LGC ARMI

Certificate of Analysis
IARM Ti64ELI-18

Titanium Alloy 6Al-4V ELI / UNS R56407

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	6.11 ± 0.05	**C**	0.033 ± 0.005	**Cr**	0.004 ± 0.002	**Cu**	0.002 ± 0.001
Fe	0.167 ± 0.006	**H**	0.0021 ± 0.0007	**Mn**	0.0014 ± 0.0008	**N**	0.006 ± 0.002
Ni	0.003 ± 0.001	**O**	0.118 ± 0.004	**Si**	0.014 ± 0.007	**Sn**	0.022 ± 0.001
V	4.01 ± 0.02						

Indicative Values listed in ppm

As (<50)	B (<100)	Bi (<50)	Ca (<50)	Co (<2)	Hf (<100)	Mg (<100)
Mo (20)	Nb (30)	P (<50)	Pb (<100)	S (5)	Sb (10)	Ta (<100)
Ti (89.7%)	W (5)	Y (<100)	Zn (<100)	Zr (20)		

Description and Intended Use

This CRM may come in the form of a solid disk, chips, or powder. The intended use of this CRM may include, but is not limited to, the calibration of instruments and the validation of analytical methods.

Instructions for Use

1. The test surface is on the opposite side of the labeled surface, which includes the material identification. 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.
2. 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.
3. The material should be stored in a cool, dry location when not in use.
4. Chips are not certified for Oxygen analysis.

LGC ARMI
ISO 9001:2008

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The following data represents all pertinent information reported as it applies to the chemical characterization of this material.

	Al	As	B	Bi	C	Ca	Co	Cr	Cu	Fe	H	Hf	Mg	Mn	Mo	N
1	6.0188	0.0012	0.00058	<0.001	0.02306	<0.001	0.00012	0.002	0.0005	0.159	0.00157	<0.001	0.0025	0.00088	0.00082	0.00323
2	6.043	0.0020	<0.001	<0.005	0.02854	<0.005	0.00013	0.0021	0.0009	0.16	0.00158	<0.005	<0.001	0.001	0.00142	0.0048
3	6.044	<0.001	<0.005		0.0302	<0.005	<0.001	0.0028	0.001	0.16333	0.0017	<0.01	<0.005	0.001	0.002	0.00546
4	6.078	<0.005	<0.01		0.0314		<0.001	0.003	0.002	0.1678	0.002		<0.01	0.00103	0.003	0.00585
5	6.0933				0.03497		<0.005	0.005	0.00309	0.1689	0.00201			0.00113	0.0035	0.00667
6	6.1175				0.035		<0.01	0.0052	0.004	0.169	0.00209			0.002	<0.01	0.00795
7	6.126				0.04			0.0056		0.16933	0.0038			0.0031	<0.001	0.009
8	6.14				0.0431					0.1701					<0.005	
9	6.1567									0.175					<0.01	
10	6.163															
11	6.21															
12																
13																
14																
15																
Mean	6.11				0.033		0.00013	0.004	0.002	0.167	0.0021			0.0014	0.002	0.006
STDV.	0.06				0.006			0.002	0.001	0.005	0.0008			0.0008	0.001	0.002
Certified	6.11	(<0.005)	(<0.01)	(<0.005)	0.033	(<0.005)	(<0.0002)	0.004	0.002	0.167	0.0021	(<0.01)	(<0.01)	0.0014	(0.002)	0.006
U_{CRM}	0.05				0.005			0.002	0.001	0.006	0.0007			0.0008		0.002
Methods	I,X,O	IM,I	IM,I	IM,I	C	IM,I	IM,I	IM,I,X	IM,I,X	IM,I,X,O	C,F,I	IM,I	IM,I	IM,I,X	IM,I,X	F,C

	Nb	Ni	O	P	Pb	S	Sb	Si	Sn	Ta	Ti	V	W	Y	Zn	Zr
1	0.00025	0.001	0.11	0.0023	<0.001	0.00045	0.00076	0.004	0.01907	0.00019	89.4233	3.967	0.00049	<0.001	0.00008	0.00118
2	0.00025	0.00187	0.11	<0.001	<0.01	0.000511	0.00095	0.0089	0.020	<0.001	89.46	3.997	0.00070	<0.001	0.001	0.0019
3	0.001	0.002	0.11755	<0.001	<0.01	<0.001	<0.001	0.0153	0.02	<0.005	89.5067	4.00	<0.001	<0.005	<0.005	<0.001
4	0.0017	0.002	0.11867	<0.005		<0.001	<0.01	0.0159	0.0204	<0.01	89.7261	4.005	<0.005	<0.01	<0.01	<0.01
5	0.01	0.0023	0.1188	<0.005		<0.001		0.018	0.022		90.60	4.008	<0.01			
6	<0.001	0.003	0.1224					0.0227	0.0225			4.01				
7		0.0033	0.1227						0.0226			4.016				
8		0.0046	0.123						0.0229			4.02				
9		0.005							0.024			4.021				
10		0.0052										4.03				
11												4.05				
12																
13																
14																
15																
Mean	0.003	0.003	0.118			0.00050	0.0010	0.014	0.022		89.7	4.01	0.0005		0.0010	0.0020
STDV.	0.004	0.001	0.005			0.00004	0.0001	0.007	0.002		0.5	0.02			0.0007	0.0005
Certified	(0.003)	0.003	0.118	(<0.005)	(<0.01)	(0.0005)	(0.001)	0.014	0.022	(<0.01)	(89.7)	4.01	(0.0005)	(<0.01)	(<0.01)	(0.002)
U_{CRM}		0.001	0.004					0.007	0.001			0.02				
Methods	IM,I,X	IM,I,X,O	F,C	IM,I	IM,I	C	IM,I	IM,I,X	IM,I,X,O	IM,I	I,X,O	I,X,O	IM,I	IM,I	IM,I	IM,I,X

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

Certification Laboratories

NSL Analytical Services, Inc.	Cleveland, OH	Dirats Laboratories	Westfield, MA
Massachusetts Materials Research, Inc.	West Boylston, MA	IMR Test Labs	Lansing, NY
EAG Laboratories, Inc.	Liverpool, NY	Applied Technical Services, Inc.	Cleveland, OH
Connecticut Metallurgical Inc.	East Hartford, CT	VHG Labs	Manchester, NH
ATI Specialty Materials, Monroe	Monroe, NC		

Certification laboratories have demonstrated performance and traceability by utilizing test methods under the scope of ISO 17025 or have shown competence through a proficiency testing program. Some of the specific CRMs and SRMs used in the analysis of the material covered by this certificate are:

NIST 363   NIST 123C   NIST 649   NIST 173   IARM 175D   IARM 178D   IARM 314B   IARM 175C   IARM 176A   IARM 178C   IARM 269A
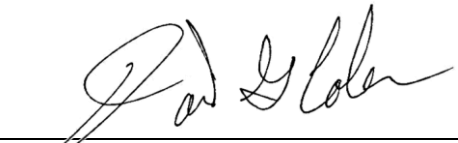
Homogeneity and Uncertainty

"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 may also be 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.

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

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

Expiration

The certification of this material is valid indefinitely, within the uncertainty specified, provided the material is handled and stored in accordance with the instructions stated on this certificate. The certification is nullified if the material is damaged, contaminated, otherwise modified, or used in a manner for which it was not intended.

David Coler, General Manager

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