



Certificate of Analysis

IARM 157D

AL 6XN / UNS N08367

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	0.020 ± 0.003	B	0.0007 ± 0.0004	C	0.0154 ± 0.0009	Co	0.102 ± 0.005
Cr	20.31 ± 0.09	Cu	0.196 ± 0.005	Fe	48.0 ± 0.3	Mn	0.626 ± 0.009
Mo	6.08 ± 0.05	N	0.203 ± 0.005	Nb	0.149 ± 0.006	Ni	23.9 ± 0.1
P	0.016 ± 0.001	S	0.0005 ± 0.0003	Si	0.28 ± 0.01	Sn	0.0036 ± 0.0006
Ti	0.009 ± 0.001	V	0.050 ± 0.002	W	0.036 ± 0.006		

Indicative Values listed in ppm

Ag (<5)	As (<40)	Au (<1)	Ba (<1)	Be (<1)	Bi (<300)	Br (<1)
Ca (<50)	Cd (<200)	Ce (<1)	Cl (<1)	Cs (<1)	Dy (<1)	Er (<1)
Eu (<1)	F (<1)	Ga (30)	Gd (<1)	Ge (10)	Hf (<700)	Hg (<1)
Ho (<1)	I (<1)	In (<1)	Ir (<1)	K (<5)	La (<70)	Li (<1)
Lu (<1)	Mg (3)	Na (<5)	Nd (<1)	O (40)	Os (<1)	Pb (<20)
Pd (<1)	Pr (<1)	Pt (<1)	Rb (<1)	Re (5)	Rh (<1)	Ru (<1)
Sb (7)	Sc (<3)	Se (<2)	Sm (<1)	Sr (<5)	Ta (30)	Tb (<1)
Te (<20)	Th (<1)	Tl (<1)	Tm (<1)	U (<1)	Y (<10)	Yb (<1)
Zn (1)	Zr (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.

	Al	B	C	Co	Cr	Cu	Fe	Mn	Mo	N	Nb	Ni	P	S	Si	Sn
1	0.011	0.00011	0.012	0.09	20.13	0.18	47.66	0.6014	5.9323	0.1892	0.139	23.66	0.0125	0.0001	0.24	0.002
2	0.015	0.00013	0.0146	0.091	20.199	0.1853	47.76	0.6095	6.0309	0.198	0.139	23.681	0.0128	0.0001	0.2402	0.0028
3	0.017	0.00015	0.015	0.0962	20.203	0.19	47.9232	0.61	6.043	0.1996	0.1448	23.795	0.014	0.0001	0.26	0.003
4	0.0176	0.00039	0.015	0.097	20.25	0.19	47.935	0.617	6.0459	0.20	0.145	23.806	0.0156	0.0002	0.26	0.0034
5	0.018	0.0005	0.015	0.098	20.28	0.1966	47.9955	0.62	6.06	0.202	0.146	23.81	0.016	0.0005	0.2677	0.0038
6	0.0198	0.0008	0.015	0.10	20.28	0.1977	48.208	0.63	6.101	0.2026	0.15	23.84	0.016	0.00057	0.271	0.0038
7	0.0199	0.001	0.0153	0.103	20.333	0.198	48.56	0.63	6.106	0.2033	0.15	23.872	0.0161	0.0006	0.2755	0.004
8	0.02	0.0014	0.0158	0.105	20.3794	0.198		0.633	6.11	0.204	0.15	23.9827	0.0169	0.001	0.277	0.0041
9	0.0205	0.0014	0.016	0.1057	20.384	0.20		0.637	6.119	0.2055	0.1522	23.99	0.017	0.0011	0.279	0.0044
10	0.0208		0.0163	0.1074	20.40	0.201		0.6373	6.16	0.215	0.16	24.1207	0.0175		0.279	0.005
11	0.021		0.0171	0.11	20.593	0.2035		0.64	6.184	0.2191	0.1672	24.3492	0.0178		0.282	
12	0.0286		0.0177	0.12		0.21		0.6463					0.018		0.2865	
13	0.0288												0.018		0.3114	
14													0.019		0.3232	
15																
Mean	0.02	0.0007	0.0154	0.102	20.31	0.196	48	0.626	6.08	0.203	0.149	23.9	0.016	0.0005	0.28	0.0036
STDV.	0.005	0.0005	0.001	0.008	0.1	0.008	0.3	0.01	0.07	0.008	0.008	0.2	0.002	0.0004	0.02	0.0009
Certified	0.020	0.0007	0.0154	0.102	20.31	0.196	48.0	0.626	6.08	0.203	0.149	23.9	0.016	0.0005	0.28	0.0036
95% C.I.	0.003	0.0004	0.0009	0.005	0.09	0.005	0.3	0.009	0.05	0.005	0.006	0.1	0.001	0.0003	0.01	0.0006
Methods	X,O,IM,I,G	O,IM,I,G	O,C	X,O,IM,I,G	X,W,O,I,G	X,W,O,I,G	X,O,I,G	X,O,IM,I,G	X,O,I,G	O,F	X,O,IM,G	X,O,I,G	X,O,IM,I,G	O,C,G	X,O,IM,I,G	O,IM,I,G

	Ti	V	W	Ag	As	Au	Ba	Be	Bi	Br	Ca	Cd	Ce	Cl	Cs	Dy
1	0.0057	0.0459	0.0169	0.000028	0.00036	0.000032	<0.000005	<0.000005	0.000003	<0.000005	0.0005	<0.00002	<0.000005	0.0000052	<0.000001	<0.000005
2	0.0059	0.0464	0.0215	<0.00005	0.0036	<0.00005	<0.00003	<0.00001	0.029	<0.00005	0.00054	<0.00005	<0.00001	<0.000001	<0.00001	<0.00001
3	0.0075	0.047	0.03	<0.00005	<0.002	<0.00005	<0.00005	<0.00005	<0.000005		0.00095	<0.0140	<0.00005		<0.00005	<0.00005
4	0.0078	0.048	0.031	<0.0005	<0.0040				<0.00005		<0.0005					
5	0.008	0.0484	0.0357		<0.0050				<0.00005		<0.0050					
6	0.0086	0.05	0.036													
7	0.0093	0.05	0.041													
8	0.01	0.05	0.042													
9	0.0102	0.0518	0.0428													
10	0.0102	0.052	0.043													
11	0.0106	0.053	0.046													
12		0.056	0.052													
13																
14																
15																
Mean	0.009	0.05	0.036		0.002						0.0007					
STDV.	0.002	0.003	0.01		0.002						0.0002					
Certified	0.009	0.050	0.036	<0.0005	<0.004	<0.0001	<0.0001	<0.0001	<0.03	<0.0001	<0.005	<0.02	<0.0001	<0.0001	<0.0001	<0.0001
95% C.I.	0.001	0.002	0.006													
Methods	X,O,IM,I,G	X,O,IM,I,G	X,O,IM,I,G	IM,G	O,IM,G	IM,G	IM,G	IM,G	O,IM,G	IM,G	IM,G	IM,G	IM,G	IM,G	IM,G	IM,G

	Er	Eu	F	Ga	Gd	Ge	Hf	Hg	Ho	I	In	Ir	K	La	Li	Lu
1	<0.000005	<0.000005	<0.00001	0.0021	<0.000001	0.00069	0.00001	<0.00001	<0.000005	<0.00001	<0.00001	0.00002	0.00001	0.000001	<0.000005	<0.000001
2	<0.00001	<0.00001	<0.00001	0.003	<0.000005	0.0018	0.0652	<0.00005	<0.00001	<0.00001	<0.00001	<0.00001	<0.000005	0.0062	<0.00001	<0.000005
3	<0.00005	<0.00005		0.0031	<0.00005	<0.001	<0.000001	<0.00005	<0.00005		<0.00005	<0.00005	<0.0005	<0.00001	<0.00005	<0.00005
4							<0.00005							<0.00005		<0.00005
5							<0.0005							<0.0010		
6																
7																
8																
9																
10																
Mean				0.003		0.001										
STDV.				0.0006		0.0008										
Certified	<0.0001	<0.0001	<0.0001	(0.003)	<0.0001	(0.001)	<0.07	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0005	<0.007	<0.0001	<0.0001
95% C.I.																
Methods	IM,G	IM,G	IM,G	IM,G	IM,G	IM,G	O,IM,G	IM,G	IM,G	IM,G	IM,G	IM,G	IM,G	O,IM,G	IM,G	IM,G

	Mg	Na	Nd	O	Os	Pb	Pd	Pr	Pt	Rb	Re	Rh	Ru	Sb	Sc	Se
1	0.00014	0.00001	<0.000001	0.00194	0.000028	0.000006	0.000032	<0.000001	0.000017	<0.00001	0.00045	0.000013	0.000012	0.0006	<0.000005	<0.00005
2	0.00023	<0.000001	<0.000005	0.0023	<0.00001	0.000009	<0.00005	<0.000005	0.000048	<0.00005	0.00052	<0.00001	<0.0001	0.00061	<0.00001	<0.0002
3	0.0003	<0.0005	<0.0001	0.0024	<0.00005	0.001	<0.00005	<0.00005	<0.00005	<0.0001	0.00063	<0.00005	<0.0001	0.00075	<0.0003	<0.0002
4	0.00035			0.0026		0.0018					<0.0010			0.00076		
5	<0.00005			0.009		<0.00005								<0.004		
6	<0.0010					<0.0001										
7																
8																
9																
10																
Mean	0.0003			0.004		0.001					0.0005			0.0007		
STDV.	0.00008			0.003		0.0009					0.00009			0.00009		
Certified	(0.0003)	<0.0005	<0.0001	(0.004)	<0.0001	<0.002	<0.0001	<0.0001	<0.0001	<0.0001	(0.0005)	<0.0001	<0.0001	(0.0007)	<0.0003	<0.0002
95% C.I.																
Methods	O,IM,I,G	IM,G	IM,G	O,F	IM,G	O,IM,G	IM,G	IM,G	IM,G	IM,G	IM,G	IM,G	IM,G	O,IM,G	IM,G	IM,G

	Sm	Sr	Ta	Tb	Te	Th	Tl	Tm	U	Y	Yb	Zn	Zr			
1	<0.000001	<0.00005	0.00007	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001	<0.000001	0.00006	0.00013			
2	<0.000005	<0.0001	0.000071	<0.000005	<0.00001	<0.000001	<0.000005	<0.000005	<0.000001	<0.00005	<0.000005	0.00012	0.00025			
3	<0.00005	<0.0005	0.0001	<0.00005	<0.0015	<0.00005	<0.00005	<0.00005	<0.00005	<0.0005	<0.00005	<0.0004	0.0019			
4			0.0046										0.002			
5			0.005										<0.00005			
6			0.0082										<0.0005			
7			<0.0005													
8			<0.01													
9																
10																
Mean			0.003									0.0001	0.001			
STDV.			0.003									0.00004	0.001			
Certified	<0.0001	<0.0005	(0.003)	<0.0001	<0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.001	<0.0001	(0.0001)	(0.001)			
95% C.I.																
Methods	IM,G	IM,G	X,O,IM,G	IM,G	IM,G	IM,G	IM,G	IM,G	IM,G	IM,G	IM,G	IM,G	O,IM,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

Participating Laboratories

Anderson Laboratories, Inc. Davis Alloys Manufacturing, LLC EAG Laboratories Laboratorio Prove Materiali S. Marco srl Laboratory Testing, Inc. Leco Corporation	Greendale, WI Sharpsville, PA Liverpool, NY Schio, Italy Hatfield, PA St. Joseph, MI	MetalTek International, Inc. Northern Analytical Laboratory, Inc. NSL Analytical Services Oxford Instruments Analytical GmbH revierlabor GmbH	Waukesha, WI Londonderry, NH Cleveland, OH Uedem, Germany Essen, Germany
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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:

1188 INCONEL X 550	ALPHA AR 646	ALPHA AR645	CRNISIMN1	IARM 202A	IV H2-C02054R	LECO 501-502	NBS 161	VHG 118879R-33
1189 NIMONIC 80A	ALPHA AR 654	ALPHA AR653	ELTRA 91100-1002	IARM 203A	IV J2-MN02124	LECO 501-646	NBS 349	VHG 119875R-20
1191 WASPALOY	ALPHA AR 676	ALPHA AR670	ELTRA 92000-22	IARM 241A	IV J2-NB01082	LECO 502-016	NIST 121A	VHG 710679419-1
1192 WASPALOY	ALPHA AR 881	ALPHA AR870	ELTRA 92000-43	IARM 2C	IV K2-FE04057	LECO 502-072	NIST 1244	VHG 97415R-21
1208 INCO 377-2	ALPHA AR 890	ALPHA AR914K	IARM 152C	IARM 347A	IV K2-MO02086	LECO 502-856	NIST 160A	
1208 INCO 718	ALPHA AR 892	BAM 230-1	IARM 157A	IARM 4C	IV K2-NB01088	LECO 717	NIST 339	
828 AL6XN	ALPHA AR1648	BAM 284-1	IARM 157B	IARM 52B	IV K2-TI02119	MBH 13X NSA11A	NIST 348A	
ALPHA AR 154	ALPHA AR1650	BAS 346A	IARM 157C	IARM JK37	IV M2-NI654716	MBH 13xNSA11	VHG 101593-12	
ALPHA AR 1653	ALPHA AR644	BRAMMER BS 189	IARM 16C	INCONEL 718	LECO 0675-31	MBH 13XNSA6B	VHG 103665-13	

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.

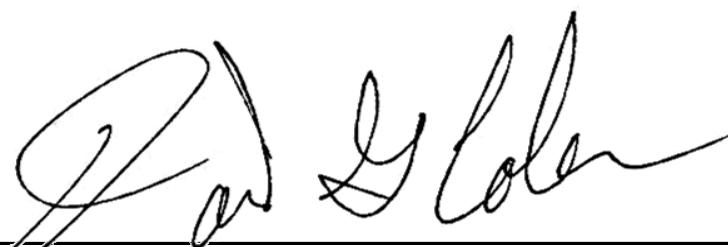
Inter-Laboratory Analysis Program (ILAP): ASTM Standard E691-87 applies to inter-laboratory studies to "Determine the Precision of a Single Test Method", but also outlines a well thought out and logical plan for conducting an inter laboratory program involving multiple analytical techniques. Therefore, 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.



David Coler, General Manager

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