Certificate of Analysis

IARM 91E

CDA 932 / UNS C93200

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Ag	**0.015** ± 0.002	**Al**	**0.0015** ± 0.0004	**As**	**0.008** ± 0.002	**Be**	**0.0005** ± 0.0004
Bi	**0.109** ± 0.009	**C**	**0.003** ± 0.001	**Cd**	**0.0011** ± 0.0004	**Co**	**0.0024** ± 0.0004
Cr	**0.0008** ± 0.0007	**Cu**	**81.3** ± 0.2	**Fe**	**0.110** ± 0.005	**Mn**	**0.0007** ± 0.0003
Ni	**0.300** ± 0.006	**P**	**0.026** ± 0.001	**Pb**	**7.59** ± 0.05	**S**	**0.028** ± 0.002
Sb	**0.168** ± 0.004	**Se**	**0.004** ± 0.001	**Si**	**0.0021** ± 0.0005	**Sn**	**6.69** ± 0.05
Zn	**3.68** ± 0.05						

Indicative Values listed in ppm

B (5)	Mg (<50)	N (4)	Nb (<8)	O (20)	Te (<400)

Description and Intended Use

This CRM may come in the form of a solid disc 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.

Interpretation of Data

1. Certified values listed reflect analysis results submitted by qualified analytical laboratories using a combination of methods and instrumentation that emulate actual methods and instrumental techniques currently utilized in the analytical community, and are reported as wt% unless otherwise noted.
2. This material was tested using both the solid disks and chips prepared from individual sections of bar. The certified values are considered representative of the overall average composition of the material.
3. Any data reported and enclosed by a parentheses ( ) is a "best estimate" and is not certified. This data could not be quantified sufficiently for certification. It was, however, reported by enough laboratories to be considered as potentially present in the matrix of the material being examined.
4. "Provisional Certificate of Analysis" reports values that support a fully certified reference material; it also indicates that values may be in a continued process of statistical evaluation and are subject to change.
5. Chips are not certified for Oxygen analysis.

The following data and accompanying statements represent all pertinent information reported in the ILAP as it applies to the chemical characterization of this material.

	Ag	Al	As	B	Be	Bi	C	Cd	Co	Cr	Cu	Fe	Mg	Mn	N	Nb
1	0.0114	0.0003	0.0013	0.0003	0.0001	0.0784	0.0012	0.0007	0.0015	0.0002	80.60	0.092	0.0002	0.00006	0.00009	0.0001
2	0.0149	0.0004	0.00568	0.0004	0.0002	0.096	0.0018	0.0007	0.002	0.0005	80.9774	0.0956	0.0002	0.0003	0.0001	0.0005
3	0.015	0.0005	0.006	0.0005	0.0002	0.1015	0.00233	0.00075	0.0021	0.0005	81.07	0.1008	0.0004	0.0005	0.0002	0.0008
4	0.015	0.001	0.006	0.0006	0.0005	0.105	0.0033	0.0008	0.0024	0.0006	81.1491	0.105	<0.0001	0.0005	0.0006	<0.0001
5	0.0158	0.0011	0.0062	<0.0004	0.0007	0.1081	0.0034	0.0009	0.0026	0.0009	81.154	0.109	<0.0002	0.0007	0.0008	
6	0.0162	0.0015	0.0065	<0.005	0.001	0.109	0.0034	0.001	0.0027	0.002	81.18	0.109792	<0.005	0.0008		
7	0.0171	0.0015	0.0078		0.001	0.109	0.0062	0.0012	0.0027		81.20	0.1104		0.001		
8		0.0017	0.0088			0.11		0.0013	0.003		81.234	0.1115		0.001		
9		0.0018	0.0101			0.11		0.0014			81.2383	0.1137		0.001		
10		0.0019	0.0108			0.111		0.0027			81.3293	0.115				
11		0.002	0.013			0.1153					81.34	0.116				
12		0.002	0.0143			0.12					81.415	0.1167				
13		0.0021				0.142					81.5903	0.118				
14		0.003									81.9729	0.12				
15											82.07					
Mean	0.015	0.0015	0.008	0.0005	0.0005	0.109	0.003	0.0011	0.0024	0.0008	81.3	0.11	0.0003	0.0007	0.0004	0.0005
STDV.	0.002	0.0008	0.004	0.0001	0.0004	0.01	0.002	0.0006	0.0005	0.0006	0.4	0.008	0.0001	0.0003	0.0003	0.0004
Certified	**0.015**	**0.0015**	**0.008**	**(0.0005)**	**0.0005**	**0.109**	**0.003**	**0.0011**	**0.0024**	**0.0008**	**81.3**	**0.110**	**(<0.005)**	**0.0007**	**(0.0004)**	**(<0.0008)**
95% C.I.	0.002	0.0004	0.002		0.0004	0.009	0.001	0.0004	0.0004	0.0007	0.2	0.005		0.0003		
Methods	O,I	X,O,I	O,I	O,I	O,I	X,O,I	O,C	O,I	O,I	O,I	W,O,I	X,O,I	O,I	O,I	F	O,I

	Ni	O	P	Pb	S	Sb	Se	Si	Sn	Te	Zn					
1	0.2824	0.001	0.021	7.468	0.0205	0.155	0.002	0.0005	6.55	0.0013	3.5569					
2	0.283	0.0011	0.0226	7.4855	0.021	0.16	0.0022	0.001	6.552	0.0033	3.58					
3	0.2838	0.00142	0.0249	7.5166	0.02646	0.165	0.0028	0.0013	6.5901	0.0047	3.591					
4	0.2886	0.0016	0.025	7.52	0.0265	0.165	0.0029	0.0015	6.6222	0.014	3.63					
5	0.295	0.0031	0.026	7.54	0.0276	0.1666	0.003	0.0015	6.63	0.0328	3.6345					
6	0.298238		0.0261	7.584	0.028	0.1672	0.0033	0.002	6.64	<0.0001	3.636					
7	0.299		0.0265	7.5976	0.029	0.16775	0.0034	0.002	6.70		3.65					
8	0.2995		0.027	7.605	0.03	0.168	0.0035	0.0022	6.7118		3.66					
9	0.301		0.027	7.65	0.03	0.169	0.005	0.0022	6.72		3.6734					
10	0.302		0.027	7.664	0.031	0.171	0.0069	0.0023	6.72		3.72					
11	0.307		0.027	7.6675	0.031	0.174		0.0028	6.7264		3.7362					
12	0.308		0.0274	7.69	0.0311	0.177		0.0032	6.742		3.784					
13	0.3114		0.0285	7.712	0.0316	0.184		0.0033	6.7558		3.79					
14	0.315		0.029		0.0328			0.0037	6.7956		3.849					
15	0.32		0.0298						6.923							
Mean	0.3	0.002	0.026	7.59	0.028	0.168	0.004	0.0021	6.69	0.01	3.68					
STDV.	0.01	0.0008	0.002	0.08	0.004	0.007	0.001	0.0009	0.1	0.01	0.09					
Certified	**0.300**	**(0.002)**	**0.026**	**7.59**	**0.028**	**0.168**	**0.004**	**0.0021**	**6.69**	**(<0.04)**	**3.68**					
95% C.I.	0.006		0.001	0.05	0.002	0.004	0.001	0.0005	0.05		0.05					
Methods	X,O,I	F	X,O,I	O,I,A	X,O,I,C	X,O,I	O,I	X,O,I	X,O,I	O,I	X,O,I					

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

Participating Laboratories

I. Schumann & Company	Bedford, OH	Colorado Metallurgical Services	Denver, CO
AY Mc Donald Mfg. Co.	Dubuque, IA	Laboratory Testing, Inc.	Hatfield, PA
Sipi-Metals Corp	Chicago, IL	Anderson Laboratories, Inc.	Greendale, WI
Berntsen Brass & Aluminum Foundry, Inc.	Madison, WI	Colonial Metals Co.	Columbia, PA
Riverside Brass & Aluminum Foundry Ltd.	New Hamburg, ON	Concast Metal Products Co.	Mars, PA
IMR Test Labs	Lansing, NY	Ingot Metal Co. Ltd.	Weston, ON
Atlas Pacific Corporation	Colton, CA		

Traceability

Members of the "Inter-Laboratory Analysis Program" (ILAP) validate test methods and instrument performance utilizing SRMs, CRMs, and RMs produced by recognized Certifying Bodies. The specific SRMs, CRMs, and RMs applicable to the material covered by this certificate are:

ALPHA AR147	BAM 376	BAS 50.01-4	BAS 54.03-4	BCS 183-4	BCS 364	BNF C11.02-1	BS 110A	BS 175BE-1
BS 314B	BS 7132	BS 822	BS 836	BS 903	BS 903B	BS 932A	BS 932E	BS 932M
CC 905	CC 932	CC 932A	CC 938-1	CC922A	CUCDB90	IARM 266A	IARM 72B	IARM 77A
IARM 78A	IARM 82A	IARM 86A	IARM 87B	IARM 89A	IARM 90A	IARM 90B	IARM 91A	IARM 91B
IARM 91C	IARM 92A	IARM 93A	IARM 94A	LECO 501-644	LECO 501-646	LECO 501-929	MBH 17866-K	MBH 17868-S
MBH 17868-Y	MBH 17869-R	MBH 17870-K	MBH 17870-S	MBH 31XB8-F	MBH 32XLB13	MBH 32XLB13B2	MBH 32XLB14-A	MBH 32XLB1-G
MBH 32XLB2-F	MBH 32XLB5-D	MBH 32XLB7-B	MBH 32XPB23A	MBH 32XPB5-H	MBH 32XSEB5-A	MBH 32XSEB6-A	MBH 33XGM21A	MBH 33XGM4-E
MBH 33XGM5-D	MBH 33XGM5L	MBH 33XGM6-C	MBH 33XGM7-D	MBH 33XRB2A	NIST 124C	NIST 3101A	NIST 3103A	NIST 3105A
NIST 3107	NIST 3108	NIST 3112A	NIST 3113	NIST 3131A	NIST 3132	NIST 3137	NIST 3149	NIST 3150
NIST 3151	NIST 3156	NIST 3162A	NIST 3169	RC 11/20	RC 11/4	RC 12/12		

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 is also 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. $$U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$$

The International Standards Organization (ISO) definitions, expressed in ISO Guide 30–1992 list the following:

Certifying Body: Any technically competent body (organization or firm, public or private) that issues a reference material certificate with the information detailed in ISO Guide 31. The only generally accepted certifying body in the United States for primary standards or Standard Reference Materials (SRM) is the U. S. Department of Commerce, National Institute of Standards & Technology (NIST), Gaithersburg, MD. All other certifying bodies in the United States produce Reference Materials (RM) or Certified Reference Materials (CRM).

Reference Material (RM): Material or substance, with one or more property values that are sufficiently homogeneous and well established, to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Certified Reference Material (CRM): Reference material, accompanied by a certificate, with one or more property values certified by a procedure, which establishes its traceability to an accurate realization of the unit in which the property values are expressed, and for which each certified value is accompanied by an uncertainty at a stated level of confidence.

Inter-Laboratory Analysis Program (ILAP): ASTM Standard E691-87 applies to inter-laboratory studies to "Determine the Precision of a Single Test Method", but also outlines a well thought out and logical plan for conducting an inter laboratory program involving multiple analytical techniques. Therefore, the guidelines established in ASTM E691-87 were applied to all aspects of this inter laboratory program, including the protocols for planning, handling, analysis and treatment of resulting data.

Methods of Analysis: The "Inter Laboratory Analysis Program" analyzes a wide variety of materials, and as a result, no single analytical method would provide optimum analytical results. Therefore, a combination of ASTM Standard Methods for classical wet chemistry, ICP, AA, Optical Emission, X-Ray spectrometric, and other accepted methods were used to produce analytical data. Carbon, Sulfur, Nitrogen, and Oxygen results were supplied from combustion and OE instrument procedures.

Expiration of Certification: The certification of this IARM is valid indefinitely, within the uncertainty specified, provided the IARM is handled and stored in accordance with the instructions stated on this certificate. The certification is nullified if the IARM is damaged, contaminated, otherwise modified, or used in a manner for which it was not intended.

Instructions for Use: The test surface is on the side opposite to the labeled surface, which includes the IARM number. 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. 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. The material should be stored in a cool, dry location when not in use. Chips are not to be used for Oxygen analysis.

Selection of Materials: A "batch" or "series" is defined as a continuous length of bar produced from a single heat. The majority of IARM materials are in wrought condition; other methods of manufacture are utilized if necessary. ILAP samples are removed from equal sections from the total length of the bar. A portion of each section is converted to chips and a thin (pin) disk for analysis by classical wet chemistry, ICP, AA, and combustion procedures, and the balance remains as a thick disk for OES and X-Ray analysis.

David Coler, General Manager

Analytical Reference Materials International

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