Brammer Standard Company, Inc.

Certificate of Analysis

BS 54G

Certified Reference Material[1]

	Certified Value[2]	Estimate of Uncertainty[3]		Certified Value[2]	Estimate of Uncertainty[3]
		Analysis listed as percent by weight			
C	**0.658**	0.007	**N**	**<0.0004**	
Mn	**0.82**	0.01	**Sn**	**0.026**	0.002
P	**0.011**	0.001	**Ti**	**0.015**	0.002
S	**0.012**	0.0015	**V**	**0.012**	0.002
Si	**0.50**	0.014			
Cu	**0.151**	0.003			
Ni	**0.163**	0.005	Information Values[4]		
Cr	**0.160**	0.005	As	<0.005	
Al	**0.018**	0.002	B	<0.0005	
Co	**0.0019**	0.0005	Ca	0.001	
Mo	**0.019**	0.002	O	<0.003	
Nb	**0.024**	0.002	W	<0.03	

[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 values are not certified and are provided for information only.

See the following pages for more information.

Certificate Number 54G-081804p1

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

BS 54G **Data listed as mass fraction expressed as percent.** **Certificate Number 54G-081804p2**

Analysis	*	C	*	Mn	*	P	*	S	*	Si	*	Cu	*	Ni	*	Cr
1	C	0.65	AIC	0.8033	AIC	0.010	C	0.0099	AIC	0.4865	AIC	0.149	AIC	0.156	AIC	0.1546
2	C	0.652	AES	0.806	AIC	0.0102	C	0.011	AES	0.496	AES	0.15	AIC	0.1605	AIC	0.157
3	C	0.655	MnP	0.817	AIC	0.0104	C	0.0110	AIC	0.50	AIC	0.1500	AES	0.161	AES	0.159
4	C	0.656	AIC	0.818	AIC	0.011	C	0.0118	AIC	0.508	AIC	0.150	MND	0.164	AIC	0.160
5	C	0.659	AIC	0.818	AES	0.011	C	0.0126	AIC	0.51	AIC	0.152	AIC	0.164	AIC	0.16
6	C	0.660	AIC	0.821	AIC	0.0121	C	0.0129	GSi	0.512	MCB	0.152	AIC	0.168	AIC	0.166
7	C	0.6638	AIC	0.83			C	0.0133	AIC	0.517	AIC	0.155	AIC	0.169	TCr	0.167
8	C	0.6683					C	0.0137								
Average		0.6580		0.8162		0.0108		0.0120		0.504		0.1511		0.1632		0.1605
Std Dev		0.0061		0.0090		0.0008		0.0013		0.011		0.0020		0.0045		0.0045
Certified		0.658		0.82		0.011		0.012		0.50		0.151		0.163		0.160
C(95%)		0.0051		0.0084		0.0008		0.0011		0.010		0.0019		0.0042		0.0042

Analysis	*	Al	*	Co	*	Mo	*	Nb	*	N	*	Sn	*	Ti	*	V
1	AIC	0.016	AIC	0.0014	AIC	0.0179	AIC	0.023	FU	0.0001	AIC	0.023	AIC	0.0135	AIC	0.0091
2	AIC	0.0178	AA	0.0018	AIC	0.019	AES	0.0231	FU	0.0002	AIC	0.025	AES	0.014	AIC	0.011
3	AES	0.0184	AIC	0.0018	AIC	0.0192	AIC	0.0234	FU	0.0002	AES	0.0258	AIC	0.014	AES	0.0114
4	AIC	0.0184	AA	0.0018	AES	0.0194	AIC	0.024	FU	<0.0003	AIC	0.027	AIC	0.015	AIC	0.0116
5	AIC	0.0185	AIC	0.0022	AIC	0.0197	AIC	0.025	FU	<0.0004	AIC	0.027	AIC	0.0151	AIC	0.0117
6	AIC	0.0187	AES	0.0024	AIC	0.0199	AIC	0.0267			AIC	0.0273	AIC	0.0162	AIC	0.014
7											AIM	0.0276				
Average		0.0180		0.00190		0.0192		0.0242				0.0261	0.0146			0.0115
Std Dev		0.0010		0.00035		0.0007		0.0014				0.0016	0.0010			0.0016
Certified		0.018		0.0019		0.019		0.024		<0.0004		0.026		0.015		0.012
C(95%)		0.0011		0.0004		0.0007		0.0015				0.0015	0.0010			0.0016

Analysis	*	As	*	B	*	Ca	*	O	*	W
1	AIC	0.001	AES	0.00019	AES	0.00016	FU	0.0006	AIC	0.0021
2	AES	0.0017	AIC	0.0002	AES	0.00017	FU	0.0007	AES	0.0026
3	AIC	<0.0001	MB	0.0003	AIC	0.00023	FU	0.00082	AIC	<0.0005
4	AA	<0.0005	AICE	0.00034	AIC	0.0005	FU	<0.003	AIC	<0.002
5	AIC	<0.0050	AIC	<0.0003	AIC	<0.0003			AIC	<0.002
6			AIC	<0.0005	AIC	<0.0010			AIC	<0.03
Not Certified		(<0.005)		(<0.0005)		(0.001)		(<0.003)		(<0.03)

* Methods of analysis listed on page 3

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

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
AA		Flame Atomic Absorption Spectrometry
AES		AES - Spark Source Optical Emission Spectrometry
AIC		AES - ICP -Inductively Coupled Plasma Spectrometry
AICE	B	AES - ICP - Inductively Coupled Plasma Spectrometry after extraction with 2-ethyl-1, 3-hexanediol
AIM		AES - ICP Mass Spectrometry addition method
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 method
MB	B	MAS - Curcumin photometric method
MCB	Cu	MAS - Bicyclohexanone oxalyldihydrazone photometric method
MND	Ni	MAS - Dimethylgloxime photometric method
MnP	Mn	MAS - Periodate oxidation photometric method
MSi	Si	MAS - Molybdenum blue photometric method (ASTM E350)
TCr	Cr	Ammonium persulfate oxidation ferrous titration method

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
Brammer Standard Co., Inc., Houston, Texas	Richard P. Beaumont
China National Analysis Center for Iron and Steel, Beijing, China	Prof. Jia Yunhai
J. Dirats and Co., Inc., Westfield, Massachusetts	Eric E. Dirats
LECO Corporation, St. Joseph, Michigan	Dennis Lawrenz
Stork Materials Technology, Herron Testing Labs, Cleveland, Ohio	Michael R. Gaydos
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 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:
SRM 13f, 13g, 15h, 100, 132b, 163, 361, 362, 363, 364, 1096, 1262, 1764, 2165, 2166, 2167; BCS 346, 401/1, BCS 455/1, 487-1.
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Additional analytical data: This material was used as an unknown test specimen number 2032 in a nationally recognized Proficiency Testing Program (PTP) for low-alloy steel. Most of the participating laboratories used one or more of the ASTM Standard Test Methods E 322, E 415, E 1019, and E 1085. The PTP data was not used in calculating the certified values listed on pages 1 and 2. The data shown below are the results from the PTP.

Combustion Instrument Analysis using ASTM Standard Test Method E 1019

	C	S	N
Number of Labs	48	47	31
Grand Average	0.6603	0.0153	0.0004
Standard Deviation	0.0093	0.0023	0.0004

Optical Emission Spectrometric Analysis using ASTM Standard Test Method E 415

	C	Mn	P	S	Si	Cu	Ni
Number of Labs	58	63	11	60	65	64	61
Grand Average	0.6568	0.8209	0.0105	0.0139	0.4983	0.1509	0.1665
Standard Deviation	0.0133	0.0120	0.0007	0.0014	0.0145	0.0041	0.0062

	Cr	Mo	Al	Co	Sn	Nb	Ti	V
Number of Labs	62	11	61	9	55	57	57	62
Grand Average	0.1572	0.0198	0.0190	0.0022	0.0260	0.0241	0.0150	0.0116
Standard Deviation	0.0043	0.0016	0.0014	0.0006	0.0016	0.0015	0.0008	0.0012

X-ray Emission Spectrometric Analysis using ASTM Standard Test Method E 322

	Mn	Cu	Ni	Cr
Number of Labs	5	5	5	5
Grand Average	0.8220	0.1526	0.1670	0.1602
Standard Deviation	0.0266	0.0032	0.0113	0.0083

X-ray Emission Spectrometric Analysis using ASTM Standard Test Method E 1085

	Mn	Si	Cu	Ni	Cr	Mo	Nb	P	V
Number of Labs	8	9	5	7	7	8	7	6	8
Grand Average	0.8189	0.5161	0.1548	0.1676	0.1573	0.0199	0.0248	0.0117	0.0125
Standard Deviation	0.0155	0.0142	0.0054	0.0037	0.0057	0.0018	0.0019	0.0017	0.0010

In-house ICP Spectrometric Data

	Al	Cr	Co	Cu	Mn	Mo	Ni	Nb	P
Number of Labs	6	9	5	9	8	8	8	4	7
Grand Average	0.0187	0.1578	0.0023	0.1537	0.8189	0.0194	0.1640	0.0247	0.0110
Standard Deviation	0.0006	0.0030	0.0012	0.0049	0.0104	0.0019	0.0038	0.0021	0.0024

	Si	Sn	Ti	V
Number of Labs	8	7	5	9
Grand Average	0.4993	0.0263	0.0156	0.0123
Standard Deviation	0.0146	0.0035	0.0010	0.0009

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: SS 455/1, 459/1; BS CSN-2D, 54D, 54E, 64C, 3941, 4972.

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 by an electric arc furnace, poured into an ingot, aluminum killed, hot worked, and annealed..

Form: This CRM is in the form of a disc, approximately 45 mm in diameter and 19 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.

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 54G-081804-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 August 18, 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 322 - 96 Standard Test Method for X-Ray Emission Spectrometric Analysis of Low-Alloy Steels and Cast Irons

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 1085 - 95 Standard Test Method for X-Ray Emission Spectrometric Analysis of Low-Alloy Steels

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 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