

**Brammer Standard Company, Inc.**  
**Certificate of Analysis**

**BS LC-6**

**Certified Reference Material for Commercially Pure Iron**

	Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>	Not Certified Informational Values <sup>3</sup>	
	Analysis listed as percent by weight		Analysis listed as mg/kg except Fe (ppm by weight)	
<b>C</b>	<b>0.0020</b>	0.0001	As	(<20)
<b>Mn</b>	<b>0.469</b>	0.006	B	(4)
<b>P</b>	<b>0.0007</b>	0.0002	Ca	(1)
<b>S</b>	<b>0.0009</b>	0.0002	Fe	(99.4%) <sup>4</sup>
<b>Si</b>	<b>0.050</b>	0.004	H	(<0.2)
<b>Cu</b>	<b>0.0003</b>	0.0001	Mg	(0.3)
<b>Ni</b>	<b>0.0057</b>	0.0006	Mo	(6)
<b>Cr</b>	<b>0.0023</b>	0.0005	Nb	(<10)
<b>Al</b>	<b>0.034</b>	0.003	Pb	(<20)
<b>Co</b>	<b>0.0021</b>	0.0003	Sb	(<1)
<b>N</b>	<b>0.0003</b>	0.0001	Sn	(<20)
<b>O</b>	<b>0.0007</b>	0.0002	V	(<10)
<b>Ti</b>	<b>0.0006</b>	0.0002	W	(<50)
			Zn	(0.4)
			Zr	(4)

<sup>1</sup> The certified value listed is the present best estimate of the true value based on the results of an interlaboratory testing program.

<sup>2</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>3</sup> Data in parentheses are not certified and are provided for information only.

<sup>4</sup> Fe calculated by difference

See the following pages for more information.

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Analysis	*	C	* Mn	* P	* S	* Si	* Cu	* Ni	* Cr	* Al	* Co	* N	* O	* Ti
1	10	0.0018	5 0.454	5 0.0003	10 0.00069	2 0.0424	3 0.00018	2 0.0045	2 0.0017	5 0.0280	2 0.0015	1 0.0002	1 0.0004	5 0.0003
2	10	0.00194	2 0.460	4 0.0006	4 0.00074	4 0.0440	2 0.0002	5 0.0051	5 0.0018	5 0.0282	3 0.0020	1 0.00026	1 0.0004	5 0.0005
3	10	0.0020	2 0.464	3 0.00066	10 0.00080	3 0.04633	2 0.0003	4 0.0052	2 0.0020	5 0.0285	4 0.0020	1 0.00027	1 0.0006	2 0.0005
4	10	0.0020	2 0.469	2 0.0007	10 0.00081	5 0.0470	6 0.0003	5 0.0052	3 0.0020	5 0.0291	1 0.0020	1 0.00027	1 0.0006	2 0.0005
5	10	0.00206	2 0.470	8 0.0007	10 0.00082	8 0.0473	6 0.0003	2 0.0058	2 0.0021	2 0.0312	5 0.0020	1 0.00029	1 0.00081	5 0.00054
6	10	0.00208	2 0.4700	8 0.0007	10 0.00093	5 0.048	2 0.0003	2 0.0059	5 0.0021	2 0.032	5 0.0021	1 0.0003	1 0.00088	2 0.0006
7	10	0.00216	8 0.470	2 0.0008	3 0.00094	2 0.048	5 0.0003	3 0.006	2 0.0022	3 0.03273	5 0.0021	1 0.00033	1 0.00091	3 0.00063
8			3 0.47202	2 0.0008	10 0.0010	8 0.0493	5 0.00031	2 0.0060	2 0.0022	5 0.033	5 0.0021	1 0.0005	1 0.00092	4 0.00065
9			2 0.473	2 0.0008	10 0.0010	3 0.050	4 0.00035	6 0.0060	4 0.0024	5 0.0345	2 0.0024	1 0.0005		2 0.0007
10			8 0.474	5 0.0008	10 0.0010	2 0.0502		6 0.0062	2 0.0031	2 0.035	2 0.0025			2 0.0007
11			6 0.474	2 0.0009	10 0.0011	2 0.0514		2 0.00620	3 0.00312	3 0.035				2 0.0008
12			2 0.474	3 0.0009	10 0.0013	2 0.0527		3 0.0063	2 0.0033	6 0.036				
13			6 0.475	2 0.0010		2 0.0532		2 0.0063		3 0.036				
14						6 0.056				6 0.037				
15						2 0.057				3 0.0370				
16						6 0.057				2 0.0378				
17										2 0.0380				
18										4 0.0400				
Average		0.00202	0.4692	0.00074	0.00093	0.0500	0.00028	0.00575	0.00234	0.0338	0.00207	0.00032	0.00069	0.00058
Std Dev		0.00009	0.0063	0.00017	0.00017	0.0044	0.00005	0.00056	0.00054	0.0037	0.00027	0.00011	0.00022	0.00014
Certified		0.0020	0.469	0.0007	0.0009	0.050	0.0003	0.0057	0.0023	0.034	0.0021	0.0003	0.0007	0.0006
# Labs		7	13	13	12	16	9	13	12	18	10	9	8	11
t		2.4469	2.1788	2.1788	2.2010	2.1314	2.3060	2.1788	2.2010	2.1098	2.2622	2.3060	2.3646	2.2281
C(95%)		0.00008	0.0038	0.00010	0.00011	0.0023	0.00004	0.0003	0.0003	0.0018	0.00019	0.00008	0.00018	0.00009

Data below listed as mg/kg (ppm by weight)

Analysis	*	As	* B	* Ca	* H	* Mg	* Mo	* Nb	* Pb	* Sb	* Sn	* V	* W	* Zn	* Zr
1	3	0.1	4 3.4	4 0.17	1 <0.2	4 0.17	2 0.6	4 0.36	4 0.014	3 0.1	8 1	4 0.2	3 7.8	4 0.25	4 1.1
2	4	0.29	3 4.3	2 0.6	1 <0.2	5 0.35	2 0.8	3 2.9	3 0.1	4 <0.1	8 3	4 0.26	2 18	5 0.54	3 5
3	5	0.31	3 4.6	2 0.7	1 <0.2		5 1	3 <10	5 0.8	5 <1	3 5.2	2 2	3 40		3 6.4
4	2	8		2 0.8			5 1		3 3		3 10	2 2	4 <0.1		
5	2	8		2 1			4 1.2		3 13		4 <0.1	3 2.9	5 <1		
6	2	<5		2 1			3 4.0		5 <0.5		5 <1	2 4	5 <1		
7	3	<5		2 1.1			2 7		5 <1		5 <1	2 5	2 <10		
8	6	<5		3 1.8			2 8		6 <1		5 <1	2 6.2	3 <50		
9	6	<5		2 2			2 8		5 <1		5 <1	2 6.7	2 <50		
10	6	<10					5 8.5		5 <1		5 <1	2 7	2 <50		
11	6	<20					2 9		5 <1		2 <1	3 10	2 <50		
12							2 14		2 <10		2 <10	2 14	2 <50		
13							2 19				3 <20	5 <1			
14												5 <1			
15												3 <10			
Average			4.10	1.02		0.26	6.3							0.40	4.2
Std Dev			0.62	0.57		0.13	5.7							0.21	2.7
Info		(<20)	(4)	(1)	(<0.2)	(0.3)	(6)	(<10)	(<20)	(<1)	(<20)	(<10)	(<50)	(0.4)	(4)

Data in parentheses are not certified but 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.

## \* Method of Analysis

1	Fusion - Thermal Conductivity Method	6	Flame Atomic Absorption Spectrometry
2	AES-ICP Inductively Coupled Plasma Spectrometry	7	Graphite Furnace - Atomic Absorption Spectrometry
3	AES- Spark-Atomic Emission Spectrometry	8	Spectrophotometric method
4	Glow Discharge Mass Spectrometry	9	Titration method
5	AES-ICP-MS Inductively Coupled Plasma with Mass Spectrometry	10	Combustion

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

**Laboratory**

Brammer Standard Company, Inc., Houston, TX  
Dirats Laboratory, Westfield, MA  
ArcelorMittal, Hamilton, Ontario, Canada  
Laboratory Testing Inc, Hatfield, PA  
Leco Technical Services Laboratory, St. Joseph, MI  
Andrew S. McCreath & Son, Inc., Harrisburg, PA  
National Analysis Center Iron and Steel, Beijing, China  
Northern Analytical Laboratory Inc., Londonderry, NH  
NSL Analytical, Cleveland, OH  
Tensile Testing Metallurgical Laboratory, Cleveland, OH  
VHG Labs, Manchester, NH

**Accredited/Registered by**

A2LA - ISO 17025, ISO Guide 34  
Nadcap - 17025  
A2LA - 17025  
Nadcap - 17025  
BSI - ISO 9001  
A2LA - ISO 17025  
CNAS - 17025  
Nadcap - ISO 17025  
Nadcap - ISO 17025  
A2LA - ISO 17025  
URS - ISO 17025

**Certification Process:** The requirements of ISO Guide 31, ISO Guide 34, ISO Guide 35, and ASTM Standard Guides E 1724 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. Methods of analysis used were a combination of ASTM Standard Test Method E 1019 plus additional ICP and AA spectrometric methods.

**Traceability:** The following Certified Reference Materials were used to validate the analytical data listed on page 2: NIST SRM 293, 345, 348a, 361, 362, 364, 2165, 2167, 2168, 3101a, 3103a, 3109a, 3112a, 3113, 3114, 3128, 3132, 3134, 3136, 3139a, 3150, 3161a, 3162a, 3163, 3165; ECRM 088-1, 096-1, 097-1; BAM 031-3.

**Homogeneity:** This Reference Material was tested for homogeneity using ASTM Standard Method E 826 and found acceptable. It was also examined by spark atomic emission spectrometry using ASTM Standard Test Method E 415 and found to be compatible with the following Reference Materials: NIST SRM 1228, 1765, 1766, 1767, 1768; JSS 169-6, 170-6, 174-6.

**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:** The BS LC-6 material was produced by Carpenter Technology Corporation, Reading, Pennsylvania. The material was made in an electric arc furnace and cast into ingots. The bar stock was hot rolled and annealed.

**Form:** This CRM is machined to the form of a disc, approximately 39 mm in diameter and 19 mm thick by Brammer Standard Company, Inc..

**Use:** This CRM is intended for use in spark atomic 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 spark atomic 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 LC-6-010809-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](http://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.  
14603 Benfer Road  
Houston, Texas 77069-2895 USA

Phone: (281) 440-9396  
Fax: (281) 440-4432

web: [www.brammerstandard.com](http://www.brammerstandard.com)  
e-mail [contact@brammerstandard.com](mailto:contact@brammerstandard.com)

Certified by: \_\_\_\_\_ on January 8, 2009.  
Beau R. Brammer

Certificate Number LC-6-010809p3

**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)**

**Brammer Standard Company's Chemical Laboratory is accredited to ISO Standard 17025 by A2LA.  
(Certificate Number 656.01)**

**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.**

**References:**

***ASTM documents available from ASTM, 1916 Race Street, Philadelphia, PA, 19103.***

E 415-08 Standard Test Method for Atomic Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel

E 826 - 08 Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry

E 1019 - 2008 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys

E 1724 - 95 (Reapproved 2001) Standard Guide for Testing and Certification of Metal and Metal-Related Reference Materials

E 1806-96(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](http://www.global.ihs.com)*

ISO Standard 17025:2005 General requirements for the competence of calibration and testing laboratories.

ISO Guide 30:1992/Amd 1:2008 Terms and definitions used in connection with reference materials.

ISO Guide 31:2000 Reference materials -Contents of certificates and labels.

ISO Guide 33:2000 Uses of certified reference materials.

ISO Guide 34:2000 General requirements for the competence of reference material producers.

ISO Guide 35:2006 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