

Brammer Standard Company, Inc.

# Certificate of Analysis

BS T-2A

Certified Reference Material<sup>1</sup> for Grade 2 Commercially Pure Titanium  
(UNS Number R50400, ASTM B348(2))

	Certified Value <sup>2</sup>	Estimate of Uncertainty <sup>3</sup>	Information Values <sup>4</sup>	
Analysis listed as percent by weight				
Al	0.005	0.001	C	0.007
Cr	0.018	0.0015	Cu	0.001
Fe	0.156 <sup>5</sup>	0.008	H	0.0020
Mn	0.003	0.0005	N	0.0044
Mo	0.002	0.0005	O	0.12
Ni	0.021	0.002	S	0.0004
Si	0.002	0.0008		
Sn	0.006	0.0015		
V	<0.002			
W	<0.002			
Zr	<0.003			

<sup>1</sup> Brammer Standard Company, Inc., is accredited by A2LA (Certificate Number 656.02) to ISO Guide 34 as a Reference Material Producer to produce Certified Reference Materials.

<sup>2</sup> The certified value listed is the present best estimate of the true value based on the results of an interlaboratory testing program.

<sup>3</sup> The uncertainties listed are based on value judgments of the material inhomogeneity and the 95% confidence interval. The half-width confidence interval C(95%) is shown on page 2.

<sup>4</sup> Information values are not certified and are provided for information only.

<sup>5</sup> The original Fe value of 0.157% certified on December 14, 2001 was revised to 0.156% after an additional laboratory reported their results.

See the following pages for more information.

Certificate Number RevT2A-012202p1

**Brammer Standard Company, Inc., 14603 Benfer Road, Houston, TX 77069-2895**  
**Telephone (281) 440-9396 Fax (281) 440-4432 [brammerstandard.com](http://brammerstandard.com)**

## BS T2A

## Data listed as mass fraction expressed as percent.

RevT2A-012201p2

Analysis	* Al	* Cr	* Fe	* Mn	* Mo	* Ni	* Si	* Sn	* V
1	AIC 0.0031	AIC 0.016	AIC 0.141	AIC 0.002	AGM 0.0013	AIC 0.018	AIC 0.001	AIC 0.0040	AIC <0.0006
2	AGM 0.00375	AIC 0.0166	XRF 0.150	AIC 0.0030	AIC 0.0018	AIC 0.0190	AGM 0.0017	AGM 0.0045	AIC <0.0006
3	AIC 0.004	XRF 0.017	AIC 0.151	AIC 0.003	AES 0.0018	AIC 0.0200	AIC 0.0018	AIC 0.005	AIC 0.0002
4	AIC 0.0040	AIC 0.017	AIC 0.153	AIC 0.0030	AIC 0.0018	AIC 0.0205	AIC 0.002	AIC 0.0055	AGM 0.00030
5	AIC 0.005	AIC 0.0177	AIC 0.156	AIC 0.0031	AIC 0.002	AGM 0.0215	AGM 0.0022	AIC 0.006	AIC 0.0006
6	AIC 0.005	AIC 0.0178	AIC 0.1608	AIC 0.0032	AIC 0.0020	AIC 0.0216	AES 0.003	XRF 0.007	AIC 0.0011
7	AIC 0.0052	AIC 0.0179	AES 0.164	AGM 0.0032	AIC 0.002	AIC 0.022	AIC 0.0032	XRF 0.007	
8	AGM 0.0055	AIX 0.018	AIC 0.165	AIC 0.0035	AIC 0.0020	XRF 0.022		AIC 0.0074	
9	AES 0.0057	AIC 0.0180	AGM 0.165	AES 0.0037	AIC 0.0021	AIC 0.0224		AES 0.0078	
10		AES 0.0186		AIX 0.004	AGM 0.0028	AIX 0.023			
11		AGM 0.021				AES 0.0234			
Average	0.0046	0.0178	0.1561	0.0032	0.0020	0.0212	0.0021	0.0059	
Std Dev	0.0009	0.0013	0.0082	0.0005	0.0004	0.0016	0.0008	0.0013	
Certified	0.005	0.018	0.156	0.003	0.002	0.021	0.002	0.006	<0.002
t	2.306	2.2281	2.306	2.2622	2.2622	2.2281	2.4469	2.306	
C(95%)	0.0007	0.0009	0.0063	0.0004	0.0003	0.0011	0.0007	0.0010	

Analysis	* W	* Zr	* C	* Cu	* H	* N	* O	* S
1	AIC <0.001	AIC <0.0008	AES 0.0041	AIC 0.0004	FU 0.0018	AGM 0.0035	FU 0.0983	AGM 0.00025
2	AIC <0.001	AIC <0.0008	C 0.005	AGM 0.00065	FU 0.00183	FU 0.0040	AGM 0.1075	C 0.0004
3	AIC <0.001	AIC <0.001	C 0.0050	AIC 0.0010	FU 0.00220	FU 0.0044	FU 0.117	C 0.0006
4	AIC <0.0010	AIC 0.0004	C 0.009	AGM 0.0010	FU 0.00221	FU 0.0046	FU 0.118	
5	AIC <0.002	AGM 0.00048	C 0.0100	AIC 0.0018		FU 0.0048	FU 0.1219	
6	AGM 0.00011	AIC 0.0010	C 0.0111	AIC 0.0019		FU 0.005	FU 0.131	
7	AIC 0.0004	AGM 0.00127					FU 0.140	
8		AES 0.0017						
9		AIC 0.0020						
Average			0.0074	0.00113	0.00196	0.00438	0.1191	0.00042
Std Dev			0.0030	0.00061	0.00019	0.00055	0.0139	0.00018
Certified	<0.002	<0.003	(0.007)	(0.001)	(0.0020)	(0.0044)	(0.12)	(0.0004)
t			2.5706	2.5706	3.1824	2.5706	2.4469	4.3027
C(95%)			0.0032	0.00064	0.00030	0.00058	0.0129	0.00044

Data in parentheses are not certified but are provided for information only.

$C(95\%) = (t \times sd) / \sqrt{n}$  The half-width confidence interval, where  $t$  is the appropriate Student's  $t$  value,  $sd$  is the interlaboratory standard deviation, and  $n$  is the number of acceptable mean values. For further information regarding the confidence interval for the certified value see ISO Guide 35:1989 section 4.

## \* Methods of Analysis

Code	Method
AES	AES - Spark Source Optical Emission Spectrometry
AIC	AES - ICP -Inductively Coupled Plasma Spectrometry
AIX	Average of Inductively Coupled Plasma Spectrometry and X-Ray Fluorescence Spectrometry
AGM	AES - Glow Discharge Mass Spectrometry
C	Combustion-Infrared Absorption (ASTM E 1019) traceable to CRMs
FU	Inert gas Fusion Method (ASTM E 1019) traceable to CRMs
XRF	X-Ray Fluorescence Spectrometry

AES = Atomic Emission Spectrometry

**Co-operating Laboratories:** The co-operating laboratories were:

**Laboratory**

AK Steel Research, Middletown, Ohio  
 Allegheny Ludlum, Technical Center, Brackenridge, Pennsylvania  
 Allvac, Monroe, North Carolina  
 Brammer Standard Co., Inc., Houston, Texas  
 J. Dirats and Co., Inc., Westfield, Massachusetts  
 LECO Corporation, St. Joseph, Michigan  
 Northern Analytical Laboratory Inc., Merrimack, New Hampshire  
 Shiva Analyticals (India) Ltd., Hoskote, Bangalore, India  
 Titanium Matels Corporation, Morgantown, Pennsylvania  
 VHG Laboratories, Inc., Manchester, New Hampshire

**Laboratory contact**

Howard P. Vail  
 Shawn D. Cooper  
 Patrick M. Cole  
 Richard P. Beaumont  
 Eric E. Dirats  
 Dennis A. Lawrenz  
 Richard J. Guidoboni  
 Dr. T. V. Ramakrishna  
 Larry E. Creasy  
 Julie M. McIntosh

**Certification Process:** The requirements of ISO Guide 31, ISO Guide 34, ISO Guide 35, and ASTM Standard Guides E 1724 and E 1831 were followed for the preparation of this reference material and certificate of analysis. This is a Certified Reference Material as defined by ISO Guide 30.

**Analysis:** Chemical analyses were made on chips prepared by a lathe from the certified portion of the discs. No standardized sampling procedures are available for titanium, but the principles of ASTM Practice 1806 were used to obtain representative test samples. The laboratories participating in the testing normally followed the requirements of ISO Guide 25 and/or ISO Standard 17025. Individual values listed on page 2 are the average of each analyst's results. Methods of analysis are listed on page 2.

**Outliers:** Some outlying data was excluded from the data listed on page 2 due to technical assessment of the co-operating laboratories and statistical evaluation.

**Traceability:** The following Certified Reference Materials were used to validate the analytical data listed on page 2: SRM 125b, 131e, 173a, 173b, 348a, 651; CE 031.

**Homogeneity:** This Certified Reference Material was tested for homogeneity using ASTM Standard Method E 826 and found acceptable. It was also examined by optical emission spectrometry and found to be compatible with the following Reference Materials: BS T2 and T4.

**Validity statement:** ISO Guide 31 states that the certificate of analysis should contain an expiration date for all materials where instability has been demonstrated or is considered possible, after which the certified value is no longer guaranteed by the certifying body. Whereas this material is in a solid form and stable, no expiration date is specified.

**Source:** This material was supplied by President Titanium, Hanson, Massachusetts.

**Form:** This Certified Reference Material is in the form of a disc, approximately 38 mm in diameter and 12 mm thick.

**Use:** This Certified Reference Material is intended for use in optical emission and x-ray spectrometric methods of analysis. Refer to ISO Guide 33 for information about the use of Reference Materials.

**Certified area:** The entire depth of the disc may be used.

**Caution:** As with any bar material, avoid optical emission spectrometric burns in the center of the disc (5 mm radius), as some segregation may be present.

**Sample Preparation:** For best analytical results, use the same method for preparing the analytical surface on all reference materials as you use for production specimens. Avoid overheating the disc during surface preparation.

**Certificate Number:** The unique identification number for this certificate of analysis is RevT2A-012201-px, where x indicates the page number. Refer to future Brammer Standard Company catalogs for information on any revisions to this or other Brammer Standard reference materials. You may also obtain information on revisions of certificates from the internet at [brammerstandard.com](http://brammerstandard.com).

**Safety Notice:** A Material Safety Data Sheet (MSDS) is not required for this material. This material will not release or otherwise result in exposure to a hazardous chemical under normal conditions of use. Inquiries concerning this Reference Material should be directed to:

Brammer Standard Co., Inc.	Phone: (281) 440-9396	web	<a href="http://brammerstandard.com">brammerstandard.com</a>
14603 Benfer Road			
Houston, Texas 77069-2895 USA	Fax: (281) 440-4432	e-mail	<a href="mailto:bramstan@netropolis.net">bramstan@netropolis.net</a>

Certified by: \_\_\_\_\_ on January 22, 2002.  
G. R. Brammer

**Brammer Standard Company, Inc., is accredited to ISO Guide 34 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials by A2LA (Certificate Number 656.02) The scope of accreditation is listed on the website: [www.brammerstandard.com](http://www.brammerstandard.com)**

**By Certificate Number 10539, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9002:1994 by National Quality Assurance, U.S.A.**

**Brammer Standard Company's Chemical Laboratory is accredited to ISO Guide 25 by A2LA. (Certificate Number 656.01)**

## **References:**

*ASTM documents available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Telephone: 610-832-9500 Fax: 610-832-9555 e-mail: [service@astm.org](mailto:service@astm.org) Website: [www.astm.org](http://www.astm.org)*

B 348 - 98 Standard Specification for Titanium and Titanium Alloy Bars and Billets

DS-56G (SAE HS-1086 Jan99) Metals & Alloys in the Unified Numbering System, 8<sup>th</sup> Edition

E 826 - 85 (Reapproved 1996) Standard Practice for Testing Homogeneity of Materials for the Development of Reference Materials

E 1019 - 2000 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys

E 1724 - 95 Standard Guide for Testing and Certification of Metal and Metal-Related Reference Materials

E 1806 - 96 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

E 1831 - 96 Standard Guide for Preparing Certificates for Reference Materials Relating to Chemical Composition of Metals, Ores, and Related Materials.

*ISO Guides available from Global Engineering - [www.global.ihs.com](http://www.global.ihs.com)*

ISO Standard 17025 (First edition, 1999), General requirements for the competence of calibration and testing laboratories.

ISO Guide 25 (Third edition, 1990), General requirements for the competence of calibration and testing laboratories.

ISO Guide 30 (Second edition, 1991), Terms and definitions used in connection with reference materials.

ISO Guide 31 (Second edition, 2000), Reference materials -Contents of certificates and labels.

ISO Guide 33 (Second edition, 2000), Uses of certified reference materials.

ISO Guide 34 (Second edition, 2000), General requirements for the competence of reference material producers.

ISO Guide 35 (Second edition, 1989), Certification of reference materials - General and statistical principles.

*Other useful documents available from NIST, U.S. Department of Commerce, Gaithersburg, MD 20899.*

NIST Special Publication 260-100, Handbook for SRM Users

NIST Special Publication 829, Use of NIST Standard Reference Materials for Decisions on Performance of Analytical Chemical Methods and Laboratories