

Certificate of Analysis

IARM Cu715-20

Copper Alloy / Monel 450 / CDA 715 / UNS C71500

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

C	0.005 ± 0.002	Co	0.004 ± 0.003	Cu	67.4 ± 0.4	Fe	0.51 ± 0.01
Mg	0.005 ± 0.002	Mn	0.80 ± 0.01	Ni	31.0 ± 0.2	P	0.009 ± 0.002
S	0.002 ± 0.001	Si	0.09 ± 0.01	Sn	0.004 ± 0.003	Ti	0.073 ± 0.003

Indicative Values listed in ppm

Ag (10)	Al (40)	As (100)	B (<50)	Bi (40)	Cd (<50)	Cr (20)
H (<10)	Mo (<50)	N (10)	Nb (<50)	O (10)	Pb (10)	Sb (10)
Se (<50)	Te (<20)	V (<50)	Zn (70)	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 for disks 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.

	C	Co	Cu	Fe	Mg	Mn	Ni	P	S	Si	Sn	Ti	Ag	Al	As	B
1	0.0017	0.0002	66.03	0.4800	0.0020	0.7680	30.58	0.0050	0.0005	0.0611	0.0001	0.0700	0.0002	0.0002	0.0007	0.0017
2	0.0038	0.0006	66.66	0.4900	0.0035	0.7700	30.58	0.0058	0.0010	0.0736	0.0007	0.0716	0.0010	0.0008	0.0070	<0.0001
3	0.0040	0.0011	67.26	0.4927	0.0037	0.7743	30.72	0.0060	0.0016	0.0752	0.0012	0.0720	<0.001	0.0010	0.0130	<0.001
4	0.0041	0.0025	67.33	0.4940	0.0040	0.7775	30.81	0.0070	0.0019	0.0778	0.0020	0.0730		0.0010	<0.0001	<0.001
5	0.0060	0.0031	67.66	0.4960	0.0041	0.7800	30.86	0.0071	0.0027	0.0888	0.0020	0.0744		0.0060	<0.0001	<0.005
6	0.0081	0.0040	67.68	0.5059	0.0074	0.7842	30.87	0.0074	0.0030	0.0890	0.0034	0.0780		0.0069	<0.005	
7		0.0050	67.69	0.5090	0.0081	0.7850	30.87	0.0080	0.0034	0.0900	0.0050			0.0106		
8		0.0059	67.80	0.5150	0.0120	0.7873	30.96	0.0082		0.0906	0.0100					
9		0.0110	67.86	0.5170		0.8010	30.97	0.0085		0.0910	0.0100					
10			67.93	0.5264		0.8010	31.16	0.0095		0.0978						
11				0.5306		0.8025	31.22	0.0095		0.0981						
12				0.5319		0.8143	31.26	0.0110		0.1000						
13				0.5320		0.8270	31.30	0.0180		0.1038						
14				0.5430		0.8270	31.49	0.0190		0.1100						
15						0.8375				0.1200						
16										0.1340						
Mean	0.0046	0.0037	67.390	0.5117	0.0056	0.7958	30.974	0.0093	0.0020	0.0938	0.0038	0.0732	0.0006	0.0038	0.0069	
STDV.	0.0022	0.0034	0.6087	0.0193	0.0033	0.0223	0.2756	0.0042	0.0011	0.0181	0.0038	0.0028	0.0006	0.0040	0.0062	
Certified	0.005	0.004	67.4	0.51	0.005	0.80	31.0	0.009	0.002	0.09	0.004	0.073	(0.001)	(0.004)	(0.01)	(<0.005)
U _{CRM}	0.002	0.003	0.4	0.01	0.002	0.01	0.2	0.002	0.001	0.01	0.003	0.003				
Methods	O,C	O,I,IM,X	O,W,I,X	X,O,I	O,I,IM	X,O,I	X,O,I	O,I,IM,X	O,I,C	X,O,I,IM	O,I,IM,X	IM,I	O,I	O,I,IM,X	O,I,IM	O,I,IM

	Bi	Cd	Cr	H	Mo	N	Nb	O	Pb	Sb	Se	Te	V	Zn	Zr
1	0.0011	0.0031	0.0010	0.0001	0.0040	0.0003	0.0010	0.0001	0.0001	0.0010	0.0005	0.0019	<0.001	0.0006	<0.0001
2	0.0012	0.0060	0.0016	0.0002		0.0005	<0.0001	0.0009	0.0001	0.0013	0.0010	<0.0001	<0.001	0.0026	<0.001
3	0.0045	<0.0001	0.0030	<0.001		0.0012	<0.0001	0.0010	0.0008	<0.0001	0.0010		<0.005	0.0060	<0.001
4	0.0050	<0.001	0.0032			<0.001	<0.001	<0.001	0.0019	<0.001	0.0030			0.0063	<0.005
5	0.0080	<0.001	<0.0001			<0.001	<0.001	<0.001	0.0020	<0.001	<0.0001			0.0077	
6	<0.0001	<0.005	<0.001			<0.005			0.0030		<0.005			0.0185	
7	<0.001		<0.001								<0.005				
8	<0.005		<0.005												
9			<0.01												
Mean	0.0040		0.0022			0.0007		0.0007	0.0013	0.0012	0.0014			0.0069	
STDV.	0.0029		0.0011			0.0005		0.0005	0.0012	0.0002	0.0011			0.0062	
Reference	(0.004)	(<0.005)	(0.002)	(<0.001)	(<0.005)	(0.001)	(<0.005)	(0.001)	(0.001)	(0.001)	(<0.005)	(<0.002)	(<0.005)	(0.007)	(<0.005)
Methods	IM,I	O,I,IM	O,I,IM,X	F	IM,I	F	O,I,IM	F	O,I,IM	O,I,IM	O,I,IM	I	IM,I	O,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

Laboratorio Prove Materiali S. Marco srl
AY Mc Donald Mfg. Co.
Colonial Metals Co.
NSL Analytical Services
Dirats Laboratories
EAG Laboratories

Schio, Italy
Dubuque, IA
Columbia, PA
Cleveland, OH
Westfield, MA
Liverpool, NY

Laboratory Testing, Inc.
Anderson Laboratories, Inc.
Sipi-Metals Corp
IMR Test Labs
Applied Technical Services
LGC Standards

Hatfield, PA
Greendale, WI
Chicago, IL
Lansing, NY
Marietta, GA
Manchester, NH

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-recognized 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

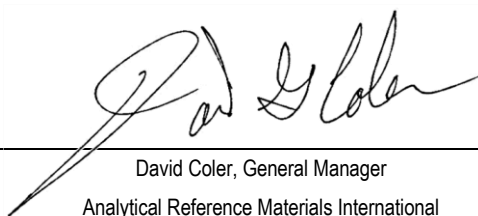
"Uncertainty" values, as reported adjacent to certified concentration values, are based on a 95% Confidence Interval. These estimated uncertainties include the combined effects of method imprecision, material inhomogeneity, and any bias between methods. Homogeneity data from experimental XRF results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