LGC ARMI

Certificate of Analysis
IARM 68D
Haynes 230 / UNS N06230
Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	0.325 ± 0.003	**B**	0.0041 ± 0.0006	**C**	0.099 ± 0.002	**Co**	0.158 ± 0.004
Cr	21.59 ± 0.04	**Cu**	0.016 ± 0.002	**Fe**	1.11 ± 0.01	**La**	0.010 ± 0.003
Mg	0.0062 ± 0.0003	**Mn**	0.492 ± 0.003	**Mo**	1.291 ± 0.009	**N**	0.0476 ± 0.0007
Nb	0.029 ± 0.001	**Ni**	60.3 ± 0.2	**O**	0.0007 ± 0.0004	**P**	0.0059 ± 0.0005
S	0.0002 ± 0.0001	**Sb**	0.00009 ± 0.00006	**Si**	0.422 ± 0.007	**Sn**	0.001 ± 0.002
Ta	0.014 ± 0.007	**Ti**	0.0108 ± 0.0007	**V**	0.009 ± 0.001	**W**	14.16 ± 0.06
Zr	0.0023 ± 0.0008						

Indicative Values listed in ppm

Ag (<0.2)   As (<10)   Bi (10)   Ca (10)   Pb (2)

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.

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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	0.3159	0.00033	0.0028	0.0000007	0.0937	0.0003	0.1489	21.480	0.013	1.0626	0.0077	0.0054	0.482	1.2547	0.0448
2	0.00002	0.320	0.0015	0.0031	0.000003	0.0945	0.0006	0.1495	21.490	0.0131	1.070	0.009	0.0058	0.4825	1.2768	0.046
3	0.00002	0.3225		0.0037	0.00001	0.097	0.001	0.1511	21.520	0.0131	1.0714	0.0092	0.0059	0.485	1.282	0.0471
4	<0.00001	0.323		0.0038	0.0026	0.0976	0.0012	0.154	21.5353	0.014	1.080	0.010	0.006	0.490	1.2833	0.0472
5	<0.00001	0.3235		0.0038	<0.00001	0.098	0.0019	0.1543	21.558	0.014	1.087	0.0114	0.0061	0.490	1.284	0.0473
6	<0.0001	0.324		0.0039	<0.0001	0.099	<0.0001	0.156	21.563	0.0146	1.1084	0.015	0.0062	0.4913	1.286	0.0478
7		0.326		0.004		0.0998		0.159	21.570	0.015	1.116		0.0062	0.492	1.287	0.048
8		0.327		0.004		0.100		0.160	21.577	0.016	1.120		0.0065	0.494	1.290	0.0482
9		0.330		0.0041		0.100		0.162	21.605	0.01614	1.122		0.0067	0.4958	1.293	0.0484
10		0.330		0.0044		0.100		0.164	21.617	0.0162	1.122		0.0071	0.49687	1.295	0.048437
11		0.331		0.005		0.1022		0.165	21.624	0.0164	1.124			0.498	1.3026	0.0485
12		0.333		0.0064		0.1022		0.166	21.6388	0.026	1.125			0.498	1.306	0.0485
13						0.1032		0.17053	21.6549		1.127			0.498	1.310	0.049
14						0.1035			21.760		1.140				1.320	
15																
Mean	0.00002	0.325	0.001	0.0041	0.001	0.099	0.001	0.158	21.59	0.016	1.11	0.01	0.0062	0.492	1.291	0.0476
STDV.	0.000006	0.005	0.0008	0.0009	0.001	0.003	0.0006	0.007	0.07	0.004	0.03	0.003	0.0005	0.006	0.02	0.001
Certified	(0.00002)	0.325	(0.001)	0.0041	(0.001)	0.099	(0.001)	0.158	21.59	0.016	1.11	0.010	0.0062	0.492	1.291	0.0476
95% C.I.		0.003		0.0006		0.002		0.004	0.04	0.002	0.01	0.003	0.0003	0.003	0.009	0.0007
Methods	IM,H,A	X,O,I,G	IM,H	O,I,D	IM,H,A	C	I	X,O,I,G	X,W,O,I,G	X,W,O,I,G	X,W,O,I,G	O,I,D	O,I	X,O,I,G	X,O,I,G	F

	Nb	Ni	O	P	Pb	S	Sb	Si	Sn	Ta	Ti	V	W	Zr		
1	0.026	59.800	0.0001	0.0043	0.00004	0.0001	0.00004	0.400	0.0001	0.0086	0.0083	0.0031	13.970	0.0002		
2	0.027	59.836	0.0002	0.0047	0.00005	0.0001	0.00005	0.405	0.00017	0.009	0.010	0.0063	13.990	0.0013		
3	0.0271	59.991	0.00024	0.0054	0.00007	0.0001	0.00006	0.4092	0.0002	0.0094	0.0106	0.008	14.080	0.0019		
4	0.0274	60.0223	0.00033	0.00542	0.00008	0.0001	0.00006	0.410	0.00021	0.0099	0.0107	0.0083	14.0947	0.0023		
5	0.028	60.204	0.0004	0.0055	0.0007	0.0001	0.0001	0.420	0.0003	0.0114	0.0109	0.0084	14.09567	0.0027		
6	0.0289	60.260	0.0004	0.0059	<0.0001	0.0001	0.0002	0.4235	0.0004	0.015	0.011	0.0087	14.110	0.0028		
7	0.0289	60.285	0.0006	0.0062		0.000174		0.4251	0.0049	0.0186	0.011	0.0093	14.120	0.0028		
8	0.029	60.400	0.0007	0.0064		0.000253		0.42567		0.034	0.0114	0.0093	14.160	0.003		
9	0.0297	60.400	0.0007	0.0067		0.0004		0.428			0.0117	0.0094	14.202	0.0033		
10	0.030	60.440	0.0008	0.00675		0.0005		0.428			0.012	0.0102	14.220			
11	0.030	60.633	0.0014	0.0068		0.0006		0.429				0.0104	14.221			
12	0.032	61.050	0.0025	0.0069				0.430				0.011	14.257			
13								0.437					14.3072			
14								0.441					14.343			
15																
Mean	0.029	60.3	0.0007	0.0059	0.0002	0.0002	0.00009	0.422	0.001	0.014	0.0108	0.009	14.16	0.0023		
STDV.	0.002	0.4	0.0007	0.0009	0.0003	0.0002	0.00006	0.01	0.002	0.009	0.001	0.002	0.1	0.001		
Certified	0.029	60.3	0.0007	0.0059	(0.0002)	0.0002	0.00009	0.422	0.001	0.014	0.0108	0.009	14.16	0.0023		
95% C.I.	0.001	0.2	0.0004	0.0005		0.0001	0.00006	0.007		0.007	0.0007	0.001	0.06	0.0008		
Methods	X,O,I,G	X,O,I	F	X,O,I	O,IM,I,H,A	C	IM,H,A	X,O,I		X,O,I	X,O,I,G,D	X,O,I,G,D	X,O,I,G	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

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Participating Laboratories

Haynes International, Inc.	Kokomo, IN	ATI Specialty Materials, Monroe	Monroe, NC
Laboratory Testing, Inc.	Hatfield, PA	Special Metals IncoTest	Hereford, UK
VDM-Metals USA, LLC	Florham Park, NJ	Huntington Alloys Corporation	Huntington, WV
Cronimet Specialty Metals USA, Inc.	Wheatland, PA	Anderson Laboratories, Inc.	Greendale, WI
ATI Specialty Materials, Lockport	Lockport, NY	ATI Flat Rolled Products, Natrona	Natrona Heights, PA
Exova - Alburtis	Los Angeles, CA	LECO Corporation	St. Joseph, MI

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 AR669	ALPHA AR881	BCS 351	BCS 454/1	BCS 462/1	BCS CRM 346	BICTA1
BS 718A	BS CSN-4	CT1177	CT1206	E1019	H2-B	HAS 200P	HAS 22A	IARM 100B
IARM 234B	IARM 56D	IARM 68A	IARM 68B	IARM 68C	IH A7247-NA22H	IH R5657	LECO 501-502	LECO 501-503
LECO 501-551	LECO 501-643	LECO 501-644	LECO 501-675	LECO 501-676	LECO 501-991	LECO 502-102	LECO 502-195	LECO 502-257
LECO 502-414	LECO 502-456	MBH 13X18003	MBH 215XHC5S	MBH 24XWASP3D	NIST 3102A	NIST 3106	NIST 3107	NIST 3109A
NIST 3127A	NIST 3128	NIST 3131A	NIST 3151	NIST 3161A	NIST 3162A	NIST 349	NIST 85	NIST 864
NIST 865	NIST 867	NIST 899C	NIST3114	NIST3165	SYN 230H	SYN QGFB		

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.

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

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

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.
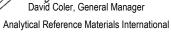
Inter-Laboratory Analysis Program (ILAP): ASTM Standard E691-87 applies to inter-laboratory studies to "Determine the Precision of a Single Test Method", but also outlines a well thought out and logical plan for conducting an inter laboratory program involving multiple analytical techniques. Therefore, 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.
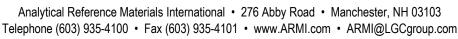
Methods of Analysis: The "Inter Laboratory Analysis Program" analyzes a wide variety of materials, and as a result, no single analytical method would provide optimum analytical results. Therefore, a combination of ASTM Standard Methods for classical wet chemistry, ICP, AA, Optical Emission, X-Ray spectrometric, 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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