

Brammer Standard Company, Inc.

Certificate of Analysis

BS T 80

Certified Reference Material¹
Low Alloy Titanium

	Certified Value ²	Estimate of Uncertainty ³		Certified Value ²	Estimate of Uncertainty ³
Analysis listed as mg/kg					
Al	746	20	Ni	156	25
B	40	4	O	768	20
C	166	20	Pd	1424	35
Co	146	20	Ru	469	25
Cr	50	8	Sn	257	25
Cu	375	20	V	446	25
Fe	93	20	W	174	10
H	59	3	Y	10	2
Mn	244	15	Zr	178	10
Mo	100	14			
N	41	10	Information Value⁴		
Nb	367	30	Si	(35)	

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

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

³ 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 pages 2 and 3.

⁴ Information value is not certified and is provided for information only.

See the following pages for more information.

Certificate Number T-80-092404p1

Analysis	*	Al	*	B	*	C	*	Co	*	Cr	*	Cu	*	Fe	*	H
1	ICPMS	720	ICPMS	35	C	130	GDMS	111	ICP	40	DCP	342	GDMS	73	FU	55.4
2	GDMS	720	ICP	40	C	156	ICP	118	GDMS	42	ICP	360	ICP	74	FU	57.5
3	ICP	735	ICP	41	C	160	ICP	140	ICP	43	ICP	363	ICP	75	FU	58
4	ICP	739	ICP	41.5	C	160	ICP	145	DCP	49.5	ICP	370	ICP	80	FU	59.1
5	ICP	748.5	ICP	42	C	161	XRF	146	ICPMS	50	XRF	372	ICP	87	FU	60.5
6	DCP	751	DCP	43.5	C	164	ICP	150	ICP	51	ICP	374	ICP	88.5	FU	60.5
7	XRF	757			C	164	ICP	150	ICP	52	ICP	375	GDMS	91	FU	61
8	ICP	750			C	164	DCP	151	ICP	52.3	ICP	385.5	ICP	93		
9	ICP	760			C	181	ICPMS	152	ICP	53	ICP	390	DCP	96.5		
10	ICP	760			C	185	ICP	154	XRF	55	ICP	392	XRF	104		
11	ICP	763			C	200	ICP	155	ICP	57	ICP	405	ICP	110		
12							DCP	164	ICP	60			PIXE	116		
13							PIXE	168					ICP	119		
Average		745.8		40.5		165.9		146.5		50.4		375.3		92.8		58.9
Std Dev		15.4		2.9		18.0		16.0		6.1		17.4		15.7		2.0
Certified		746		40		166		146		50		375		93		59
# Labs		11		6		11		13		12		11		13		7
t		2.2281		2.5706		2.2281		2.1788		2.2010		2.2281		2.1788		2.4469
C(95%)		10.3		3.1		12.1		9.7		3.9		11.7		9.5		1.9

Analysis	*	Mn	*	Mo	*	N	*	Nb	*	Ni	*	O	*	Pd	*	Ru
1	XRF	226	ICP	84.5	FU	30	ICP	332	GDMS	115	FU	747	ICP	1390	ICP	450
2	DCP	231	ICP	90	FU	34.5	ICP	340	PIXE	117	FU	747.8	ICP	1400	ICPMS	450
3	ICP	236	ICP	91	FU	38.6	ICP	346	ICP	138	FU	771.5	ICP	1400	ICP	450
4	ICP	240	ICP	93	FU	39	XRF	370	ICP	140	FU	771.8	ICPMS	1400	ICP	460
5	ICP	240	XRF	95	FU	39	ICP	370	ICP	148	FU	780.8	ICP	1420	ICP	472.5
6	ICP	240	ICP	98	FU	40	ICP	370	ICP	152	FU	790	DCP	1425	ICP	474
7	ICP	247	DCP	99.5	FU	40	ICPMS	370	XRF	159			DCP	1430	DCP	474
8	ICP	247	ICP	100	FU	40	ICP	390	ICP	160			ICP	1470	XRF	481
9	ICP	247	ICP	100	FU	42	DCP	412	ICP	160			XRF	1477	DCP	508
10	ICP	251	ICP	105	FU	49			ICP	162						
11	GDMS	254	ICP	118	FU	49.5			ICP	164						
12	ICPMS	257	ICPMS	126	FU	50			ICP	164						
13	GDMS	260							ICPMS	180						
14									GDMS	186						
15									ICP	190						
Average		244.3		100.0		41.0		366.7		155.7		768.2		1423.6		468.8
Std Dev		10.0		11.8		6.0		25.0		21.9		17.5		31.3		19.0
Certified		244		100		41		367		156		768		1424		469
# Labs		13		12		12		9		15		6		9		9
t		2.1788		2.2010		2.2010		2.3060		2.1448		2.5706		2.3060		2.3060
C(95%)		6.1		7.5		3.8		19.2		12.1		18.3		24.1		14.6

Analysis	*	Sn	*	V	*	W	*	Y	*	Zr	*	Si
1	ICP	225	XRF	415	ICP	156	ICP	8.6	ICP	170	DCP	17
2	ICP	240	ICP	420	XRF	167	ICP	10	XRF	170	ICP	20
3	ICP	240	GDMS	420	ICP	170	ICP	10	ICP	172	ICP	30
4	ICP	243	ICP	430	ICP	172	XRF	10	ICP	172.5	ICP	30
5	DCP	246	ICP	437	GDMS	175	ICP	10	ICP	175	DCP	33
6	XRF	250	ICPMS	445	ICP	175	ICP	10.5	ICP	176	ICP	54.5
7	ICP	250	ICP	456	ICP	178.5	DCP	11	ICP	178	XRF	60
8	ICP	270	ICP	460	ICP	180	DCP	11	XRF	181		
9	DCP	279	ICP	460	ICPMS	180	ICP	12	DCP	185		
10	ICP	280	DCP	461	DCP	187	ICP	12	ICP	201		
11	ICPMS	300	ICP	465								
12			XRF	480								
Average		256.6		445.8		174.1		10.5		178.1		34.9
Std Dev		22.5		21.1		8.5		1.0		9.4		16.4
Certified		257		446		174		10		178		(35)
# Labs		11		12		10		10		10		7
t		2.2281		2.2010		2.2622		2.2622		2.2622		2.4469
C(95%)		15.1		13.4		6.1		0.7		6.7		15.1

* Methods of analysis are listed below.

Data in parentheses is not certified but is 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
ICP	AES - Inductively Coupled Plasma Spectrometry
DCP	AES - Direct Current Plasma Spectrometry
GDMS	Glow Discharge Mass Spectrometry
ICPMS	Inductively Coupled Plasma Mass Spectrometry
PIXE	Proton Induced X-Ray Emission Spectrometry
XRF	X-Ray Emission Fluorescence Spectrometry
C	Combustion-Infrared Absorption
FU	Inert gas Fusion Method

AES = Atomic Emission Spectrometry

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

Laboratory

AK Steel, Research & Technology, Middletown, Ohio
Allegheny Ludlum Steel Corp., Brackenridge, Pennsylvania
Allvac, Monroe, North Carolina
J. Dirats and Co., Inc., Westfield, Massachusetts
CEZUS, Ugine, France
Elemental Analysis, Inc., Lexington, Kentucky
LECO Corporation, St. Joseph, Michigan
Northern Analytical Laboratory, Inc., Merrimack, New Hampshire
Shiva Technologies, Inc., Syracuse, New York
TIMET, Morgantown, Pennsylvania
TIMET, Henderson Technical Laboratory, Henderson, Nevada
TIMET, Henderson Process Laboratory, Henderson, Nevada
TIMET, Toronto Process Laboratory, Toronto, Ontario, Canada
TIMET, UK-Witton, Birmingham, England
VHG Laboratories, Inc., Manchester, New Hampshire
Wah Chang, Albany, Oregon

Laboratory contact

Robert Crain
Pat Cole
Eric E. Dirats
Laurent Trecani
David Shewmaker
Dennis Lawrenz
William A. Guidoboni
D. Sathyamurthy
Larry Creasy
Gerald Boesenecker
James Kiely
John Low
Matthew Chamberlain-Webber
Julie M. McIntosh
Gary Beck

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. The laboratories participating in the testing normally followed the requirements of ISO Standard 17025. Individual values listed on pages 2 and 3 are the average of each analyst's results. Methods of analysis used were a combination of ASTM Standard Test Methods E 1409, E 1447, E1937, and E 2371 plus other ICP, DCP, ICPMA, GDMS, and XRF spectrometric methods.

Outliers: Some outlying data was excluded from the data listed on pages 2 and 3 due to technical assessment of the cooperating laboratories and statistical evaluation.

Traceability: The following Reference Materials were used to validate the analytical data listed on pages 2 and 3 **CRMs:** SRM 650, 651, 652, 654, 1640, 2433, 3107, 3101A, 3112A, 3113, 3114, 3126A, 3131, 3132A, 3134, 3136, 3137, 3138, 3139A, 3150, 3161A, 3163, 3165, 3167A, 3169. **RM**s LECO 501-320, 501-348, 501-551, 501-646, 501-657, 501-664, 501-674, 762-741; **BS** T-2A, BS T-4, BS T-4A

Homogeneity: This Reference Material was tested for homogeneity and found acceptable.

Validity statement: ISO Guide 31 states that the certification 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 CRM was produced by TIMET, Henderson, Nevada. It was double vacuum arc melted by the consumable electrode method, cast into ingots, and forged into bars..

Form: This CRM is in the form of a disc, approximately 40 mm in diameter and 12 mm thick.

Use: This CRM 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.

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

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 T-80-092404-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.

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.
14603 Benfer Road
Houston, Texas 77069-2895 USA

Phone: (281) 440-9396

Fax: (281) 440-4432

web brammerstandard.com

e-mail contact@brammerstandard.com

Certified by: _____ on September 24, 2004.
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

By Certificate Number 10539, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9001:2000 by National Quality Assurance, U.S.A.

Brammer Standard Company's Chemical Laboratory is accredited to ISO Standard 17025 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 Website: www.astm.org

E 1409 - 04 Standard Test Method for the Determination of Oxygen in Titanium and Titanium Alloys by the Inert Gas Fusion Technique

E 1447 - 01 Standard Test Method for the Determination of Hydrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Thermal Conductivity Method

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

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

E 1937 - 04 Standard Test Method for the Determination of Nitrogen in Titanium and Titanium Alloys by the Inert gas Fusion Technique

E 2371 - 04 Standard Test Method for Analysis of Titanium and Titanium Alloys by Atomic Emission Plasma Spectrometry

ISO Guides and Standards available from Global Engineering - www.global.ihs.com

ISO Standard 17025 (First edition, 1999), 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