

# Certificate of Analysis

BS Number CC-17

Reference Material for Chill-cast Iron

	Certified Value <sup>1,2</sup>	Estimate of Uncertainty <sup>3</sup>		Certified Value <sup>1,2</sup>	Estimate of Uncertainty <sup>3</sup>
Analysis listed as percent by weight					
<b>C</b>	<b>2.32</b>	0.03	<b>Ca</b>	<b>0.0001</b>	0.00005
<b>Mn</b>	<b>0.39</b>	0.01	<b>Ce</b>	(0.002)	
<b>P</b>	<b>0.20</b>	0.01	<b>Co</b>	<b>0.020</b>	0.002
<b>S</b>	<b>0.17</b>	0.004	<b>La</b>	(<0.0002)	
<b>Si</b>	<b>3.93</b>	0.06	<b>Mg</b>	(0.0004)	
<b>Cu</b>	<b>0.11</b>	0.008	<b>Nb</b>	(0.006)	
<b>Ni</b>	<b>2.06</b>	0.04	<b>Pb</b>	(0.0002)	
<b>Cr</b>	<b>0.93</b>	0.02	<b>Sb</b>	(0.002)	
<b>Mo</b>	<b>1.81</b>	0.02	<b>Sn</b>	(0.004)	
<b>Al</b>	<b>0.004</b>	0.001	<b>Te</b>	(0.005)	
<b>As</b>	(0.009)		<b>Ti</b>	<b>0.019</b>	0.003
<b>B</b>	<b>0.0005</b>	0.0002	<b>V</b>	<b>0.012</b>	0.003
<b>Bi</b>	(0.01)		<b>W</b>	(0.004)	
			<b>Zr</b>	(<0.001)	

<sup>1</sup> 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.

<sup>2</sup> Data in parentheses are not certified and are provided for information only.

<sup>3</sup> 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.

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.

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Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo
1	2.285	0.375	0.191	0.1678	3.86	0.098	2.019	0.902	1.782
2	2.30	0.376	0.195	0.168	3.88	0.098	2.035	0.919	1.791
3	2.307	0.38	0.195	0.1696	3.90	0.099	2.04	0.920	1.80
4	2.308	0.388	0.198	0.17	3.902	0.102	2.06	0.927	1.802
5	2.315	0.39	0.199	0.17	3.91	0.105	2.077	0.927	1.81
6	2.325	0.391	0.205	0.170	3.972	0.106	2.084	0.93	1.819
7	2.326	0.392	0.206	0.171	3.995	0.1086	2.11	0.94	1.82
8	2.33	0.397	0.209	0.175	4.009	0.11		0.945	1.82
9	2.334	0.401	0.21			0.111		0.945	1.83
10	2.34	0.402	0.213			0.112		0.958	1.84
11		0.406				0.122		0.96	
Average	2.317	0.391	0.202	0.170	3.929	0.107	2.061	0.934	1.811
Std Dev	0.017	0.010	0.007	0.002	0.056	0.007	0.032	0.018	0.018
Certified	2.32	0.39	0.20	0.17	3.93	0.11	2.06	0.93	1.81

Analysis	Al	As	B	Bi	Ca	Ce	Co	La	Mg
1	0.0027	0.0031	0.00026	0.0002	0.00007	0.0001	0.017	<0.0001	0.0002
2	0.0028	0.0035	0.0003	0.0009	0.00008	0.0002	0.018	0.0001	0.0002
3	0.0035	0.0058	0.00031	0.0154	0.0001	0.006	0.019	0.0001	0.00023
4	0.004	0.0080	0.0005	0.016	0.00012		0.0190		0.00030
5	0.004	0.008	0.0006	0.0165	0.00015		0.0200		0.00037
6	0.0043	0.008	0.0007	0.0230			0.020		0.0004
7	0.005	0.0082	0.0007				0.0202		0.0004
8		0.0098					0.021		0.0006
9		0.0106					0.0210		0.00063
10		0.0150					0.021		
11		0.016					0.022		
12									
13									
Average	0.0038	0.0087	0.00048	0.0120	0.00010	0.0021	0.0198		0.00037
Std Dev	0.0008	0.0041	0.00019	0.0093	0.00003	0.0034	0.0015		0.00016
Certified	0.004	(0.009)	0.0005	(0.01)	0.0001	(0.002)	0.020	(<0.0002)	(0.0004)

Analysis	Nb	Pb	Sb	Sn	Te	Ti	V	W	Zr
1	0.004	0.00010	0.0006	0.001	0.002	0.017	0.009	0.001	<0.0001
2	0.008	0.0002	0.00073	0.0019	0.0031	0.017	0.010	0.0015	0.0009
3		0.0002	0.0008	0.003	0.0046	0.0179	0.011	0.0017	
4			0.0011	0.0039	0.0048	0.018	0.0111	0.003	
5			0.0015	0.0044	0.006	0.018	0.0121	0.0039	
6			0.0023	0.005	0.0069	0.0182	0.0125	0.004	
7			0.0025	0.0056		0.019	0.0128	0.005	
8			0.0029	0.006		0.019	0.017	0.006	
9						0.019	0.017	0.008	
10						0.022			
11						0.024			
Average	0.0060	0.00017	0.0016	0.0039	0.0046	0.0190	0.0125	0.0038	
Std Dev	0.0028	0.00006	0.0009	0.0018	0.0018	0.0021	0.0028	0.0023	
Certified	(0.006)	(0.0002)	(0.002)	(0.004)	(0.005)	0.019	0.012	(0.004)	(<0.001)

**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. 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.

