Brammer Standard Company, Inc.

Certificate of Analysis

BS Number CC-11

Reference Material for Chill-cast Iron

	Certified Value[1,2]	Estimate of Uncertainty[3]		Certified Value[1,2]	Estimate of Uncertainty[3]
		Analysis listed as percent by weight			
C	**3.00**	0.03	**Ca**	**0.0002**	0.0001
Mn	**1.18**	0.02	**Ce**	(0.001)	
P	**0.022**	0.001	**Co**	**0.021**	0.002
S	(0.024)[4]		**La**	(0.001)	
Si	**1.92**	0.02	**Mg**	(0.013)[4]	
Cu	**0.14**	0.005	**Nb**	(0.003)	
Ni	**0.064**	0.004	**Pb**	**0.0007**	0.0002
Cr	**0.060**	0.003	**Sb**	**0.14**	0.015
Mo	**0.011**	0.002	**Sn**	**0.045**	0.003
Al	**0.029**	0.002	**Te**	(0.002)	
As	**0.006**	0.002	**Ti**	**0.011**	0.002
B	**0.0012**	0.0002	**V**	**0.016**	0.001
Bi	(<0.0005)		**W**	(0.002)	
			Zr	(0.002)	

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

[2] Data in parentheses are not certified and are provided for information only.

[3] The uncertainties listed are based on value judgments of the material inhomogeneity and possible bias in the determined analytical values. No attempt is made to derive exact statistical measurements of imprecision because several methods were used in the determination of most constituents.

[4] Sulfur and magnesium were found to be not homogeneous between samples and within samples.

The requirements of ISO Guide 31 and ISO Guide 35 were generally followed for the preparation of this reference material and certificate of analysis. This is a reference material as defined by ISO Guide 30.

See reverse side for more information.

Certificate Number CC-11-040495

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

BS Number CC-11 Certificate number CC-11-040495

Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo
1	2.97	1.161	0.0204	0.021	1.89	0.130	0.059	0.0568	0.010
2	2.975	1.165	0.0205	0.023	1.90	0.133	0.063	0.0574	0.0105
3	2.98	1.167	0.021	0.0234	1.904	0.135	0.063	0.058	0.0108
4	3.010	1.17	0.021	0.0237	1.91	0.135	0.063	0.059	0.0108
5	3.01	1.176	0.0214	0.024	1.913	0.136	0.0632	0.059	0.011
6	3.013	1.19	0.022	0.0245	1.918	0.1374	0.0644	0.060	0.011
7	3.02	1.194	0.0220	0.0245	1.92	0.139	0.0644	0.0607	0.011
8	3.025	1.20	0.022	0.025	1.927	0.139	0.065	0.061	0.012
9		1.207	0.023	0.027	1.929	0.14	0.065	0.061	0.0120
10		1.22	0.023	0.0276	1.94	0.14	0.066	0.062	0.012
11					1.95	0.140	0.066	0.062	0.013
12							0.070	0.064	0.013
Average	3.000	1.185	0.0216	0.0244	1.918	0.137	0.0643	0.0601	0.0114
Std Dev	0.022	0.020	0.0009	0.0019	0.018	0.003	0.0026	0.0021	0.0010
Certified	3.000	1.18	0.022	(0.024)	1.92	0.14	0.064	0.060	0.011

Analysis	Al	As	B	Bi	Ca	Ce	Co	La	Mg
1	0.026	0.0035	0.0009	<0.0001	0.00008	0.0001	0.017	0.0001	0.0117
2	0.0264	0.0035	0.0011	<0.0005	0.00015	0.002	0.018	0.0002	0.0118
3	0.0279	0.0041	0.0012	0.0001	0.00020		0.0195	0.003	0.0120
4	0.028	0.006	0.0012		0.00029		0.0198		0.012
5	0.028	0.0066	0.0012		0.0003		0.0200		0.012
6	0.029	0.007	0.0012				0.0208		0.0126
7	0.029	0.007	0.00136				0.021		0.0127
8	0.030	0.0071	0.0014				0.022		0.013
9	0.0301	0.0075	0.0017				0.0227		0.0133
10	0.0307	0.0078					0.023		0.0143
11	0.032	0.0082					0.023		0.015
Average	0.0288	0.0062	0.00125		0.00020	0.0011	0.0206	0.0011	0.0128
Std Dev	0.0018	0.0017	0.00022		0.00009	0.0013	0.0020	0.0016	0.0011
Certified	0.029	0.006	0.0012	(<0.0005)	0.0002	(0.001)	0.021	(0.001)	(0.013)

Analysis	Nb	Pb	Sb	Sn	Te	Ti	V	W	Zr
1	0.002	0.00045	0.120	0.041	0.0008	0.0084	0.015	0.001	0.0006
2	0.0035	0.0006	0.120	0.0414	0.001	0.010	0.015	0.001	0.002
3		0.0007	0.124	0.043	0.002	0.0108	0.015	0.001	0.0020
4		0.00089	0.127	0.0434	0.0031	0.011	0.0155	0.0018	0.0022
5		0.001	0.128	0.044	0.0041	0.011	0.016	0.002	
6			0.135	0.045		0.0113	0.016	0.003	
7			0.144	0.0465		0.012	0.0168	0.004	
8			0.145	0.048		0.012	0.017	0.0053	
9			0.147	0.0480		0.012	0.017		
10			0.157	0.050		0.013	0.0171		
11			0.16			0.014	0.018		
Average	0.0028	0.00073	0.137	0.0450	0.0022	0.0114	0.0162	0.0024	0.0017
Std Dev	0.0011	0.00022	0.014	0.0030	0.0014	0.0015	0.0010	0.0016	0.0007
Certified	(0.003)	0.0007	0.14	0.045	(0.002)	0.011	0.016	(0.002)	(0.002)

Analysis: Chemical analyses were made on chips prepared by a lathe from the certified portion of the discs. The individual values listed in the data table are the average of each analyst's results. Methods of analysis used were a combination of ASTM Standard Methods E 350, E 351, E 1019, plus additional ICP and AA spectrometric methods and Neutron Activation Analysis. The following Certified Reference Materials were used to validate the analytical data: NIST SRM 5k, 5L, 32e, 36b, 82b, 100b, 122g, 125b, 129c, 293, 334, 338, 342a, 345, 346, 348a, 361, 362, 363, 364, 365, 898, 1270, 3102, 3103, 3106, 3107, 3110, 3127, 3128, 3131, 3156, 3168; ECRM 084-1, 085-1, 088-1, 096-1, 097-1, 184-1, 428-1, 478-1, 479-1, 480-1, 481-1; BCS 345, 346, 455, 455/1, 456/1, 458/1, 475; JSS 190-1 through 195-1; BAM 039-1, 039-2, 044-1; IMZ 1.74/1; CMSI 1530, 1533, 1551.

Co-operating Laboratories:

American Cast Iron Pipe Company, Birmingham, Alabama
Analytical Associates Inc., Detroit, Michigan
Anarem, Praha, Czech Republic
Brammer Standard Co., Inc., Houston, Texas
Crucible Specialty Metals, Syracuse, New York
J. Dirats and Co., Inc., Westfield, Massachusetts
Laboratory Testing Inc., Dublin, Pennsylvania
LECO Corporation, St. Joseph, Michigan
Shiva Technologies, Inc., Cicero, New York
Spectrochemical Laboratories, Inc., Pittsburgh, Pennsylvania
VHG Laboratories, Inc., Manchester, New Hampshire

Homogeneity: This Reference Material was tested for homogeneity using ASTM Standard Method E 826 and found acceptable for all of the tested elements except sulfur and magnesium. It was also examined by optical emission spectrometry and found to be compatible with the following Certified Reference Materials: NIST SRM C1145A, C1146A, 1147, C1150A, C2424; CKD 241 through 249.

Source: This material was melted and cast by Intermet Research and Development, Intermet Corporation, Lynchburg, Virginia, using a coreless induction furnace. It was chill-cast into a sample mold with a copper chill-plate producing 288 discs simultaneously.

Description and Use: This Reference Material is in the form of a disc, approximately 32 mm in diameter and 17 mm thick. It is intended for use in optical emission and x-ray spectrometric methods of analysis.

Certified Area: The area certified of each disc is the portion extending upward 10 mm from the larger diameter surface.

Note: Shrinkage cavities may appear in the top portion of some discs. These cavities are normal and will not affect the certified portion of the disc.

Preparation: Use the same method for preparing the analytical surface on all reference materials and specimens for best results. 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 4, 1995.
G. R. Brammer

Referenced Documents

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 351 - 93 Standard Test Methods for Chemical Analysis of Cast Iron - All Types

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.