

Brammer Standard Company, Inc.
Certificate of Analysis

B.S. 20E

Reference Material for Gray Iron

	Certified Value ¹	Estimate of Uncertainty ²		Certified Value ¹	Estimate of Uncertainty ²
Carbon	3.24	0.03	Aluminum	0.006	0.001
Manganese	0.80	0.01	Cobalt	0.006	0.002
Phosphorus	0.042	0.003	Tin	0.093	0.006
Sulfur	0.044	0.002	Titanium	0.017	0.002
Silicon	2.29	0.03	Vanadium	0.007	0.002
Copper	0.23	0.01			
Nickel	0.156	0.004	Uncertified Values ³		
Chromium	0.088	0.001	Arsenic	(0.003)	
Molybdenum	0.042	0.002	Antimony	(<0.002)	

(analysis listed as percent by weight)

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

² 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.

³ The values in parentheses are not certified and are provided for information only.

Some of the co-operating laboratories were:

Analytical Consulting Services, Houston, Texas
 Analytical Process Labs, Milwaukee, Wisconsin
 Anderson Laboratories, Milwaukee, Wisconsin
 Charles C. Kawin Company, Broadview, Illinois
 Chicago Spectro Service Labs, Chicago, Illinois
 Midstates Analytical Labs, Tulsa, Oklahoma
 Spectrochemical Labs, Pittsburgh, Pennsylvania
 Taussig Associates, Chicago, Illinois

See the following pages for more information.

Original Certificate Number 20E-062591
 New Certificate Number REV-20E-121109

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

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

BS 20E analysis listed as percent by weight Certificate Number REV-20E-121109

Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo
1	3.23	0.79	0.039	0.042	2.27	0.219	0.152	0.087	0.041
2	3.237	0.797	0.042	0.044	2.285	0.22	0.154	0.0880	0.041
3	3.24	0.80	0.043	0.044	2.30	0.224	0.156	0.088	0.042
4	3.27	0.80	0.043	0.0444	2.31	0.233	0.158	0.088	0.043
5		0.814		0.046		0.24	0.159	0.0890	0.045
6		0.819				0.24			
Average	3.244	0.803	0.0418	0.0441	2.291	0.229	0.1558	0.0880	0.0424
Std Dev	0.018	0.011	0.0019	0.0014	0.018	0.010	0.0029	0.0007	0.0017
Certified	3.24	0.80	0.042	0.044	2.29	0.23	0.156	0.088	0.042
t	3.18	2.57	3.18	2.78	3.18	2.57	2.78	2.78	2.78
C (95%)	0.028	0.011	0.0030	0.0018	0.028	0.010	0.0036	0.0009	0.0021

continued from above

Analysis	Al	Co	Sn	Ti	V	As	Sb
1	0.0057	0.0049	0.087	0.0153	0.0057	0.0021	0.001
2	0.006	0.005	0.090	0.017	0.0061	0.0028	<0.001
3	0.0061	0.006	0.094	0.018	0.007	0.0051	
4	0.0063	0.007	0.095	0.018	0.008		
5			0.098				
Average	0.0060	0.0057	0.0928	0.0171	0.0067	0.0033	
Std Dev	0.0003	0.0010	0.0043	0.0013	0.0010	0.0016	
Certified	0.006	0.006	0.093	0.017	0.007	(0.003)	(<0.002)
t	3.18	3.18	2.78	3.18	3.18	4.30	
C (95%)	0.0004	0.0016	0.0055	0.0020	0.0016	0.0039	

$C(95\%) = (t \times sd) / \sqrt{n}$ 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 arsenic and antimony values are 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

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.

Available Form: This Reference Material is available only in the form of a disc, approximately 50 mm in diameter and 13 mm thick.

Certificate Number: The unique identification number for this certificate of analysis is REV-20E-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: www.brammerstandard.com e-mail contact@brammerstandard.com
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Revision Certified by: Beau R. Brammer on December 11, 2009.

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

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

- 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

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

Certificate Number REV-20E-121109