

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

B.S. 20G

**Reference Material for Gray Iron**

	Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>		Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>
<b>Carbon</b>	<b>3.33</b>	0.02	<b>Molybdenum</b>	<b>0.19</b>	0.01
<b>Manganese</b>	<b>0.58</b>	0.02	<b>Tin</b>	<b>0.12</b>	0.02
<b>Phosphorus</b>	<b>0.028</b>	0.004	<b>Titanium</b>	<b>0.012</b>	0.002
<b>Sulfur</b>	<b>0.029</b>	0.002	<b>Vanadium</b>	<b>0.018</b>	0.002
<b>Silicon</b>	<b>3.02</b>	0.04	<b>Aluminum</b>	<b>0.008</b>	0.002
<b>Copper</b>	<b>0.54</b>	0.02	<b>Arsenic</b>	<b>0.004</b>	0.001
<b>Nickel</b>	<b>0.38</b>	0.01	<b>Cobalt</b>	<b>0.022</b>	0.002
<b>Chromium</b>	<b>0.086</b>	0.004	<b>Antimony</b>	<b>(&lt;0.001)<sup>3</sup></b>	

*(analysis listed as percent by weight)*

<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> The antimony value is not certified and is provided for information only.

Some of the co-operating laboratories were:

Brammer Standard Co., Inc., Houston, Texas  
J. Dirats and Co., Inc., Westfield, Massachusetts  
Charles C. Kawin Company, Broadview, Illinois  
Tyler Pipe Company, Tyler, Texas  
VHG Laboratories, Inc., Manchester, New Hampshire  
Midstates Analytical Labs, Tulsa, Oklahoma

Chicago Spectro Service Labs, Chicago, Illinois  
Anderson Laboratories, Milwaukee, Wisconsin  
Analytical Process Labs, Milwaukee, Wisconsin  
Taussig Associates, Chicago, Illinois  
Analytical Consulting Services, Houston, Texas

CAUTION: Because this Reference Material contains a high percent of carbon and silicon, care must be taken in its application. Make certain that corrections are made for possible element interference and dilution effects.

See the following pages for more information

Previous Certificate Number REV20G-062591  
New Certificate Number **REV-20G-121109**

**New Certificate Number REV-20G-121109 Revised to show uncertainty values on December 11, 2009**

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

**BS 20G Analysis listed as percent by weight Certificate Number REV-20G-121109**

Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo
1	3.31	0.56	0.025	0.025	2.98	0.52	0.36	0.08	0.17
2	3.31	0.57	0.026	0.027	2.989	0.527	0.369	0.08	0.177
3	3.315	0.578	0.027	0.0279	3.00	0.528	0.37	0.084	0.18
4	3.32	0.58	0.029	0.028	3.03	0.533	0.371	0.085	0.184
5	3.33	0.58	0.034	0.0286	3.05	0.54	0.38	0.086	0.187
6	3.33	0.58		0.029	3.06	0.54	0.384	0.087	0.19
7	3.336	0.59		0.030		0.55	0.386	0.088	0.19
8	3.35	0.595		0.033		0.56	0.391	0.09	0.20
9	3.36	0.60				0.57		0.091	0.207
10		0.602				0.58			
Average	3.329	0.584	0.0282	0.0286	3.018	0.545	0.376	0.0857	0.1872
Std Dev	0.018	0.013	0.0036	0.0023	0.033	0.02	0.01	0.0039	0.0114
<b>Certified</b>	<b>3.33</b>	<b>0.58</b>	<b>0.028</b>	<b>0.029</b>	<b>3.02</b>	<b>0.54</b>	<b>0.38</b>	<b>0.086</b>	<b>0.19</b>
t	2.31	2.26	2.78	2.36	2.57	2.26	2.36	2.31	2.31
C (95%)	0.013	0.010	0.0044	0.0019	0.035	0.014	0.009	0.003	0.009

Analysis	Al	As	Co	Sn	Ti	V	Sb
1	0.003	0.003	0.011	0.099	0.010	0.015	0.0008
2	0.0035	0.0036	0.013	0.10	0.0101	0.016	<0.001
3	0.0036	0.004	0.014	0.11	0.0107	0.018	
4	0.0043		0.014	0.11	0.011	0.018	
5	0.006		0.015	0.118	0.011	0.018	
6				0.126	0.012	0.019	
7				0.127	0.013	0.020	
8				0.131	0.013	0.021	
9				0.134	0.014	0.0216	
Average	0.0041	0.0035	0.0134	0.1172	0.0116	0.0185	
Std Dev	0.0012	0.0005	0.0015	0.0131	0.0014	0.0022	
<b>Certified</b>	<b>0.008</b>	<b>0.004</b>	<b>0.022</b>	<b>0.12</b>	<b>0.012</b>	<b>0.018</b>	<b>(&lt;0.001)</b>
t	2.78	4.30	2.78	2.31	2.31	2.31	
C (95%)	0.0015	0.0013	0.0019	0.0101	0.0011	0.0017	

$C(95\%) = (t \times sd) / \sqrt{n}$  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 35:2006 section 6.

The antimony data is provided for information only.

**Analysis:** Chemical analyses were performed on chips taken from cross-sections of the discs. The individual values listed above are the average of each analyst's results.

**Methods of Analysis:** Methods of analysis used were a combination of ASTM Standard Methods E 322, E 350, E 351, E 485, E 1019, plus additional ICP, and AA spectrometric methods. The following Certified Reference Materials were used to validate the analytical data listed above: NIST SRM 32e, 122h, 125b, 361, 362, 363, 364; BAM 039-2, 044-1; BCS 455/1, 456/1, 458/1; ECRM 085-1, 088-1, 096-1, 184-1, 481-1, 483-1; GBW 01402; IMZ 1.74, 1.22/1

**Homogeneity:** This Reference Material was tested for homogeneity using ASTM Standard Method E 826 found acceptable. It was also examined by spark atomic emission spectrometry and found to be compatible with the following Certified Reference Materials: NIST SRM C1137a, C1145a, C1146a, C1150a; CKD 232 - 239A, CKD 241 - 249

**Available Form:** This Reference Material is available only in the form of a disc, approximately 47 mm in diameter and 13 mm thick.

**CAUTION:** This material was produced by continuous casting into bars. Avoid using the outer 3 mm of the radius on the analytical surface. Each disc contains free graphite which will cause difficulty in obtaining acceptable burns with some atomic emission spectrometer's arc/spark sources.

**Certificate Number:** The unique identification number for this certificate of analysis is REV-20G-121109. This BS 20E Certificate of Analysis is revised to show the estimate of uncertainty for the certified values.

Refer to the "Certificates" section of the Brammer Standard Company website for any revision to this or other Brammer Standard Company's Certificates of Analysis

**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: <a href="http://www.brammerstandard.com">www.brammerstandard.com</a> e-mail <a href="mailto:contact@brammerstandard.com">contact@brammerstandard.com</a>
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Revision Certified by: \_\_\_\_\_ on December 11, 2009.  
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](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. - [www.astm.org](http://www.astm.org)

- E 322 Standard Test Method for X-ray Emission Spectrometric Analysis of Low-Alloy Steels and Cast Irons
- E 350 Standard Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron
- E 351 Standard Test Methods for Chemical Analysis of Cast Iron - All Types
- E 485 Standard Test Method for Optical Emission Vacuum Spectrometric Analysis of Blast Furnace Iron by the Point-to-Plane Technique
- E 826 Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry
- E 1019 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques

*ISO Guides and Standards available from Global Engineering - [www.global.ihs.com](http://www.global.ihs.com)*

ISO Guide 35 Reference Materials - General and statistical principles for certification

**Certificate Number REV20G-121109**