

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

**B.S. 50E**

**Reference Material for Pure Iron**

	Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>		Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>
Analysis listed as percent by weight					
<b>C</b>	<b>0.0010</b>	0.0003	<b>As</b>	<b>0.0026</b>	0.0004
<b>Mn</b>	<b>0.015</b>	0.002	<b>Co</b>	<b>0.004</b>	0.001
<b>P</b>	<b>0.003</b>	0.001	<b>N</b>	<b>0.0092</b>	0.0010
<b>S</b>	<b>0.012</b>	0.001	<b>O</b>	<b>0.024</b>	0.001
<b>Si</b>	<b>0.007</b>	0.001	<b>Pb</b>	<b>&lt;0.0001</b>	
<b>Cu</b>	<b>0.019</b>	0.001	<b>Sn</b>	<b>0.0024</b>	0.0004
<b>Ni</b>	<b>0.030</b>	0.003	Informational values <sup>3</sup>		
<b>Cr</b>	<b>0.075</b>	0.004	<b>B</b>	(0.0001)	
<b>Mo</b>	<b>0.006</b>	0.001	<b>Ca</b>	(0.0001)	
<b>V</b>	<b>0.044</b>	0.004	<b>Nb</b>	(0.0001)	
<b>Al</b>	<b>&lt;0.003</b>		<b>Ti</b>	(0.002)	

<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.

See reverse side for more information.

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Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Al
1	0.00068	0.0124	0.0024	0.0110	0.0067	0.018	0.0267	0.0694	0.00463	0.040	<0.0002
2	0.00073	0.013	0.0025	0.01120	0.0067	0.0186	0.0274	0.070	0.0049	0.042	<0.001
3	0.00084	0.0144	0.0029	0.01149	0.007	0.0188	0.028	0.076	0.0057	0.043	<0.001
4	0.00092	0.0154	0.00295	0.01159	0.0072	0.0188	0.029	0.076	0.006	0.045	<0.002
5	0.00095	0.0161	0.003	0.01169	0.0072	0.019	0.0294	0.0762	0.0066	0.048	0.000012
6	0.00102	0.0163	0.0030	0.01181	0.0073	0.019	0.0299	0.0780	0.0069		0.0006
7	0.00105	0.0163	0.004	0.01185	0.0075	0.0192	0.035	0.0808			0.0008
8	0.00107	0.0176	0.0043	0.01195	0.0079		0.036				0.0009
9	0.0011			0.01240	0.0089						0.0010
10	0.00115			0.01282							0.0025
11	0.00115			0.01302							
12	0.00116			0.01351							
Average	0.00098	0.0152	0.0031	0.01203	0.0074	0.0188	0.0302	0.0752	0.0058	0.0436	
sd	0.00016	0.0018	0.0007	0.00076	0.0007	0.0004	0.0035	0.0041	0.0009	0.0030	
Certified	0.0010	0.015	0.003	0.012	0.007	0.019	0.030	0.075	0.006	0.044	<0.003
C(95%) <sup>1</sup>	0.00010	0.0015	0.0006	0.00052	0.0005	0.0004	0.0029	0.0038	0.0010	0.0038	

sd = standard deviation

Analysis	As	Co	N	O	Pb	Sn	B	Ca	Nb	Ti
1	0.0020	0.0034	0.00845	0.0224	<0.005	0.0020	<0.0001	0.000012	0.00008	0.0009
2	0.0022	0.0035	0.0092	0.0236	<0.00001	0.0020	0.000007	0.00005	0.0003	0.0010
3	0.0025	0.0041	0.0095	0.02365	<0.0001	0.0021	0.00009	0.00015	0.0004	0.003
4	0.0026	0.0042	0.0098	0.026	0.00004	0.0024	0.00015	0.0002	0.0007	0.003
5	0.0028	0.0054			0.00006	0.0026	0.00016		0.0020	
6	0.0028					0.0029	0.00028			
7	0.0033					0.0030				
Average	0.0026	0.0041	0.0092	0.0239		0.0024		0.00010	0.0007	0.0020
sd	0.0004	0.0008	0.0006	0.0015		0.0004		0.00009	0.0008	0.0012
Certified	0.0026	0.004	0.0092	0.024	<0.0001	0.0024	(0.0001)	(0.0001)	(0.0001)	(0.002)
C(95%) <sup>1</sup>	0.0004	0.0010	0.0009	0.0024		0.0004				

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

<sup>(1)</sup>  $C(95\%) = (t \times sd) / \sqrt{n}$  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.

**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 Guide 25. The individual values listed above are the average of each analyst's results. Methods of analysis used were a combination of ASTM Standard Methods E 350, E 415, and E 1019, plus additional ICP and AA spectrometric methods.

**Co-operating Laboratories:** Some of the co-operating laboratories were:

Analytical Associates, Inc., Detroit, Michigan  
 ANAREM, Prague, Czech Republic  
 Brammer Standard Co., Inc., Houston, Texas  
 Coleman Testing Laboratories, Riverside, New Jersey  
 Crucible Specialty Steel, Syracuse, New York  
 J. Dirats and Co., Inc., Westfield, Massachusetts  
 DOFASCO, Hamilton, Ontario, Canada  
 Laboratory Testing Inc., Dublin, Pennsylvania  
 LECO Corporation, St. Joseph, Michigan  
 Ledoux & Company, Teaneck, New Jersey  
 Andrew S. McCreath & Son, Inc., Harrisburg, Pennsylvania  
 Jeffrey A. Nunes Laboratories, Inc., Washington, Pennsylvania  
 Shiva Technologies, Inc., Cicero, New York  
 Spectrochemical Laboratories, Inc., Pittsburgh, Pennsylvania  
 Thyssen Stahl AG, Duisburg, Federal Republic of Germany  
 VHG Laboratories, Inc., Manchester, New Hampshire

**Homogeneity:** This Reference Material was tested for homogeneity using ASTM Standard Practice E 826 and found acceptable.

**Traceability:** This Reference Material was also examined by optical emission spectrometry and found to be compatible with the following Certified Reference Materials: NIST SRM 1265, 1765, 1766, 1767, 1768. The following Certified Reference Materials were used to validate the analytical data listed on page 2: NIST SRM 32e, 101g, 111b, 125b, 131e, 361 to 365, 898, 2165, 2166, 2167, 2168; BAM 039-2, 044-1; BCS 346, 455/1, 456/1, 458/1; ECRM 085-1, 088-1, 096-1, 097-1, 184-1; GBW 01402; IMZ 1.22, 1.74; JSS 003-1, 1203-1.

**Source:** This material was produced by Carpenter Technology Corporation, Reading, Pennsylvania. The material was made in an electric arc furnace and cast into ingots. The ingots were hot worked into bars and annealed.

**Available Form:** This Reference Material is available only in the form of a disc, approximately 44 mm (1.75") in diameter and 19 mm (0.75") thick.

**Use:** This Reference Material is intended for use in optical emission and x-ray spectrometric methods of analysis. 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.

**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  
14603 Benfer Road  
Houston, Texas 77069-2895 USA Fax: (281) 440-4432

Certified by: \_\_\_\_\_ on April 26, 1996.  
G. R. Brammer

Certificate Number 50E-042696

## References :

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

E 322 - 67 (Reapproved 1990) Standard Method for X-Ray Emission Spectrometric Analysis of Low-Alloy Steels and Cast Irons

E 350 - 90 Standard Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

E 415 - 85 (Reapproved 1995) Standard Test Method for Optical Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel

E 826 - 85 (Reapproved 1990) Standard Practice for Testing Homogeneity of Materials for the Development of Reference Materials

E 1019-93 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys

*ISO Guides available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.*

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 (First edition, 1981), Contents of certificates of reference materials.

ISO Guide 33 (First edition, 1989), Uses of certified reference materials.

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