



# Certificate of Analysis

## IARM 76D

CDA 485 / UNS C48500

### Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

<b>Ag</b>	<b>0.0014 ± 0.0004</b>	<b>Al</b>	<b>0.002 ± 0.001</b>	<b>As</b>	<b>0.004 ± 0.002</b>	<b>Be</b>	<b>0.0006 ± 0.0008</b>
<b>Bi</b>	<b>0.0011 ± 0.0004</b>	<b>C</b>	<b>0.002 ± 0.001</b>	<b>Cd</b>	<b>0.0010 ± 0.0002</b>	<b>Co</b>	<b>0.0010 ± 0.0005</b>
<b>Cr</b>	<b>0.0006 ± 0.0003</b>	<b>Cu</b>	<b>60.7 ± 0.2</b>	<b>Fe</b>	<b>0.013 ± 0.002</b>	<b>Mg</b>	<b>0.0005 ± 0.0004</b>
<b>Mn</b>	<b>0.0006 ± 0.0003</b>	<b>Ni</b>	<b>0.003 ± 0.001</b>	<b>P</b>	<b>0.0018 ± 0.0003</b>	<b>Pb</b>	<b>1.69 ± 0.03</b>
<b>S</b>	<b>0.0012 ± 0.0004</b>	<b>Sb</b>	<b>0.0040 ± 0.0006</b>	<b>Si</b>	<b>0.0037 ± 0.0009</b>	<b>Sn</b>	<b>0.73 ± 0.01</b>
<b>Zn</b>	<b>36.8 ± 0.3</b>						

Indicative Values listed in ppm

<b>B (&lt;10)</b>	<b>N (&lt;10)</b>	<b>Nb (&lt;20)</b>	<b>O (6)</b>	<b>Se (&lt;10)</b>	<b>Te (&lt;90)</b>	<b>Zr (&lt;10)</b>
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#### 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	0.0009	0.001	0.0005	0.001	0.00005	0.0004	0.0005	0.0008	0.0003	0.00007	59.8209	0.008	0.0001	0.0002	0.0006	0.0005
2	0.001	0.001	0.0013	<0.0001	0.00005	0.0009	0.0013	0.0008	0.0003	0.0005	60.177	0.0097	0.0002	0.0002	0.00092	0.002
3	0.0012	0.0014	0.0018	<0.001	0.0001	0.001	0.0019	0.0009	0.0006	0.0005	60.41	0.0108	0.0005	0.0003	0.00095	<0.0001
4	0.0012	0.0018	0.002		0.0005	0.001	0.0022	0.001	0.001	0.0005	60.57	0.0123	0.0005	0.0004	<0.0001	<0.0001
5	0.0015	0.0022	0.0023		0.001	0.001	0.0034	0.001	0.001	0.0006	60.63	0.0123	0.0008	0.0005	<0.001	<0.0001
6	0.0016	0.0022	0.0025		0.002	0.0016	0.0035	0.0012	0.001	0.001	60.65	0.013043	0.001	0.0005		
7	0.0021	0.003	0.0055			0.0017			0.0015	0.001	60.75	0.0132		0.0005		
8		0.0035	0.00737						0.0022		60.7614	0.0148		0.001		
9		0.005014	0.0075								60.85	0.015		0.0015		
10			0.0075								60.915	0.015				
11											60.9416	0.015				
12											61.04383	0.015				
13											61.3633	0.019				
14																
15																
Mean	0.0014	0.002	0.004		0.0006	0.0011	0.002	0.001	0.001	0.0006	60.7	0.013	0.0005	0.0006	0.0008	
STDV.	0.0004	0.001	0.003		0.0008	0.0004	0.001	0.0002	0.0006	0.0003	0.4	0.003	0.0003	0.0004	0.0002	
<b>Certified</b>	<b>0.0014</b>	<b>0.002</b>	<b>0.004</b>	<b>(&lt;0.001)</b>	<b>0.0006</b>	<b>0.0011</b>	<b>0.002</b>	<b>0.0010</b>	<b>0.0010</b>	<b>0.0006</b>	<b>60.7</b>	<b>0.013</b>	<b>0.0005</b>	<b>0.0006</b>	<b>(&lt;0.001)</b>	<b>(&lt;0.002)</b>
95% C.I.	0.0004	0.001	0.002		0.0008	0.0004	0.001	0.0002	0.0005	0.0003	0.2	0.002	0.0004	0.0003		
Methods	O,IM,I	O,IM,I	O,IM,I	O,IM,I	O,IM,I	O,IM,I	O,C	O,IM,I	O,IM,I	O,IM,I	W,O,IM,I	O,IM,I	O,IM,I	O,IM,I	F	O,IM,I

	Ni	O	P	Pb	S	Sb	Se	Si	Sn	Te	Zn	Zr				
1	0.0005	0.0001	0.0011	1.62	0.0001	0.0032	0.001	0.001	0.704	0.0023	35.54396	<0.0001				
2	0.001	0.00048	0.0014	1.63	0.0008	0.0035	0.001	0.0023	0.7063	0.0048	36.388	<0.0003				
3	0.002	0.0005	0.0015	1.653	0.001	0.0036	0.001	0.0027	0.71386	0.0053	36.54	<0.001				
4	0.002	0.00064	0.0016	1.6675	0.001	0.0043	<0.00003	0.0028	0.722	0.0088	36.60					
5	0.002	0.0013	0.0017	1.679	0.0011	0.0044	<0.0001	0.0031	0.723	<0.00005	36.65					
6	0.0023	<0.001	0.002	1.6945	0.0011	0.0047	<0.0001	0.0033	0.726	<0.0001	36.6708					
7	0.0027		0.002	1.6972	0.0012			0.004	0.727		36.71					
8	0.0029		0.002	1.699	0.0012			0.004	0.728		36.8418					
9	0.0033		0.0024	1.70	0.0012			0.0041	0.735		36.8837					
10	0.0045		0.00273	1.705	0.0013			0.0054	0.739		36.9501					
11	0.0061			1.73	0.002			0.005729	0.746		37.036					
12				1.731	0.00253			0.006	0.7497		37.08					
13				1.7942					0.751		37.32					
14									0.765		38.1208					
15																
Mean	0.003	0.0006	0.0018	1.69	0.0012	0.004		0.0037	0.73	0.005	36.8					
STDV.	0.002	0.0004	0.0005	0.05	0.0006	0.0006		0.001	0.02	0.003	0.6					
<b>Certified</b>	<b>0.003</b>	<b>(0.0006)</b>	<b>0.0018</b>	<b>1.69</b>	<b>0.0012</b>	<b>0.0040</b>	<b>(&lt;0.001)</b>	<b>0.0037</b>	<b>0.73</b>	<b>(&lt;0.009)</b>	<b>36.8</b>	<b>(&lt;0.001)</b>				
95% C.I.	0.001		0.0003	0.03	0.0004	0.0006		0.0009	0.01		0.3					
Methods	X,O,IM,I	F	X,O,IM,I	X,O,I	O,I,C	O,IM,I	O,IM,I,A	X,O,IM,I	X,O,I	O,IM,I,A	X,O,I	O,IM,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  
Special Metals IncoTest  
Element - Newtown  
Colonial Metals Co.  
Sipi-Metals Corp  
Colorado Metallurgical Services

Bedford, OH  
Hereford, UK  
Newtown, PA  
Columbia, PA  
Chicago, IL  
Denver, CO

Atlas Pacific Corporation  
Laboratory Testing, Inc.  
Anderson Laboratories, Inc.  
NSL Analytical Services  
Concast Metal Products Co.  
Exova - Gary

Colton, CA  
Hatfield, PA  
Greendale, WI  
Cleveland, OH  
Mars, PA  
Gary, IN

### 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 AR148	ALPHA AR881	ALPHA AR892	ALPHA AR946	BCS 179/2	BCS 351	BCS 390	BCS 454/1	BCS 462/1
BNF C38/01-1	BNF C38/02-1	BNF C38/03-1	BNF C38/04-1	BNF C38/05-1	BNF C42/21-1	BNF C42/22-1	BNF C42/23	BNF C48/05
BS 482A	BS 485	BS 857B-1	BS 863	CLAXTON 485	CTIF L1A	CTIF L2	CTIF L20A	CTIF L3A
CTIF L4-1	CTIF L6A	CTIF LH1	CTIF LH2	CTIF LH13A	CTIF LH2	CTIF LH5A	CTIF LH6-1	CTIF LH7-1A
CTIF LH8-1	IARM 73B	IARM 73C	IARM 74A	IARM 75B	IARM 76A	IARM 76C	IARM 86C	IMN WM1
IMN WM2	IMN WM3	IMN WM4	IMN WM5	LECO 501-147	LECO 501-550	LECO 501-643	LECO 502-102	MBH 31X7835
MBH 31X7835.3E	MBH 31X7835.6A	MBH 31XB26C	MBH 31XB4	MBH 39X17866.AC	MBH 39X17868.AE	NIST 3101A	NIST 3102A	NIST 3103A
NIST 3105A	NIST 3106	NIST 3112A	NIST 3113	NIST 3132	NIST 3136	NIST 3137	NIST 3139A	NIST 3149
NIST 3150	NIST 37D	NIST 37E	NIST 898	RC 112				

### 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 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.

$$1. N_{min} = \max(10, \sqrt[3]{N_{prod}})$$

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

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.



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