Brammer Standard Company, Inc.

Certificate of Analysis

BS 291

Certified Reference Material[1] for Chill-cast Iron

	Certified Value[2]	Estimate of Uncertainty[3]		Certified Value[2]	Estimate of Uncertainty[3]
		Analysis listed as percent by weight			
C	**3.38**	0.03	Co	**0.0064**	0.0005
Mn	**0.59**	0.01	Mg	**0.060**	0.003
P	**0.020**	0.002	N	**0.0060**	0.0005
S	**0.011**	0.001	Sn	**0.024**	0.002
Si	**2.30**	0.01	Ti	**0.007**	0.001
Cu	**0.160**	0.009	V	**0.007**	0.0005
Ni	**0.097**	0.005			
Cr	**0.104**	0.005			
Mo	**0.030**	0.002			
Al	**0.021**	0.003			
As	**0.0045**	0.0008			
Ca	**0.0017**	0.0003			

[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.

See the following pages for more information.

Certificate Number 291-011607p1

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BS 291 **Data listed as mass fraction expressed as percent.** **Certificate Number 291-011607p2**

Analysis *	C	*	Mn	*	P	*	S	*	Si	*	Cu	*	Ni	*	Cr	*	Mo
1	C 3.359	ICPA	0.575	ICPA	0.0182	C	0.0099	ICPA	2.29	OES	0.151	OES	0.0962	ICPA	0.101	ICPA	0.029
2	C 3.360	ICPA	0.581	ICPA	0.019	C	0.0104	GRA	2.292	TITR	0.154	ICPA	0.0964	ICPA	0.104	OES	0.030
3	C 3.37	OES	0.589	ICPA	0.0194	C	0.0110	OES	2.30	TITR	0.155	ICPA	0.0965	OES	0.104	ICPA	0.0305
4	C 3.39	ICPA	0.59	ICPA	0.0202	C	0.011	GRA	2.300	ICPA	0.160	ICPA	0.0965	ICPA	0.1063	ICPA	0.0305
5	C 3.40	ICPA	0.5933	OES	0.0207	C	0.0111			ICPA	0.1601	ICPA	0.102	ICPA	0.107	ICPA	0.031
6				SP	0.0207	C	0.0112			ICPA	0.169						
7				SP	0.0214	C	0.0112			ICPA	0.170						
8						C	0.0112										
Average	3.376		0.5857		0.0199		0.0109		2.2955		0.1599		0.0975		0.104		0.0302
Std Dev	0.018		0.0075		0.0011		0.0005		0.0053		0.0073		0.0025		0.002		0.0008
Certified	3.38		0.59		0.020		0.011		2.30		0.160		0.097		0.104		0.030
t	2.7764		2.7764		2.4469		2.3646		3.1824		2.4469		2.7764		2.7764		2.7764
C(95%)	0.023		0.0093		0.0010		0.0004		0.0084		0.0068		0.0031		0.003		0.0009

Analysis *	Al	*	As	*	Ca	*	Co	*	Mg	*	N	*	Sn	*	Ti	*	V
1	ICPA 0.0181	GFAA	0.0039	ICPA	0.0013	ICPA	0.006	OES	0.0578	T	0.0055	ICPM	0.0226	ICPA	0.0064	OES	0.0065
2	OES 0.0186	OES	0.0043	ICPA	0.0016	OES	0.0062	ICPA	0.0599	T	0.0055	ICPM	0.0229	OES	0.0066	ICPA	0.0069
3	ICPA 0.0215	GFAA	0.0045	ICPA	0.0017	ICPA	0.0066	ICPA	0.0603	T	0.0056	ICPA	0.0231	ICPA	0.007	ICPA	0.0070
4	ICPA 0.0215	GFAA	0.0046	ICPA	0.0018	ICPA	0.0067	ICPA	0.0605	T	0.0060	OES	0.0233	ICPA	0.0071	ICPA	0.0070
5	ICPM 0.023	ICPA	0.0052	OES	0.00185	ICPA	0.0067			T	0.0063	ICPA	0.0255	ICPA	0.0071	ICPA	0.0070
6										T	0.00636	ICPA	0.0255				
7										T	0.00636	ICPA	0.026				
Average	0.0205		0.0045		0.0017		0.00644		0.0596		0.00595		0.0241		0.0068		0.0069
Std Dev	0.0021		0.0005		0.0002		0.00032		0.0012		0.00041		0.0015		0.0003		0.0002
Certified	0.021		0.0045		0.0017		0.0064		0.060		0.0060		0.024		0.007		0.007
t	2.7764		2.7764		2.7764		2.7764		3.1824		2.4469		2.4469		2.7764		2.7764
C(95%)	0.0026		0.0006		0.0003		0.00040		0.0020		0.0004		0.0014		0.0004		0.0003

***** Methods of analysis listed on below.

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.

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

Laboratory	**Laboratory contact**
Brammer Standard Co., Inc., Houston, Texas	Richard P. Beaumont
China National Analysis Center for Iron and Steel, Beijing, China	Liu Zheng
J. Dirats and Co., Inc., Westfield, Massachusetts	Eric E. Dirats
LECO Corporation, St. Joseph, Michigan	Dennis Lawrenz
VHG Laboratories, Inc., Manchester, New Hampshire	Julie M. McIntosh

Methods of Analysis

Code	**Element Method**
OES	Spark Source Optical Emission Spectrometry
ICPA	ICP -Inductively Coupled Plasma Spectrometry
ICPM	ICP -Inductively Coupled Plasma Mass Spectrometry
GFAA	Graphite Furnace Atomic Absorption Spectrometry
C	C, S Combustion-Infrared Absorption (ASTM E 1019) traceable to CRMs
T	N Inert gas Fusion Method (ASTM E 1019) traceable to CRMs
SP	Spectrophotometric method
TITR	Titrimetric
GRA	Gravimetry with perchloric acid method

Certification Process: The requirements of ISO Guide 31, ISO Guide 34, ISO Guide 35 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 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 338, 3101a, 3103a, 3109 a, 3112a, 3114, 3131a, 3132, 3133, 3134, 3136, 3139a, 3150, 3161a, 3162a, 3165; ECRM 480-1, CKD 227, CMSI 1551.

Homogeneity: This Reference Material was tested for homogeneity using ASTM Standard Method E 826 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 melted and cast by Greens Bayou Foundry, Inc. Houston, Texas, using an induction furnace. It was chill-cast into a mold with copper chill-plates on both the top and bottom producing all discs simultaneously.

Form: This CRM is in the form of a disc, approximately 34 mm in diameter and 17 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. Beware of possible voids in the center of the discs.

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 291-011607-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 www.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 www. brammerstandard.com
14603 Benfer Road
Houston, Texas 77069-2895 USA Fax: (281) 440-4432 e-mail contact@brammerstandard.com

Certified by: _____ on January 16, 2007

Beau 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 (Reapproved 2004) Standard Test Method for X-Ray Emission Spectrometric Analysis of Low-Alloy Steels and Cast Irons

E 826 - 85 (Withdrawn 2005) Standard Practice for Testing Homogeneity of Materials for the Development of Reference Materials

E 1019 - 2003 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys

E 1806 - 96 (Reapproved 2006) Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

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

ISO Standard 17025 (Second edition, 2005), General requirements for the competence of testing and calibration laboratories.

ISO Guide 30 (Second edition, 1992), 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 (Third edition, 2006), Reference Materials - General and statistical principles for certification .

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