Brammer Standard Company, Inc.

Certificate of Analysis

BS 54F

Certified Reference Material[1] for High Carbon - Boron Steel Alloy

	Certified Value[2]	Estimate of Uncertainty[3]		Certified Value[2]	Estimate of Uncertainty[3]
			Analysis listed as percent by weight		
C	**0.70**	0.005	**N**	**0.0023**	0.0006
Mn	**0.82**	0.005	**Nb**	**0.023**	0.002
P	**0.010**	0.001	**Sn**	**0.030**	0.001
S	**0.018**	0.002	**Ta**	**<0.002**	
Si	**0.50**	0.01	**Ti**	**0.017**	0.002
Cu	**0.166**	0.005	**V**	**0.009**	0.002
Ni	**0.17**	0.005	**W**	**0.025**	0.003
Cr	**0.18**	0.004	**Zr**	**<0.002**	
Mo	**0.031**	0.003			
As	**0.0014**	0.0003			
B	**0.0022**	0.0002	**Information Value[4]**		
Ca	**0.0001**	0.00003	Al	0.002	
Co	**0.062**	0.004			

[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 page 2.

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

See the following pages for more information.

Certificate Number 54F-110801p1

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Analysis	*	C	*	Mn	*	P	*	S	*	Si	*	Cu	*	Ni	*	Cr	*	Mo
1	C	0.690	AIC	0.815	MBA	0.0085	C	0.015	AIC	0.484	AIC	0.159	AES	0.16	AIC	0.179	AIC	0.027
2	C	0.6904	AES	0.817	AIC	0.009	C	0.0152	AIC	0.488	AES	0.16	MND	0.160	AES	0.18	XRF	0.027
3	C	0.696	AES	0.82	AIC	0.0095	C	0.0155	GSi	0.490	AES	0.16	AIC	0.164	XRF	0.18	AIC	0.0300
4	C	0.697	AES	0.82	AIC	0.010	C	0.016	AES	0.490	AIC	0.163	AES	0.17	AES	0.18	AIC	0.0312
5	C	0.698	AIC	0.821	AES	0.010	C	0.0160	AES	0.49	AES	0.165	AIC	0.172	TCr	0.182	MMo	0.0312
6	C	0.6995	AIC	0.822	AES	0.011	C	0.0168	AIC	0.501	AIC	0.165	AES	0.172	MCS	0.182	AES	0.0315
7	C	0.701	AIC	0.823	AIC	0.0111	C	0.017	AIC	0.501	AIC	0.166	AIC	0.173	AES	0.183	AIC	0.032
8	C	0.7011	AIC	0.825	AES	0.0111	C	0.0177	AES	0.503	MCB	0.170	AIC	0.177	AIC	0.184	AIC	0.032
9	C	0.7034	MnP	0.827			C	0.0183	AXO	0.524	XRF	0.170	AIC	0.177	AIC	0.185	AES	0.032
10	C	0.7038					C	0.0185			AIC	0.174			AIC	0.185	AES	0.032
11	C	0.706					C	0.019			AIC	0.174					AIC	0.032
12	C	0.707					C	0.0198										
13	C	0.710					C	0.0207										
14	C	0.711					C	0.0207										
15	C	0.7156					C	0.0210										
Average		0.7020		0.821		0.0100		0.0178		0.497		0.1660		0.169		0.182		0.0307
Std Dev		0.0073		0.004		0.0010		0.0021		0.012		0.0054		0.007		0.002		0.0019
Certified		0.70		0.82		0.010		0.018		0.50		0.166		0.17		0.18		0.031
t		2.1448		2.306		2.3646		2.1448		2.306		2.2281		2.306		2.2622		2.2281
C(95%)		0.0040		0.0029		0.0008		0.0012		0.0094		0.0036		0.005		0.002		0.0013

Analysis	*	As	*	B	*	Ca	*	Co	*	N	*	Nb	*	Sn
1	AES	0.0011	AES	0.00201	AGM	0.00008	AIC	0.055	FU	0.0017	AGM	0.021	AIC	0.029
2	AES	0.0011	AIC	0.0021	AIC	0.00009	XRF	0.056	FU	0.0017	AIC	0.021	AES	0.0290
3	AGM	0.0012	AIC	0.0021	AIC	0.000098	AIC	0.0614	FU	0.0019	AIC	0.0227	AIC	0.0298
4	AIC	0.0014	MBD	0.0021	AIC	0.000099	AIC	0.0618	FU	0.00208	AIC	0.023	AIC	0.030
5	AAH	0.0016	MBD	0.0023	AIC	0.0001	AES	0.062	FU	0.00224	AIC	0.023	AIC	0.030
6	AAH	0.0016	AIC	0.0023	AIC	0.00011	AES	0.062	FU	0.0023	AES	0.0231	AIC	0.0306
7	AIC	0.0018	AGM	0.0025	AES	0.00012	AES	0.0626	FU	0.0027	AES	0.024	AES	0.0306
8							M5	0.0636	FU	0.0033	AIC	0.0243	AGM	0.031
9							AIC	0.064			AXO	0.0245	MSn	0.0312
10							AIC	0.064			MNb	0.0248		
11							AIC	0.069						
Average		0.00140		0.00220		0.00010		0.0619		0.00228		0.0231		0.0301
Std Dev		0.00028		0.00017		0.00001		0.0038		0.00056		0.0013		0.0008
Certified		0.0014		0.0022		0.0001		0.062		0.0023		0.023		0.030
t		2.4469		2.4469		2.4469		2.2281		2.3646		2.2622		2.306
C(95%)		0.00026		0.00016		0.00001		0.0026		0.0005		0.0010		0.0006

Analysis	*	Ta	*	Ti	*	V	*	W	*	Zr	*	Al
1	AIC	<0.0002	AES	0.015	AIC	0.0080	AES	0.0232	AIC	<0.0003	AIC	0.0005
2	AIC	<0.0002	AIC	0.0166	AIC	0.008	AIC	0.024	AIC	<0.0003	AIC	0.0007
3	AIC	<0.0005	AIC	0.0168	AIC	0.0080	AIC	0.0258	AIC	<0.0003	AES	0.001
4	AGM	<0.0005	AIC	0.017	AIC	0.0080	AIC	0.026	AIC	0.0001	AGM	0.001
5	AIC	<0.002	AXO	0.0175	AES	0.0082	AIC	0.026	AGM	0.00017	AES	0.0017
6			AIC	0.0180	AIC	0.00822	MWC	0.0262	AES	0.0009	AIC	0.002
7			AES	0.018	MVE	0.00845	AIC	0.0262	AES	0.0010	AIC	0.002
8			AGM	0.018	AES	0.009					AIC	0.0020
9			AIC	0.0181	AES	0.010					AES	0.003
10			AES	0.0184	AXO	0.0105						
11			MTD	0.0185	AGM	0.012						
Average				0.0174		0.0089		0.0253				0.0015
Std Dev				0.0010		0.0013		0.0012				0.0008
Certified		<0.002		0.017		0.009		0.025		<0.002		(0.002)
t				2.2281		2.2281		2.4469				
C(95%)				0.0007		0.0009		0.0011				

* Methods of analysis listed on page 3

Data in parentheses are not certified but are provided for information only.
Data listed as mass fraction expressed as percent.

C(95%) = (t x sd)/ 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	Element	Method
AAH		Flame Atomic Absorption Spectrometry with hydride generation
AES		AES - Spark Source Optical Emission Spectrometry
AGM		AES - GD - Glow Discharge - Mass Spectrometry
AIC		AES - ICP -Inductively Coupled Plasma Spectrometry
AXO		Average from X-Ray Fluorescence and Spark Source Optical Emission Spectrometry
C	C, S	Combustion-Infrared Absorption (ASTM E 1019) traceable to CRMs
FU	N, O	Inert gas Fusion Method (ASTM E 1019) traceable to CRMs
GSi	Si	Gravimetry with perchloric acid (ASTM 350)
M5	Co	MAS - 5-Cl-PADAB spectrophotometric
MBA	P	MAS - Butyl acetate extraction phosphorus-molybdenum blue photometric
MBD	B	MAS - Distillation separation-curcumin photometric
MCB	Cu	MAS - Bicyclohexane oxalyldihydrazone photometric
MCS	Cr	MAS - Diphenyl carbazide photometric after separation with Na_2CO_3
MMo	Mo	MAS - Thiocyanate after extraction with butyl acetate
MNb	Nb	MAS - Sulphochlorophenol S photometric
MND	Ni	MAS - Dimethylgloxime photometric
MnP	Mn	MAS - Periodate oxidation
MSn	Sn	MAS - Phenylfluorone photometric
MTD	Ti	MAS - Diantipyrylmethane photometric
MVE	V	MAS - n-benzoyl phenylhydroxylamine extraction photometric
MWC	W	MAS - Chlorpromazine hydrochloride sodium thiocyanate - tri-chloromethane extraction
TCr	Cr	Persulfate oxidation, ferrous sulfate titrimetric
XRF		X-Ray Fluorescence spectrometry

AES = Atomic Emission Spectrometry
MAS = Molecular Absorption Spectrometry (photometric, spectrophotometric methods)

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

Laboratory	Laboratory contact
AK Steel Research, Middletown, Ohio	Howard P. Vail
Allegheny Ludlum, Technical Center, Brackenridge, Pennsylvania	Shawn Cooper
Allvac, Lockport, New York	Thomas Herdlein
Brammer Standard Co., Inc., Houston, Texas	Richard P. Beaumont
China National Analysis Center for Iron and Steel, Beijing, China	Prof. Wang Haizhou
Crucible Specialty Steel, Syracuse, New York	William Mastroe
J. Dirats and Co., Inc., Westfield, Massachusetts	Eric E. Dirats
Griffin Wheel Company, Technical Center, Bensenville, Illinois	Richard Petersen
Griffin Wheel Company, Kansas City, Kansas	Kevin Denison
Griffin Wheel Company, Keokuk, Iowa	Rod Nagel
LECO Corporation, St. Joseph, Michigan	Dennis Lawrenz
Shiva Technologies, Inc., Syracuse, New York	Don Shuman
VHG Laboratories, Inc., Manchester, New Hampshire	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 in accordance with ASTM Standard Practice E 1806. 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 used were a combination of ASTM Standard Test Method E 1019 and E 415 plus additional ICP and AA spectrometric methods.

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

Traceability: The following Certified Reference Materials were used to validate the analytical data listed on page 2:
NIST SRM 13e, 13g, 14g, 15h, 163, 337a, 341, 361, 362, 363, 364, 365, 890, 1761, 1764, 2165, 2167; ECRM 478-1, 890; BCS 345, 346, 461/1; BS CSN2-1

Homogeneity: This Reference Material was tested for homogeneity using ASTM Standard Method E 826 and found acceptable. It was also examined by optical emission spectrometry using ASTM Standard Test Method E 415 and found to be compatible with the following Reference Materials: CRMs: NIST SRM 1264A, CKD 181A, BS CSN-2D, BS XEEH, BS 54D, BS 2992, BS 3941.

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 material was produced by National Iron and Steel Research Institute, Beijing, China. It was melted by an electric arc furnace, poured into ingots, forged round, and finished with a normalized heat treatment .

Form: This Reference Material is in the form of a disc, approximately 42 mm in diameter and 20 mm thick.

Use: This 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 54F-110801-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 bramstan@netropolis.net

Certified by: _____ on October 30, 2001.
G. R. Brammer

Certificate Number 54F-110801p4

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 9002:1994 by National Quality Assurance, U.S.A.

Brammer Standard Company's Chemical Laboratory is accredited to ISO Guide 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 415 - 85 (Reapproved 1999) Standard Test Method for Optical Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel

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

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

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