

Certified Reference Material **Certificate of Analysis**

Product ID: IARM-TI662-19

ISO 17034:2016 ISO/IEC 17025:2017 ISO 9001:2015

Product Description: Titanium Alloy, Ti 6-6-2 / R56620

Description and Intended Use: This **Certified Reference Material** is covered under the scope of accreditation to **ISO 17034** by LGC Standards - Manchester, NH. As an ISO 17034 certified reference material, appropriate use of this material will fulfill the certified reference material and traceability requirements for use in **ISO 17025** accredited laboratories. This CRM may come in the form of a solid disk, 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.

Certified Values listed in wt.% with associated uncertainties											
Al	5.58	± 0.05	C	0.0084	± 0.0008	Co	0.00026	± 0.00007	Cr	0.0050	± 0.0007
Cu	0.47	± 0.02	Fe	0.52	± 0.02	H	0.0048	± 0.0003	Mn	0.0013	± 0.0003
Mo	0.0015	± 0.0003	N	0.022	± 0.004	Ni	0.0032	± 0.0003	O	0.19	± 0.01
P	0.003	± 0.001	S	0.002	± 0.001	Sn	2.03	± 0.02	V	5.53	± 0.04
Zr	0.0008	± 0.0004									

Indicative Values listed in ppm							
B (8)	Hf (<10)	Mg (10)	Nb (50)	Pb (10)	Ru (<10)	Si (60)	
Ti (85.7%)	W (5)	Y (50)					

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 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.

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

Certification Laboratories: Much of the analytical work performed to assess this material has been carried out by laboratories with proven competence, as indicated by their accreditation to ISO 17025. It is an implicit requirement for this accreditation that analytical work should be performed with due traceability, via an unbroken chain of comparisons, each with stated uncertainty, to primary standards such as the mole, or to nationally- or internationally-recognized reference materials. Of the individual results herein, some have traceability (to the mole) via primary analytical methods. Some are traceable to substances of known stoichiometry. Most have traceability via commercial solutions. Furthermore, some results have additional traceability to NIST standards, as part of the analytical calibration or process control.

- LGC Standards - Manchester, NH
- Connecticut Metallurgical, Inc. - East Hartford, CT
- Dirats Laboratories - Westfield, MA
- IMR Test Labs - Lansing, NY
- NSL Analytical Services - Cleveland, OH
- SGS MSi - Melrose Park, IL
- Applied Technical Services - Marietta, GA
- EAG Laboratories - Liverpool, NY
- Sheffield Assay Office - Sheffield, UK
- Scrooby's Laboratory Service - Rynfield, South Africa
- TEC Eurolab - Campogalliano, Italy
- TCR Engineering Services - Maharashtra, India
- Lucid Laboratories - Telangana, India
- Laboratory Testing, Inc. - Hatfield, PA

Instructions for Use: 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. 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 recommended for gas analysis.

Period of Validity: 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.


Kimberly Halkotis, Global Product Manager

February 2, 2022
Certification Date



ISO 17034 Accredited: Reference Materials
Producer, Certificate # 2848.02
ISO/IEC 17025 Accredited: Chemical
Testing, Certificate # 2848.01

Conditions of Sale and Supply: All CRMs & RMs sold are subject to applicable LGC Standard Terms and Conditions of Sale.



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

Lab	Al	B	C	Co	Cr	Cu	Fe	H	Hf	Mg	Mn	Mo	N
1	5.3423	0.0001	0.0069	0.00014	0.003	0.416	0.436	0.004	0.0005	0.0003	<0.001	0.0009	0.0079
2	5.473	0.00039	0.007	0.00016	0.0032	0.437	0.486	0.0044	0.0006	0.001	0.0009	0.001	0.01442
3	5.473	0.001	0.007	0.0002	0.0034	0.438	0.489	0.0046	0.0014	0.001	0.0009	0.001	0.018
4	5.53	0.001	0.0074	0.0002	0.0036	0.443	0.49	0.0046	<0.00005	0.001	0.001	0.001	0.0185
5	5.542	0.0014	0.0079	0.00023	0.0039	0.445	0.49466	0.0047	<0.0001	0.0017	0.001	0.0011	0.02
6	5.542	<0.00005	0.008	0.0003	0.004	0.4728	0.5086	0.0047	<0.002	<0.0002	0.001	0.0013	0.02
7	5.56	<0.0002	0.0082	0.0003	0.0049	0.473	0.5203	0.0048	<0.002	<0.0010	0.0011	0.0016	0.0251
8	5.574	<0.0005	0.0083	0.0004	0.005	0.4739	0.5213	0.005	<0.005	<0.002	0.0013	0.0016	0.0251
9	5.575	<0.0005	0.0088	0.0004	0.005	0.48	0.524	0.0054		<0.002	0.0016	0.0016	0.026
10	5.5936	<0.0010	0.00983	<0.0010	0.005	0.4828	0.528	0.00557		<0.0020	0.0018	0.0019	0.0264
11	5.61	<0.002	0.0101	<0.0020	0.00565	0.4888	0.529			<0.005	0.002	0.002	0.0269
12	5.6201	<0.005	0.011	<0.005	0.0058	0.49	0.5334			<0.005	0.0022	0.0021	0.033
13	5.624				0.0059	0.491	0.5377				<0.0010	0.0021	
14	5.646				0.006	0.495	0.54				<0.002	0.0021	
15	5.65				0.0061	0.5054	0.545				<0.002	<0.005	
16	5.661				0.0064	0.5112	0.5607				<0.005		
17	5.6892				0.0076		0.575				<0.005		
18	5.775				<0.0035								
19					<0.005								
Mean	v	0.0008	0.0084	0.0003	0.0050	0.4714	0.5187	0.0048	0.0008	0.0010	0.0013	0.0015	0.0218
STDV	0.0957	0.0005	0.0013	0.0001	0.0013	0.0276	0.0328	0.0005	0.0005	0.0005	0.0005	0.0005	0.0067
Certified	5.58	(0.0008)	0.0084	0.00026	0.0050	0.47	0.52	0.0048	<(0.001)	(0.001)	0.0013	0.0015	0.022
U _{CRM}	0.05		0.0008	0.00007	0.0007	0.02	0.02	0.0003			0.0003	0.0003	0.004
Methods	I,O,X	I,O,IM	C,IM,O	IM,I,O,AA	I,IM,O,X	O,I,IM,AA,X	I,O,IM,AA,X	F,IM	I,O,IM,X	I,O,IM,AA,X	I,IM,O,AA,X	I,IM,O,X	F,IM,W,O

Lab	Nb	Ni	O	P	Pb	Ru	S	Si	Sn	Ti	V	W	Y	Zr
1	0.0002	0.0023	0.1574	0.0006	0.00007	0.00047	0.0007	0.0005	1.967	84.88	5.352	0.0001	0.0003	0.0001
2	0.0017	0.0026	0.178	0.0025	0.00007	0.0007	0.001	0.001	1.9825	85.63	5.41	0.00015	0.0044	0.0002
3	0.0021	0.00261	0.1897	0.0025	0.0011	<0.0005	0.001	0.001	1.99	85.7084	5.446	0.0002	<0.00005	0.0002
4	0.004	0.003	0.193	0.0028	0.0018	<0.001	0.0011	0.0011	2	86	5.487	0.001	<0.0002	0.0002
5	0.004	0.003	0.193	0.0031	0.002	<0.0010	0.0023	0.0025	2	86.05	5.494	0.001	<0.0005	0.00021
6	0.004	0.003	0.196	0.0038	<0.0001	<0.002	0.0032	0.00293	2.007		5.53	<0.0002	<0.001	0.0003
7	0.0046	0.0031	0.196	0.0045	<0.0005	<0.0020	<0.0005	0.0046	2.01		5.533	<0.0005	<0.001	0.0003
8	0.0051	0.0032	0.203	<0.0005	<0.0010	<0.005	<0.0005	0.005	2.017		5.5345	<0.0010	<0.001	0.0003
9	0.0053	0.0033	0.203	<0.0020	<0.002		<0.001	0.005	2.041		5.54	<0.002	<0.0010	0.0004
10	0.0054	0.0034	0.236	<0.005	<0.002		<0.0010	0.006	2.052		5.547	<0.002	<0.005	0.0009
11	0.015	0.0035		<0.0050	<0.002			0.0087	2.059		5.547	<0.002		0.001
12	<0.001	0.00363			<0.002			0.0088	2.0636		5.548	<0.0020		0.001
13	<0.0010	0.0039			<0.005			0.0088	2.065		5.5498	<0.005		0.0017
14	<0.002	0.004						0.009	2.0677		5.56			0.0019
15		<0.005						0.0098	2.069		5.565			0.0026
16								0.0105	2.0733		5.579			<0.0010
17								0.0143	2.086		5.6			<0.005
18								<0.001			5.64			
19											5.6532			
Mean	0.0047	0.0032	0.1945	0.0028	0.0010	0.0006	0.0016	0.0059	2.0324	85.6537	5.5324	0.0005	0.0024	0.0008
STDV	0.0038	0.0005	0.0199	0.0012	0.0009	0.0002	0.0010	0.0041	0.0374	0.4688	0.0724	0.0005	0.0029	0.0008
Certified	(0.005)	0.0032	0.19	0.003	(0.001)	<(0.001)	0.002	(0.006)	2.03	(85.7)	5.53	(0.0005)	<(0.005)	0.0008
U _{CRM}		0.0003	0.01	0.001			0.001		0.02		0.04			0.0004
Methods	I,O,IM,X	IM,I,O,AA,X	F,IM	I,O,IM,W	IM,I,O,AA,X	I,O,IM	C,IM,O	I,O,IM,W,X	O,I,X	O,IM	I,O,X	IM,I,O,X	I,O,IM	I,IM,O,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

