LGC ARMI

Certificate of Analysis
IARM 338A
Alloy 602CA / UNS N06025
Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	2.13 ± 0.02	**B**	0.0049 ± 0.0007	**C**	0.168 ± 0.002	**Ca**	0.002 ± 0.001
Co	0.035 ± 0.002	**Cr**	25.0 ± 0.3	**Cu**	0.0059 ± 0.0009	**Fe**	9.74 ± 0.03
Mg	0.0058 ± 0.0003	**Mn**	0.052 ± 0.003	**Mo**	0.0017 ± 0.0005	**N**	0.0276 ± 0.0006
Nb	0.004 ± 0.001	**Ni**	62.3 ± 0.2	**O**	0.0010 ± 0.0003	**P**	0.003 ± 0.001
Pb	0.00007 ± 0.00002	**S**	0.0008 ± 0.0002	**Si**	0.020 ± 0.002	**Sn**	0.00037 ± 0.00009
Ti	0.130 ± 0.003	**V**	0.0026 ± 0.0005	**Y**	0.06 ± 0.01	**Zr**	0.081 ± 0.004

Indicative Values listed in ppm

Ag (1)	As (<5)	Bi (<1)	Sb (0.9)	Ta (20)	W (<200)

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	Mg	Mn	Mo	N	Nb
1	0.00001	2.076	0.0001	0.0026	0.00001	0.162	0.001	0.031	23.90	0.0039	9.666	0.005	0.042	0.001	0.0263	0.002
2	0.00002	2.098	0.0002	0.0034	<0.00001	0.164	0.0012	0.0319	24.039	0.0048	9.6901	0.0056	0.047	0.001	0.0265	0.0024
3	0.00002	2.10	0.00042	0.0041	<0.00001	0.165	0.0016	0.032	24.47	0.005	9.70	0.0058	0.0485	0.0012	0.0268	0.003
4	0.0002	2.12	<0.005	0.0043	<0.0001	0.1666	0.0017	0.0328	25.014	0.005	9.70	0.0058	0.05	0.0014	0.027	0.0033
5	0.00031	2.12		0.0045		0.167	0.0028	0.034	25.0316	0.005	9.7008	0.0058	0.05	0.0015	0.0275	0.0038
6	<0.0002	2.121		0.0046		0.167	0.0033	0.034	25.0571	0.0053	9.702	0.0059	0.051	0.002	0.0276	0.0039
7		2.1286		0.005		0.168		0.035	25.073	0.0054	9.75	0.006	0.0519	0.002	0.0278	0.0055
8		2.15		0.0052		0.1681		0.035	25.097	0.006	9.751	0.006	0.052	0.002	0.0281	0.0056
9		2.15		0.0052		0.1689		0.0353	25.351	0.006	9.766	0.0063	0.0527	0.003	0.0282	0.0078
10		2.159		0.0053		0.17		0.0369	25.40	0.006	9.77		0.0537		0.0285	
11		2.16		0.00555		0.1733		0.0369	25.417	0.0063	9.81		0.054		0.0294	
12		2.209		0.0056		0.1763		0.041	25.443	0.0087	9.834		0.055			
13				0.0077					25.49	0.009			0.0604			
14									25.7301				0.061			
15																
Mean	0.0001	2.13	0.0002	0.0049		0.168	0.002	0.035	25	0.0059	9.74	0.0058	0.052	0.0017	0.0276	0.004
STDV.	0.0001	0.04	0.0002	0.001		0.004	0.0009	0.003	0.5	0.001	0.05	0.0004	0.005	0.0006	0.0009	0.002
Certified	(0.0001)	2.13	(<0.0005)	0.0049	(<0.0001)	0.168	0.002	0.035	25.0	0.0059	9.74	0.0058	0.052	0.0017	0.0276	0.004
95% C.I.		0.02		0.0007		0.002	0.001	0.002	0.3	0.0009	0.03	0.0003	0.003	0.0005	0.0006	0.001
Methods	I,IM,H,A	X,O,I,G	IM,I,H	O,IM,I,G	IM,H,A	O,C	I	X,O,IM,I,G	X,W,O,I,G	X,O,IM,I,G	X,W,O,I,G	O,IM,I	X,O,IM,I,G	X,O,IM,I,G	F	X,O,IM,I,G

	Ni	O	P	Pb	S	Sb	Si	Sn	Ta	Ti	V	W	Y	Zr		
1	61.852	0.0005	0.001	0.00004	0.0004	0.000056	0.0159	0.00014	0.001	0.121	0.0016	0.0002	0.021	0.0654		
2	61.983	0.0005	0.0011	0.00006	0.0005	0.00006	0.018	0.0003	0.001	0.126	0.002	0.0013	0.0516	0.0721		
3	62.12	0.0006	0.0012	0.00008	0.0005	0.0001	0.0184	0.0004	0.0019	0.126	0.002	0.006	0.058	0.0778		
4	62.20	0.0008	0.0012	0.000082	0.0006	0.0001	0.019	0.0004	0.002	0.127	0.0023	0.015	0.0633	0.079		
5	62.24	0.0009	0.0015	0.00009	0.000752	0.00011	0.019	0.0004	0.005	0.128	0.0023	0.02	0.0653	0.0795		
6	62.3992	0.00094	0.0016	0.00009	0.0009	<0.005	0.02	0.0004		0.129	0.003	<0.0004	0.067	0.08		
7	62.433	0.0011	0.0019		0.001		0.02	0.0004		0.1294	0.0031	<0.005	0.0684	0.0807		
8	62.507	0.0011	0.0023		0.001		0.02	0.0005		0.13	0.0032	<0.010	0.07	0.0816		
9	62.51	0.0013	0.0039		0.0014		0.021			0.1303	0.0033	<0.02	0.0702	0.082		
10	62.531	0.0013	0.004				0.0216			0.1305	0.0034		0.0707	0.082		
11		0.002	0.0047				0.0235			0.136			0.10	0.086		
12			0.0057				0.027			0.138				0.087		
13			0.006							0.14				0.09		
14														0.0901		
15																
Mean	62.3	0.001	0.003	0.00007	0.0008	0.00009	0.02	0.00037	0.002	0.13	0.0026	0.01	0.06	0.081		
STDV.	0.2	0.0004	0.002	0.00002	0.0003	0.00003	0.003	0.0001	0.002	0.005	0.0006	0.009	0.02	0.007		
Certified	62.3	0.0010	0.003	0.00007	0.0008	(0.00009)	0.020	0.00037	(0.002)	0.130	0.0026	(<0.02)	0.06	0.081		
95% C.I.	0.2	0.0003	0.001	0.00002	0.0002		0.002	0.00009		0.003	0.0005		0.01	0.004		
Methods	X,W,I	F	X,W,O,IM,I,G	I,IM,H,A	O,C	IM,I,H	X,O,IM,I,G	X,IM,H,A	X,O,I	X,O,I,IM,G	X,O,I,IM,G	X,O,I,IM,G	X,IM,I	X,O,IM,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

Participating Laboratories

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 AR654	ALPHA AR660	ALPHA AR669	ALPHA AR872	ALPHA AR890	BCS 351	BCS 454/1	BCS 462/1	BS 223D
BS 690	BS 750	BS CSN-4	CT631	HAS 601A	HF4112	HF4113	IARM 207A	IARM 54A
IARM 56A	IARM 56D	IARM 60A	IARM 62B	IARM 68B	IARM69A	IH 021313	IH R5657	IH RV675
LECO 501-147	LECO 501-503	LECO 501-510	LECO 501-550	LECO 501-643	LECO 501-644	LECO 501-676	LECO 502-102	LECO 502-195
LECO 502-257	LECO 502-328	LECO 502-414	NIST 1206-2	NIST 1244	NIST 1245	NIST 1249	NIST 125	NIST 1254
NIST 136C	NIST 1765	NIST 2424A	NIST 3102A	NIST 3103A	NIST 3106	NIST 3107	NIST 3109A	NIST 3114
NIST 3128	NIST 3131A	NIST 3134	NIST 3137	NIST 3139A	NIST 3150	NIST 3151	NIST 3155	NIST 3161A
NIST 3163	NIST 3165	NIST 3167A	NIST 3169	NIST 349A	NIST 361	NIST 362	NIST 363	NIST 364
NIST 6151	NIST 65A	NIST 864	NIST 865	NIST 867	NIST 897	NIST3107	NIST349	RV676
SUS 12/12	SUS 13/11	SUS 14/11	SUS RN11/10	TRAMPS 100412				

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.

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

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

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.