		4.5000	0.0030	0.0110	0.0057		0.0016	0.0006	<0.005	0.0200	0.0050	<0.005	<0.005	0.0375	<0.005	
5		4.5030	<0.001	0.0112	0.0065		0.0019	0.0007		0.0234	0.0057	<0.005		0.0377	<0.005	
6		4.5530		0.0140	0.0070		<0.001	0.0077		0.0260	0.0057			0.0385		
7		4.6283		0.0140	0.0080		<0.001	<.002		0.0261	0.0070			0.0390		
8		4.6470		0.0148	<0.005			<0.001		0.0279	0.0071			0.0390		
9		4.7110		0.0160	<0.005			<0.005		0.0280	<0.005			0.0435		
10		4.7243		0.0201				<0.005		0.0289						
11																
12																
13																
14																
15																
Mean	0.00001	4.4953	0.0012	0.0129	0.0062	0.0001	0.0012	0.0017	0.0004	0.0224	0.0056	0.0005	0.0017	0.0382	0.0002	
STDV.		0.2098	0.0013	0.0038	0.0011		0.0006	0.0029		0.0063	0.0010	0.0004	0.0019	0.0024	0.0000	
Certified	**(0.00001)**	**4.5**	**(0.001)**	**0.013**	**0.006**	**(0.0001)**	**(0.0012)**	**(0.002)**	**(<0.001)**	**0.022**	**0.0056**	**(0.001)**	**(<0.005)**	**0.038**	**(<0.001)**	
U_{CRM}		0.2		0.003	0.001			0.004		0.004	0.0008			0.002		
Methods	F	I	F	I,IM	IM,I	IM	C	IM,I	IM	I,IM	IM,A,I	IM,I	IM,I	I,IM	IM,I	

Legend: W = Classical, C = Combustion, F = Fusion, A = AA or GFAA, I = ICP-OES, IM=ICP-MS, D = DC Arc, O =Spark OES, X = XRF, G = GDAES or GDMS, H = Hollow Cathode AES, BAL= by Difference

Certification Laboratories

Laboratory Testing, Inc.	Hatfield, PA	NSL Analytical Services	Cleveland, OH
IMR Test Labs	Lansing, NY	Dirats Laboratories	Westfield, MA
Applied Technical Services	Marietta, GA	EAG Laboratories	Liverpool, NY
LGC Standards	Manchester, NH	Luvak Laboratories Inc.	Boylston, MA
Massachusetts Materials Research Inc.	West Boylston, MA	SGS MSi	Melrose Park, IL

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-recognised 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.

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 calculated 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.

Kimberly Halkiotis, Global Product Manager

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