LGC ARMI

Certificate of Analysis
IARM 273A

Alloy C263 / UNS N07263

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	0.49 ± 0.01	**As**	0.0011 ± 0.0008	**B**	0.0012 ± 0.0005	**C**	0.060 ± 0.001
Co	20.12 ± 0.07	**Cr**	20.43 ± 0.03	**Cu**	0.007 ± 0.002	**Fe**	0.285 ± 0.008
Mg	0.003 ± 0.001	**Mn**	0.214 ± 0.006	**Mo**	5.84 ± 0.04	**N**	0.0037 ± 0.0003
Nb	0.019 ± 0.002	**Ni**	50.3 ± 0.1	**O**	0.0012 ± 0.0003	**P**	0.003 ± 0.001
S	0.0003 ± 0.0001	**Si**	0.078 ± 0.008	**Sn**	0.0010 ± 0.0009	**Ta**	0.007 ± 0.005
Ti	2.12 ± 0.04	**V**	0.007 ± 0.001	**W**	0.019 ± 0.003	**Zr**	0.0010 ± 0.0004

Indicative Values listed in ppm

Ag (<1)	Bi (<80)	Ca (<20)	La (<50)	Pb (<1)	Sb (<10)

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	Bi	C	Ca	Co	Cr	Cu	Fe	La	Mg	Mn	Mo	N
1	0.00001	0.4534	0.00018	0.0002	0.000001	0.0566	0.00003	19.94	20.32	0.002	0.2676	<0.000005	0.001	0.1975	5.75	0.00258
2	0.000015	0.4623	0.0003	0.0002	0.0000025	0.057	0.0001	19.97	20.377	0.0023	0.27	<0.005	0.0017	0.202	5.7728	0.0033
3	0.000017	0.4735	0.001	0.0003	0.000006	0.05815	0.0008	19.98	20.38	0.0042	0.2721		0.0021	0.2084	5.777	0.0033
4	0.000018	0.4741	0.00146	0.001	0.00001	0.0588	0.001	19.998	20.41	0.0054	0.276		0.0022	0.209	5.7995	0.00331
5	0.000023	0.478	0.0015	0.001	0.0001	0.059	0.002	20.023	20.41	0.006	0.277		0.00225	0.2099	5.8276	0.00335
6	<0.0001	0.482	0.0022	0.0011	0.001	0.059	<0.0001	20.106	20.414	0.006	0.28		0.0023	0.214	5.829	0.0035
7	<0.0002	0.483		0.0011	0.0075	0.05936	<0.002	20.144	20.42	0.007	0.2868		0.00246	0.216	5.833	0.00353
8		0.4879		0.0011	<0.000005	0.0596		20.151	20.4593	0.0073	0.289		0.005	0.2163	5.8438	0.0037
9		0.5043		0.0014	<0.0001	0.06		20.20	20.4662	0.01	0.2892		0.0056	0.217	5.86	0.0038
10		0.51		0.0019	<0.0001	0.0603		20.231	20.47	0.01033	0.29			0.2184	5.877	0.0039
11		0.512		0.002		0.06035		20.24	20.47	0.011	0.295			0.22	5.889	0.004
12		0.5131		0.0025		0.0604		20.2432	20.519		0.304			0.234	5.91	0.00417
13						0.0616		20.2875			0.309				5.957	0.00436
14						0.0633										0.0046
15																
Mean	0.000017	0.49	0.0011	0.0012	0.001	0.06	0.001	20.12	20.43	0.007	0.285		0.003	0.214	5.84	0.0037
STDV.	0.000005	0.02	0.0008	0.0007	0.003	0.002	0.0008	0.1	0.05	0.003	0.01		0.002	0.009	0.06	0.0005
Certified	(<0.0001)	0.49	0.0011	0.0012	(<0.008)	0.060	(<0.002)	20.12	20.43	0.007	0.285	(<0.005)	0.003	0.214	5.84	0.0037
95% C.I.		0.01	0.0008	0.0005	0.003	0.001		0.07	0.03	0.002	0.008		0.001	0.006	0.04	0.0003
Methods	IM,H,G,A	X,O,I	O,IM,G	O,IM,I,G	O,IM,H,G,A	O,C	I,G	X,O,I	X,O,W	X,O,I	X,O,I	I,G	O,I	X,O,I	X,O,I	F

	Nb	Ni	O	P	Pb	S	Sb	Si	Sn	Ta	Ti	V	W	Zr		
1	0.015	49.946	0.0001	0.0011	0.00002	0.00011	0.000069	0.051	0.00017	0.0004	2.001	0.004	0.012	0.0005		
2	0.0164	50.073	0.000675	0.0013	0.000029	0.0002	0.00007	0.06	0.0002	0.0006	2.0273	0.0048	0.0138	0.0005		
3	0.017	50.08	0.00077	0.0014	0.000029	0.0002	0.00007	0.07	0.000252	0.0025	2.055	0.005	0.015	0.0006		
4	0.0177	50.124	0.0008	0.0015	0.000033	0.0002	0.0001	0.072	0.0003	0.003	2.0785	0.006	0.0153	0.001		
5	0.018	50.222	0.00108	0.0018	0.000034	0.0002	0.0001	0.0754	0.00051	0.0119	2.12	0.0063	0.0172	0.001		
6	0.018	50.2411	0.0011	0.0031	<0.0001	0.00024	0.001	0.0774	0.0007	0.0128	2.13	0.0065	0.018	0.001		
7	0.0184	50.37	0.00131	0.0033	<0.0005	0.00029		0.078	0.0009	0.0133	2.134	0.0068	0.0193	0.0011		
8	0.019	50.40	0.0014	0.0036		0.0003		0.08	0.003	0.015	2.1389	0.0072	0.0195	0.0016		
9	0.021	50.4338	0.0016	0.004		0.0004		0.081	0.0033		2.142	0.00835	0.0195	0.0021		
10	0.0224	50.54	0.00163	0.0042		0.0005		0.0832			2.148	0.0085	0.022			
11	0.0228	50.55	0.00164	0.0049		0.0005		0.089			2.174	0.01033	0.025			
12	0.0268	50.656	0.0017	0.005		0.00052		0.0935			2.18	0.0119	0.027			
13			0.002	0.006		0.0006		0.1034			2.183					
14																
15																
Mean	0.019	50.3	0.0012	0.003	0.000029	0.0003	0.0002	0.078	0.001	0.007	2.12	0.007	0.019	0.001		
STDV.	0.003	0.2	0.0005	0.002	0.000006	0.0002	0.0004	0.01	0.001	0.006	0.06	0.002	0.004	0.0005		
Certified	0.019	50.3	0.0012	0.003	(<0.0001)	0.0003	(<0.001)	0.078	0.0010	0.007	2.12	0.007	0.019	0.0010		
95% C.I.	0.002	0.1	0.0003	0.001		0.0001	0.0005	0.008	0.0009	0.005	0.04	0.001	0.003	0.0004		
Methods	X,O,I,G	X,O,I	F	X,W,O,I,G	O,IM,I,H,G,A	O,C	O,IM,H,G	X,O,I,G	O,IM,I,H,G,A	X,O,I,G	X,O,I	X,O,I,G	X,O,I,G	X,O,I,G		

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

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273A-10162017-IARM-F
10/16/2017   2 / 3

Participating Laboratories

ATI Specialty Materials, Monroe	Monroe, NC	Huntington Alloys Corporation	Huntington, WV
VDM-Metals USA, LLC	Florham Park, NJ	Laboratory Testing, Inc.	Hatfield, PA
Alcoa Howmet, Dover Alloy	Dover, NJ	Exova - Teesside	Middlesbrough, UK
Exova - Portland	Portland, OR	Latrobe Specialty Metals, A Carpenter Co.	Latrobe, PA
Anderson Laboratories, Inc.	Greendale, WI	Haynes International, Inc.	Kokomo, IN
Special Metals IncoTest	Hereford, UK	ATI Specialty Materials, Lockport	Lockport, NY

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 AR511	ALPHA AR654	ALPHA AR660	ALPHA AR669	ALPHA AR673	ALPHA AR688	ALPHA AR871	ALPHA AR881	ALPHA AR890
BAS 310/1	BCS 310/1	BCS 326/1	BCS 350	BCS 351	BCS 387	BCS 387/1405	BCS 454/1	BCS 462/1
BCS CRM 346	BCS CRM346A	BS 198	BS 199	BS 199A	BS 263	BS 617	BS H-6A	EMRC 377/1
HAS 263A	IARM 100B	IARM 56D	IARM 62B	IARM 62C	IARM 66C	IARM 68B	IH 37969	IH R1780
IH R5657	IH WASP 66	LECO 501-502	LECO 501-503	LECO 501-551	LECO 501-643	LECO 501-644	LECO 501-645	LECO 501-646
LECO 501-674	LECO 501-675	LECO 501-991	LECO 501-992	LECO 502-102	LECO 502-257	MBH 24XWASP3D	NIST 1187	NIST 1190
NIST 1191	NIST 1193	NIST 1205	NIST 1206	NIST 1207-2	NIST 1208-1	NIST 1249	NIST 1254	NIST 1260
NIST 1261	NIST 1262	NIST 1263	NIST 1264	NIST 131G	NIST 155	NIST 169	NIST 1763	NIST 1765
NIST 3102A	NIST 3103A	NIST 3106	NIST 3107	NIST 3109A	NIST 3113	NIST 3114	NIST 3128	NIST 3131A
NIST 3134	NIST 3139A	NIST 3151	NIST 3155	NIST 3161A	NIST 3165	NIST 345	NIST 348A	NIST 349
NIST 349A	NIST 361	NIST 363	NIST 364	NIST 72G	NIST 864	NIST 865	NIST 867	NIST 899C
NIST H5	RNI 11/10	RNI 12/12	RNI 13/11	RNI 14/11	RNI 15/12			

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.

$$1. \quad N_{min} = \max\left(10, \sqrt[3]{N_{prod}}\right) \qquad\qquad 2. \quad U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$$

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
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ISO 9001:2008