

Brammer Standard Company, Inc.

Certificate of Analysis

BS CC-25

Chill-cast Iron Reference Material

	Certified Value ^{1,2}	Estimate of Uncertainty ³		Certified Value ¹	Estimate of Uncertainty ³
Analysis listed as percent by weight					
C	3.50	0.03	La	0.003	0.0005
Mn	0.34	0.01	Mg	0.109	0.004
P	0.041	0.003	Nb	<0.004	
S	0.010	0.0015	Sb	0.105	0.008
Si	1.33	0.03	Sn	0.19	0.01
Cu	1.29	0.02	Ti	0.009	0.001
Ni	2.36	0.02	V	0.013	0.001
Cr	0.093	0.003	W	0.038	0.003
Mo	0.86	0.02			
Al	0.009	0.001		Provisional value	
As	0.152	0.006	N	(0.004)	
B	0.011	0.001	Pb	(0.001)	
Ce	0.008	0.0015	Te	(0.002)	
Co	0.17	0.01	Zr	(0.002)	

¹ The certified value listed 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 the 95% confidence interval. The half-width confidence interval C(95%) is shown on page 2.

See reverse side for more information.

Certificate Number CC25-020700p1

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Analysis	*	C	*	Mn	*	P	*	S	*	Si	*	Cu	*	Ni	*	Cr	*	Mo
1	H	3.47	N	0.3255	P1	0.0378	H	0.007	C	1.28	C	1.25	C	2.32	C	0.087	C	0.834
2	H	3.47	C	0.33	C	0.038	H	0.007	C	1.30	C	1.27	C	2.341	A	0.089	W	0.838
3	H	3.472	N	0.330	C	0.039	C	0.0094	J	1.32	R2	1.28	C	2.36	C	0.090	C	0.84
4	H	3.482	N	0.332	P1	0.0393	H	0.0100	B	1.32	C	1.28	K	2.365	U	0.092	C	0.85
5	H	3.50	E	0.333	B	0.0396	H	0.010	E	1.33	E	1.290	E	2.368	C	0.092	C	0.852
6	H	3.50	C	0.333	C	0.0399	H	0.0103	C	1.330	A	1.295	X1	2.37	Z	0.0930	B	0.852
7	H	3.505	C	0.338	C	0.040	H	0.01068	J	1.336	E	1.298	C	2.37	C	0.0930	Z	0.857
8	H	3.51	C	0.34	C	0.0410	H	0.0108	C	1.34	C	1.30	A	2.379	C	0.093	A	0.859
9	A	3.515	C	0.340	P	0.0438	H	0.0108	A	1.346	C	1.310	C	2.38	M1	0.0947	C	0.86
10	H	3.53	A	0.345	C	0.0440	H	0.0112	J	1.352	C		C	2.38	C	0.0954	C	0.87
11	H	3.544	C	0.35	A	0.0450	A	0.0116	E	1.36					B	0.0955	C	0.889
12							H	0.0117							E	0.0956		
Average		3.500		0.336		0.0407		0.0100		1.329		1.286		2.363		0.0925		0.855
Std Dev		0.025		0.007		0.0025		0.0016		0.023		0.018		0.019		0.0027		0.016
Certified		3.50		0.34		0.041		0.010		1.33		1.29		2.36		0.093		0.86
t		2.2281		2.2281		2.2281		2.201		2.2281		2.306		2.2622		2.201		2.2281
C (95%)		0.017		0.005		0.0017		0.0010		0.016		0.014		0.014		0.0017		0.010

Analysis	*	Al	*	As	*	B	*	Ce	*	Co	*	La	*	Mg	*	Nb	*	Sb
1	B	0.0078	C	0.140	C	0.0098	Z	0.006	C	0.156	C	0.002	E	0.104	C	<0.0005	C	0.096
2	A	0.008	N1	0.145	B	0.0099	C	0.0064	C	0.159	C	0.0027	C	0.105	C	<0.002	S1	0.0966
3	C	0.0086	Z	0.1513	T	0.0105	C	0.0069	C	0.160	C	0.0027	E	0.107	C	<0.002	B	0.0994
4	C	0.0087	D	0.152	A	0.0106	C	0.0070	C	0.160	CM	0.0028	E	0.110	C	<0.002	AA	0.1014
5	C	0.009	B	0.153	C	0.0108	C	0.008	C	0.16	C	0.0029	C	0.110	IC	0.00025	A	0.106
6	C	0.0090	C	0.153	C	0.011	B	0.009	C	0.163	B	0.003	A	0.111	C	0.00034	C	0.108
7	C	0.009	B	0.154	C	0.0112	C	0.009	Z	0.1644	C	0.0030	C	0.111	C	0.0007	Z	0.1087
8	C	0.010	C	0.156	T	0.01145	CM	0.00936	A	0.166	Z	0.0031	C	0.111	CM	0.00098	E	0.1091
9	AA	0.0104	C	0.163	CE	0.012	C	0.0095	C	0.168	C	0.0032	CM	0.114	B	0.0011	C	0.113
10					CE	0.012			E	0.180					C	0.0020	C	0.114
11									AA	0.1827					A	0.003		
12									B	0.188								
Average		0.0089		0.1519		0.0109		0.0079		0.1673		0.0028		0.1092				0.1052
Std Dev		0.0008		0.0065		0.0008		0.0014		0.0105		0.0004		0.0032				0.0065
Certified		0.009		0.152		0.011		0.008		0.17		0.003		0.109		<0.004		0.105
t		2.306		2.306		2.2622		2.306		2.201		2.306		2.306				2.2622
C (95%)		0.0006		0.0050		0.0005		0.0010		0.0067		0.0003		0.0025				0.0046

Analysis	*	Sn	*	Ti	*	V	*	W	*	N	*	Pb	*	Te	*	Zr
1	A	0.174	A	0.008	C	0.0115	C	0.035	V	0.0038	EE	0.0003	C	0.00009	C	0.0007
2	T1	0.177	C	0.0083	C	0.0115	C	0.035	V	0.0039	C	0.00035	C	0.0003	C	0.0017
3	C	0.177	C	0.0086	A	0.012	C	0.036	V	0.00523	SW	0.00040	CM	0.00035	CM	0.0024
4	E	0.179	C	0.009	C	0.012	C	0.036			EE	0.0004	AA	0.00193	C	0.0025
5	B	0.183	C	0.0091	C	0.012	B	0.0361			C	0.0005	F	0.003	C	0.0026
6	C	0.193	AA	0.0091	W	0.0127	C	0.0390			C	0.0015	B	0.003	B	0.003
7	C	0.193	C	0.0094	C	0.0129	Z	0.0404			G	0.0017	C	0.004	C	0.003
8	C	0.195	C	0.010	C	0.0129	C	0.041			A	0.002			C	0.0030
9	C	0.198	C	0.010	C	0.0132	W	0.0415							B	0.0035
10	AA	0.205	B	0.0101	B	0.0133	B	0.042								
11			C	0.0102	C	0.014										
Average		0.1874		0.0093		0.0125		0.0382		0.0043		0.0009		0.0018		0.0025
Std Dev		0.0107		0.0008		0.0008		0.0029		0.0008		0.0007		0.0016		0.0008
Certified		0.19		0.009		0.013		0.038		(0.004)		(0.001)		(0.002)		(0.002)
t		2.2622		2.2281		2.2281		2.2622		4.3027		2.3646		2.4469		2.306
C (95%)		0.0077		0.0005		0.0005		0.0020		0.0020		0.0006		0.0015		0.0006

* Methods of analysis listed on page 3.

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

Data listed as mass fraction expressed as percent.

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

Code	Element	Method
A	various	AES - Optical Emission - Glow Discharge
AA	various	AAS - Flame Atomic Absorption Spectrometry - standard addition method
B	various	AES - Optical Emission - Spark Source
C	various	AES - Inductively Coupled Plasma
CE	B	AES - Inductively Coupled Plasma after solvent extraction
CM	various	AES - Inductively Coupled Plasma Mass Spectrometry
D	various	AES- Inductively Coupled Plasma after hydride generation
E	various	AAS - Flame Atomic Absorption Spectrometry
EE	Pb	AAS - Flame Atomic Absorption Spectrometry after solvent extraction
F	various	AAS - Flame Atomic Absorption Spectrometry after hydride generation
G	various	AAS - Electro-thermic atomization - graphite furnace
H	C, S	Combustion-Infrared Absorption (ASTM E 1019)
IC	Nb	Ion Chromotography
J	Si	Gravimetry, with perchloric acid
K	Ni	Gravimetry, with diacetyldioxime
M1	Cr	Titration, peroxidisulphate oxidation
N	Mn	MAS - periodate oxidation
N1	As	MAS - Standard addition method
P	P	MAS - molybdivanadophosphoric acid
P1	P	MAS - bismuth phosphorus molybdenum blue
R2	Cu	MAS - biscyclohexanone oxalyldihydrazone
S1	Sb	MAS - malachite green benzene extraction
SW	Pb	Square-wave polarographic
T	B	MAS - distillation, curcumine
T1	Sn	MAS - Phenylfluorone
U	Cr	MAS - diphenylcarbazide
V	N	Inert gas Fusion Method (ASTM E 1019)
W	Mo	MAS - thiocyanate
X1	Ni	MAS - dimethylglyoxime
Z	various	INAA - Instrumental Neutron Activation Analysis

AES = Atomic Emission Spectrometry

MAS = Molecular Absorption Spectrometry (photometric - spectrophotometer methods)

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

Laboratory

ANAREM, Prague, Czech Republic
 AK Steel Research, Middletown, Ohio
 Brammer Standard Co., Inc., Houston, Texas
 China National Analysis Center for Iron and Steel, Beijing, China
 Crucible Specialty Steel, Syracuse, New York
 J. Dirats and Co., Inc., Westfield, Massachusetts
 IMR Test Labs, Lansing, New York
 LECO Corporation, St. Joseph, Michigan
 Shiva Technologies, Inc., Syracuse, New York
 Shiva Analyticals (India) Ltd., Hoskote, Bangalore, India
 VHG Laboratories, Inc., Manchester, New Hampshire

Laboratory contact

Karel Bičovský
 Howard Vail
 Richard P. Beaumont
 Prof. Wang Haizhou
 William Mastroe
 Eric E. Dirats
 Timothy J. McGrady and Terence C. O'Brien
 Dennis Lawrenz
 Don Shuman
 Dr. T. V. Ramakrishna
 Julie M. McIntosh

Certification Process: The requirements of ISO Guide 31, ISO Guide 34, ISO Guide 35, and ASTM Standard Guides E 1724 and E 1831 were followed for the preparation of this reference material and certificate of analysis. This is a 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 Guide 25. The individual values listed on page 2 are the average of each analyst's results. Methods of analysis used were a combination of ASTM Standard Test Methods E 350 and E 1019 plus additional ICP and AA spectrometric methods.

Outliers: Some outlying data was excluded from the data listed on page 2 due to technical assessment of the cooperating laboratories and statistical evaluation.

Traceability: The following Certified Reference Materials were used to validate the analytical data listed on page 2: NIST SRM 5L, 7f, 338, 363, 364, CC1173, 1761, 2166, C2423, C2424a, C2425; ECRM 471-1, 480-1, 481-1; CKD 215, 235, 238A, 239A, 241 - 249; CMSI 1530, 1533, 1551.

Homogeneity: This Reference Material was tested for homogeneity using ASTM Standard Method E 826 and found acceptable. It was also examined by optical emission spectrometry using ASTM Standard Test Method E 1999 and found to be compatible with the following Certified Reference Materials: NIST SRM C2423A; CKD 238, 239, 244.

Validity statement: ISO Guide 31 requires that a validity period statement be included in the certificate of analysis. This Reference Material is valid for 20 years from the certificate date.

Source: This material was melted and cast by American Centrifugal, Birmingham, Alabama, using an electric arc furnace. It was chill-cast into a mold on a copper chill-plate producing all 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.

CAUTION: The high magnesium content may interfere with proper sparking on an optical emission spectrometer. An increase in the preburn time may be required for proper spark excitation of the disc.

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 CC25-020700-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 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

Certified by: _____ on February 7, 2000.
G. R. Brammer

Certificate Number CC25-020700p4

By Certificate Number 10539, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9002:1994 by National Quality Assurance, U.S.A.

**Brammer Standard Company's Chemical Laboratory is accredited to ISO Guide 25 by A2LA.
(Certificate Number 656.01)**

References:

*ASTM documents available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959,
Telephone: 610-832-9500 Fax: 610-832-9555 e-mail: service@astm.org Website: www.astm.org*

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

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

E 1724 - 95 Standard Guide for Testing and Certification of Metal and Metal-Related Reference Materials

E 1806 - 96 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

E 1831 - 96 Standard Guide for Preparing Certificates for Reference Materials Relating to Chemical Composition of Metals, Ores, and Related Materials.

E 1999 - 99 Standard Test Method for Analysis of Cast Iron Using Optical Emission Spectrometry

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 34 (First edition, 1996), Quality system guidelines for the production of 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

Certificate Number CC25-020700p5