



ARMI

ISO Certified · 9001 · 17025 · 17043 · 17034

Certificate of Analysis

IARM Ti64P-18

Additive Manufacturing Powder (-53/+16µ) Titanium Alloy 6-4 / UNS R56400

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	6.47 ± 0.09	C	0.051 ± 0.004	Fe	0.216 ± 0.005	H	0.0018 ± 0.0007
Mn	0.011 ± 0.002	N	0.04 ± 0.02	O	0.15 ± 0.02	S	0.0014 ± 0.0006
Sn	0.008 ± 0.001	V	4.24 ± 0.05				

Indicative Values listed in ppm

As (<50)	B (<50)	Bi (<50)	Ca (<50)	Cd (<10)	Co (<110)	Cr (40)
Cu (<50)	Hf (<20)	Mg (<100)	Mo (<50)	Nb (4)	Ni (30)	P (10)
Pb (3)	Pd (<20)	Sb (3)	Se (<50)	Si (210)	Ta (<50)	Ti (88.7%)
W (4)	Y (<20)	Zn (<100)	Zr (<40)			

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** certified laboratories. This CRM will come in the form of powder. The intended use of this CRM may include, but is not limited to, the calibration of instruments and the validation of analytical methods. The following particle size distribution is provided by the manufacturer and should be used for information only.

Test	Units	Result
-75/+63	volume %	0
-63/+53	volume %	0.9
-53/+45	volume %	22.3
-45	volume %	76.9
Tap Density	g/cc	2.9
Hall Flow	sec	23.9
Apparent Density	g/cc	2.5

Instructions for Use

1. The minimum sample size should be individually evaluated based on the analytical technique used; this would typically be greater than 0.1 grams.
2. The material should be stored in a cool, dry location when not in use.

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

	Al	C	Fe	H	Mn	N	O	S	Sn	V	As	B	Bi	Ca	Cd	Co
1	6.313	0.042	0.20	0.001	0.0077	0.02	0.0725	0.00063	0.007	4.082	0.0011	0.001	0.006	0.001	0.000324	0.00007
2	6.321	0.0472	0.209	0.0012	0.01	0.022	0.151	0.000897	0.0072	4.1931	<0.001	<0.0005	<0.001	0.0023	<0.001	0.003
3	6.336	0.048	0.211	0.0013	0.0110	0.0318	0.154	0.00127	0.0077	4.226	<0.001	<0.001	<0.001	<0.001	<0.001	0.011
4	6.365	0.048	0.2147	0.0014	0.011	0.0322	0.1562	0.0015	0.0082	4.23	<0.005	<0.001	<0.005	<0.005	<0.005	<0.0005
5	6.47	0.0482	0.2161	0.0015	0.0114	0.033	0.1593	0.002	0.009	4.24		<0.005		<0.005		<0.001
6	6.54	0.05059	0.22	0.0016	0.01189	0.035	0.16	0.002	0.009	4.27						<0.005
7	6.55	0.05467	0.22	0.002	0.012	0.0422	0.1605		0.01	4.287						<0.01
8	6.58	0.055	0.221	0.0021		0.0454	0.167			4.295						
9	6.59	0.05697	0.222	0.004		0.0667	0.186			4.3017						
10	6.635	0.0591	0.223			0.0895				4.31						
11																
Mean	6.47	0.051	0.216	0.0018	0.011	0.04	0.15	0.0014	0.008	4.24						
STDV.	0.1	0.005	0.007	0.0009	0.002	0.02	0.03	0.0006	0.001	0.07						
Certified	6.47	0.051	0.216	0.0018	0.011	0.04	0.15	0.0014	0.008	4.24	<0.005	<0.005	<0.005	<0.005	<0.001	<0.011
U _{CRM}	0.09	0.004	0.005	0.0007	0.002	0.02	0.02	0.0006	0.001	0.05						
Methods	I	C	I,IM	F	I,IM	F	F	I,C	I,IM,A	I	IM,I	I,IM	I,IM	I,IM	IM	IM,I

	Cr	Cu	Hf	Mg	Mo	Nb	Ni	P	Pb	Pd	Sb	Se	Si	Ta	Ti	W
1	0.001	0.0014	<0.001	0.0023	0.000583	0.000403	0.00099	0.00095	0.000273	<0.001	0.000237	<0.001	0.016	<0.001	88.60	0.00034
2	0.0014	0.0017	<0.002	<0.0005	0.00079	0.00048	0.001	0.00187	0.00032	<0.002	0.00031	<0.001	0.016	<0.001	88.60	0.00038
3	0.0018	0.002		<0.001	0.0022	0.008	0.00113	<0.001	<0.001		<0.001	<0.005	0.0167	<0.001	88.63	<0.001
4	0.00183			<0.001	0.004	<0.001	0.0016	<0.001	<0.001		<0.001		0.017	<0.002	88.86	<0.001
5	0.002			<0.005	0.0044	<0.002	0.0099	<0.002	<0.001		<0.002		0.02147	<0.005	88.9411	<0.001
6	0.0022			<0.01	<0.001	<0.01	<0.001	<0.005	<0.01		<0.002		0.0327			<0.002
7	0.0131				<0.001		<0.005	<0.005								<0.005
8	<0.001				<0.005		<0.005									
9	<0.005															
10	<0.005															
Mean	0.003	0.0017			0.002	0.00000	0.003	0.001	0.0003		0.0003		0.02		88.7	0.0004
STDV.	0.004	0.0003			0.002	0.004	0.004	0.0006	0.00003		0.00005		0.007		0.2	0.00003
	(0.004)	<0.005	<0.002	<0.01	<0.005	(0.0004)	(0.003)	(0.001)	(0.0003)	<0.002	(0.0003)	<0.005	(0.021)	<0.005	(88.7)	(0.0004)
Methods	I,IM	I,IM	I,IM	IM,I	IM,I	IM,I	I,IM	IM,I	IM,A,I	I,IM	IM,A,I	I,IM	I,IM	I,IM	I,IM	IM,I

	Y	Zn	Zr													
1	0.0014	<0.001	0.00016													
2	<0.0005	<0.001	0.00022													
3	<0.001	<0.005	0.0036													
4		<0.01	<0.001													
5			<0.001													
6			<0.005													
Mean			0.001													
STDV.			0.002													
	<0.002	<0.01	<0.004													
Methods	I,IM	I,IM	I,IM													

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

Applied Technical Services, Inc. Dirats Laboratories IMR Test Labs LGC Standards Massachusetts Materials Research, Inc. SGS MSi	Marietta, GA Westfield, MA Lansing, NY Manchester, NH West Boylston, MA Melrose Park, IL	Connecticut Metallurgical, Inc. EAG Laboratories, Inc. Laboratory Testing, Inc. Luvak Laboratories NSL Analytical Services, Inc.	East Hartford, CT Liverpool, NY Hatfield, PA Boylston, MA Cleveland, OH
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Certification laboratories have demonstrated performance and traceability by utilizing a variety of test methods all under the scope of ISO 17025. Some of the specific CRMs and SRMs used in the analysis of the material covered by this certificate are:

IARM 175C IARM 175D IARM 176A IARM 6D IARM 56A NBS 184 NBS 856 SRM 173 SRM 649

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 ICP 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 ICP. 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.

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

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

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

Analytical Reference Materials International

