

Certificate of Analysis

BS Number CC-9

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	2.97	0.03	Ca	0.0003	0.0001
Mn	2.04	0.02	Ce	(0.0003)	
P	0.028	0.002	Co	0.086	0.003
S	0.068	0.003	La	0.0012	0.0002
Si	2.29	0.02	Mg	0.0005	0.0002
Cu	1.21	0.02	Nb	(0.006)	
Ni	0.34	0.015	Pb	0.0011	0.0004
Cr	0.095	0.004	Sb	0.14	0.008
Mo	0.21	0.015	Sn	0.094	0.010
Al	0.027	0.003	Te	(0.004)	
As	0.056	0.002	Ti	(0.11) ⁴	
B	0.025	0.0015	V	0.31	0.015
Bi	(0.002)		W	(0.008)	
			Zr	0.004	0.001

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 Titanium was 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-9-040495

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Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo
1	2.94	2.024	0.026	0.0633	2.269	1.179	0.310	0.092	0.196
2	2.94	2.027	0.0262	0.0639	2.28	1.19	0.328	0.092	0.205
3	2.952	2.030	0.0269	0.066	2.283	1.20	0.34	0.0926	0.207
4	2.958	2.03	0.0270	0.0666	2.285	1.201	0.34	0.093	0.208
5	2.96	2.040	0.028	0.0675	2.29	1.21	0.341	0.0945	0.208
6	2.98	2.05	0.028	0.0678	2.29	1.216	0.346	0.095	0.211
7	2.985	2.06	0.029	0.068	2.293	1.217	0.348	0.0964	0.213
8	2.989	2.07	0.029	0.070	2.30	1.22	0.350	0.097	0.218
9	3.000		0.029	0.0712	2.31	1.22	0.353	0.098	0.22
10				0.0729	2.337		0.359	0.103	0.224
11							0.360		0.23
Average	2.967	2.041	0.0277	0.0677	2.294	1.206	0.343	0.0954	0.213
Std Dev	0.022	0.017	0.0012	0.0030	0.019	0.014	0.014	0.0034	0.010
Certified	2.97	2.04	0.028	0.068	2.29	1.21	0.34	0.095	0.21

Analysis	Al	As	B	Bi	Ca	Ce	Co	La	Mg
1	0.024	0.0549	0.0233	0.0001	0.0002	0.0002	0.0816	0.0010	0.00038
2	0.0247	0.055	0.0236	0.0002	0.00024	0.0003	0.0828	0.0010	0.0004
3	0.025	0.0555	0.02369	0.0009	0.00026	0.0003	0.083	0.0011	0.00041
4	0.0264	0.056	0.0237	0.0036	0.0003		0.087	0.0011	0.0005
5	0.0265	0.0567	0.0245	0.0037	0.00041		0.087	0.0012	0.0005
6	0.027	0.057	0.0248				0.087	0.0013	0.0006
7	0.0271	0.0570	0.0263				0.087	0.0014	0.00062
8	0.0276	0.0572	0.0266				0.0880	0.0015	0.0007
9	0.030	0.058					0.0885		0.00075
10	0.033						0.089		
11							0.090		
Average	0.0271	0.0564	0.0246	0.0017	0.00028	0.00027	0.0864	0.00120	0.00054
Std Dev	0.0027	0.0011	0.0013	0.0018	0.00008	0.00006	0.0028	0.00019	0.00013
Certified	0.027	0.056	0.025	(0.002)	0.0003	(0.0003)	0.086	0.0012	0.0005

Analysis	Nb	Pb	Sb	Sn	Te	Ti	V	W	Zr
1	0.003	0.0004	0.133	0.081	0.0016	0.103	0.295	0.001	0.0029
2	0.008	0.0009	0.135	0.085	0.002	0.1039	0.298	0.0025	0.0039
3		0.00095	0.135	0.0864	0.0023	0.105	0.30	0.004	0.004
4		0.0011	0.135	0.087	0.0033	0.105	0.310	0.004	0.0045
5		0.0012	0.136	0.089	0.0052	0.107	0.311	0.005	
6		0.0014	0.138	0.094	0.007	0.108	0.314	0.0085	
7		0.0015	0.139	0.099	0.0089	0.109	0.316	0.009	
8			0.140	0.1007		0.111	0.316	0.009	
9			0.141	0.101		0.112	0.319	0.016	
10			0.147	0.102		0.112	0.327	0.0176	
11			0.15	0.104		0.124	0.334		
Average	0.0055	0.00106	0.139	0.0936	0.0043	0.1091	0.313	0.0077	0.0038
Std Dev	0.0035	0.00037	0.005	0.0081	0.0028	0.0059	0.012	0.0056	0.0007
Certified	(0.006)	0.0011	0.14	0.094	(0.004)	(0.11)	0.31	(0.008)	0.004

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 titanium. 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 Internet Research and Development, Internet 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.

