

# Brammer Standard Company, Inc.

## Certificate of Analysis

### BS 291EG

Certified Reference Material for Chill Cast Iron

	Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>	<b>Certified Values<sup>3</sup></b>	Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>	
<b>Al</b>	<b>0.048</b>	0.001		<b>Nb</b>	<b>0.0033</b>	0.0003
<b>B</b>	<b>0.0055</b>	0.0002		<b>Ni</b>	<b>0.099</b>	0.001
<b>C</b>	<b>3.21</b>	0.05		<b>P</b>	<b>0.0192</b>	0.0005
<b>Ca</b>	<b>0.0010</b>	0.0001		<b>Pb</b>	<b>0.0004</b>	0.0001
<b>Cr</b>	<b>0.015</b>	0.002		<b>S</b>	<b>0.0118</b>	0.0008
<b>Cu</b>	<b>0.232</b>	0.009		<b>Si</b>	<b>2.07</b>	0.02
<b>Fe</b>	<b>93.6</b>	0.2		<b>Sn</b>	<b>0.0482</b>	0.0009
<b>Mg</b>	<b>0.045</b>	0.001		<b>Ti</b>	<b>0.0158</b>	0.0004
<b>Mn</b>	<b>0.479</b>	0.005		<b>V</b>	<b>0.0082</b>	0.0003
<b>Mo</b>	<b>0.0075</b>	0.0003		<b>Zr</b>	<b>0.0024</b>	0.0002

### Informational Values<sup>3,4</sup>

As (0.0005)

Co (0.0032)

Sb (0.01)

W (0.0030)

For each element, the certified value listed is the present best estimate of the true value based on the mean of the weighted results of an interlaboratory testing program. See page 4-5 for more information on its calculation.

<sup>2</sup> For each element, the uncertainty listed is based on a statistical evaluation of the contributions of homogeneity and the interlaboratory testing program. See page 4-5 for more information on its calculation.

<sup>3</sup> Values are given in weight percent. Values in brackets are reported by difference.

<sup>4</sup> Values in parentheses are not certified and are provided for information only.

The requirements of ISO Guides 30, 31, and 35 were followed for the preparation of this Certified Reference Material and certificate of analysis.

Analysis	*	Al	*	B	*	C	*	Ca	*	Cr	*	Cu	*	Fe	*	Mg	*	Mn	*	Mo
1	3	0.0456667	3	0.00531	3	3.1	3	0.00073	3	0.0097	14	0.20967	10	93.25	3	0.04459	4	0.4673333	3	0.0069
2	10	0.046	14	0.0053333	3	3.12	3	0.00074	3	0.0105	10	0.21667	4	93.4	3	0.04461	3	0.472	3	0.0069
3	14	0.0467	3	0.00534	3	3.14	3	0.00074	3	0.0124	4	0.225	14	93.433333	3	0.04471	3	0.4733333	3	0.0069
4	3	0.0474	3	0.00534	3	3.14	3	0.00079	3	0.0125	3	0.228	4	93.443233	3	0.04475	3	0.474	3	0.007
5	3	0.0475	3	0.00534	3	3.16	3	0.00083	10	0.013	3	0.22833	4	93.58	3	0.04483	4	0.4742333	3	0.007
6	3	0.0477	3	0.00534	3	3.16	4	0.0008333	3	0.0131	3	0.229	3	93.6	3	0.04491	3	0.475	3	0.0071
7	3	0.0477	4	0.0053667	3	3.16	3	0.00085	3	0.0132	3	0.229	16	[93.64]	3	0.04499	3	0.475	4	0.0071333
8	3	0.0478	3	0.00539	3	3.16	3	0.00087	3	0.0134	4	0.2296	16	[93.65]	3	0.045	3	0.475	3	0.0072
9	3	0.0478	3	0.0054	3	3.16	3	0.00088	3	0.0136	10	0.23	16	[93.66]	3	0.04501	3	0.477	3	0.0072
10	3	0.0478	3	0.0054	3	3.17	3	0.00088	3	0.014	3	0.23	16	[93.68]	3	0.04505	3	0.478	3	0.0072
11	3	0.0478	3	0.00541	3	3.17	3	0.00089	3	0.0142	3	0.231	16	[93.75]	3	0.04505	3	0.478	3	0.0073
12	4	0.0479	3	0.00541	3	3.18	14	0.0009	4	0.014367	3	0.231	10	93.883333	3	0.04506	3	0.478	3	0.0073
13	3	0.0479	3	0.00541	3	3.19	3	0.00092	3	0.0144	3	0.232			3	0.04506	3	0.478	3	0.0073
14	3	0.0479	3	0.00541	3	3.19	3	0.00094	3	0.0144	3	0.232			3	0.04506	3	0.478	3	0.0073
15	3	0.048	3	0.00541	3	3.19	3	0.00095	3	0.0147	3	0.233			3	0.04508	3	0.479	3	0.0073
16	3	0.0481	3	0.00543	3	3.19	3	0.00095	3	0.0147	3	0.233			3	0.0451	3	0.479	3	0.0073
17	3	0.0481	3	0.00545	3	3.19	3	0.00096	3	0.0148	3	0.233			3	0.04511	3	0.479	3	0.0073
18	3	0.0481	3	0.00545	3	3.19	3	0.00096	3	0.0149	3	0.233			3	0.04513	3	0.48	3	0.0074
19	3	0.0482	3	0.00546	3	3.2	3	0.00096	4	0.015067	3	0.233			3	0.04515	3	0.48	3	0.0074
20	3	0.0483	3	0.0054667	3	3.2	3	0.00096	14	0.0151	3	0.233			3	0.04518	3	0.48	3	0.0074
21	3	0.0484	3	0.00547	3	3.2	3	0.00097	3	0.0152	3	0.233			3	0.04523	10	0.48	3	0.0074
22	3	0.0484	3	0.00547	3	3.2	3	0.00097	4	0.015233	3	0.234			3	0.04524	3	0.481	3	0.0075
23	3	0.0484	3	0.00548	3	3.21	3	0.00097	3	0.0153	3	0.234			3	0.04526	3	0.481	3	0.0075
24	5	0.048433	3	0.00549	3	3.23	3	0.001	3	0.0153	3	0.234			3	0.04527	3	0.481	3	0.0075
25	3	0.0485	3	0.0055	3	3.23	3	0.001	3	0.015333	3	0.234			3	0.04527	3	0.481	3	0.0075
26	3	0.0485	3	0.00552	3	3.23	3	0.001	3	0.0154	3	0.234			3	0.0453	3	0.481	3	0.0075
27	3	0.0485	3	0.00552	3	3.23	3	0.00104	3	0.0155	3	0.234			3	0.04537	14	0.481667	3	0.0075
28	3	0.0486	3	0.00552	3	3.23	3	0.00105	3	0.0156	3	0.234			3	0.04537	3	0.482	3	0.0075
29	3	0.0487	3	0.00552	3	3.23	3	0.00107	3	0.0157	3	0.234			3	0.04539	3	0.482	3	0.0076
30	3	0.0487	3	0.00553	3	3.24	3	0.00107	3	0.0157	3	0.234			3	0.04542	3	0.482	3	0.0076
31	3	0.0488	3	0.00553	3	3.25	3	0.00108	3	0.0158	3	0.235			3	0.04543	3	0.482	3	0.0076
32	3	0.0488	3	0.00553	3	3.25	3	0.00108	3	0.0159	3	0.236			3	0.04544	3	0.482	3	0.0076
33	3	0.0488	3	0.00555	3	3.25	3	0.00109	3	0.0159	3	0.237			3	0.04546	3	0.482	3	0.0077
34	3	0.0488	3	0.00555	3	3.26	3	0.0011	3	0.0159	3	0.237			3	0.04547	3	0.482	3	0.0077
35	3	0.0488	3	0.00555	3	3.26	4	0.0011	3	0.0159	3	0.238			3	0.04551	3	0.483	3	0.0077
36	3	0.0489	3	0.00557	3	3.27	3	0.00112	5	0.0162	3	0.238					3	0.483	3	0.0077
37	3	0.0489	3	0.00557	3	3.28	3	0.00116	3	0.0163	3	0.238					3	0.484	5	0.007733
38	3	0.0489	3	0.00558	3	3.28	4	0.0012	3	0.0167	3	0.239					3	0.484	3	0.0078
39	3	0.049	3	0.00559	3	3.28	3	0.00128	3	0.0168	4	0.23917					3	0.484	3	0.0078
40	3	0.0491	3	0.0056	1	3.326667	3	0.00134	3	0.0169	3	0.24					3	0.484	3	0.0078
41	3	0.0491	3	0.0056	3	3.34	3	0.00135	3	0.0169	3	0.24					3	0.485	3	0.0078
42	3	0.0492	3	0.00566			3	0.00139	3	0.017	3	0.24					3	0.485	3	0.0079
43	3	0.0492	3	0.00568			3	0.0019	3	0.0175	3	0.241					3	0.485	3	0.008333
44	3	0.0494	4	0.0058					3	0.0182	3	0.241					3	0.488	14	0.008367
45	3	0.0496	4	0.005967					3	0.0184	3	0.242					3	0.488	4	0.0088
46			5	0.006267					3	0.0191	3	0.243					3	0.491	10	0.009
47									3	0.0213	3	0.251					10	0.491667		
48											4	0.2667					4	0.499667		
Average		0.04835		0.00552		3.206		0.001000		0.01509		0.2320		93.601		0.04514		0.4794		0.00745
Std Dev		0.00074		0.00012		0.051		0.000060		0.00025		0.0032		0.031		0.00076		0.0055		0.00016
H		0.0020		0.00075		0.022		0.00039		0.0011		0.0045		0.24		0.0019		0.007		0.00085
U <sub>1</sub>		0.0021		0.00076		0.055		0.00040		0.0012		0.0055		0.24		0.0021		0.0087		0.00086
t-statistic		2.02		2.01		2.02		2.02		2.01		2.01		2.20		2.03		2.01		2.01
U <sub>2</sub>		0.0043		0.0015		0.11		0.00080		0.0024		0.011		0.52		0.0042		0.017		0.0017
U <sub>3</sub>		0.00064		0.00022		0.017		0.00012		0.00035		0.0016		0.15		0.00071		0.0025		0.00026
Certified		<b>0.048</b>		<b>0.0055</b>		<b>3.21</b>		<b>0.0010</b>		<b>0.015</b>		<b>0.232</b>		<b>93.6</b>		<b>0.045</b>		<b>0.479</b>		<b>0.0075</b>
Uncertainty		0.001		0.0002		0.05		0.0001		0.002		0.009		0.2		0.001		0.005		0.0003
Tolerance		0.004		0.0008		0.15		0.0003		0.006		0.027		0.5		0.003		0.015		0.0009

Analysis	*	Nb	*	Ni	*	P	*	Pb	*	S	*	Si	*	Sn	*	Ti	*	V	*	Zr
1	10	0.001	3	0.0951	4	0.0176333	5	0.0001	3	0.0101	3	2.04333	5	0.0398667	3	0.0153	14	0.0077333	10	0.001
2	4	0.0026667	3	0.0952	3	0.0176667	3	0.0001	3	0.0102	4	2.04967	3	0.044	3	0.0154	4	0.0077333	5	0.0010467
3	3	0.0027	4	0.0959667	4	0.0184667	5	0.0001233	3	0.0104	3	2.05	4	0.0462333	3	0.0155	3	0.008	4	0.0018
4	3	0.0029	3	0.0967	10	0.0185	4	0.0001333	3	0.0105	3	2.05	3	0.0464333	3	0.0155	3	0.0081	3	0.0021
5	3	0.0029	10	0.097	3	0.0186	3	0.0002	3	0.0106	3	2.06	3	0.0475	3	0.0155	3	0.0081	3	0.0021
6	3	0.003	3	0.0971	5	0.0186667	3	0.0002	3	0.0106	3	2.06	3	0.0475	3	0.0155	3	0.0081	3	0.0022
7	3	0.003	3	0.0972	3	0.0188	3	0.0002	3	0.0106	3	2.06	3	0.0476	3	0.0155	3	0.0081	3	0.0022
8	3	0.003	3	0.0973	3	0.0188	5	0.0002	3	0.011	3	2.06	9	0.0479	3	0.0156	3	0.0082	3	0.0023
9	3	0.003	3	0.0975	3	0.0188	3	0.0002	3	0.011	3	2.06	3	0.0479	3	0.0156	3	0.0082	3	0.0023
10	3	0.003	3	0.0976	14	0.0188333	9	0.0002	3	0.011	3	2.06	3	0.0479	3	0.0156	3	0.0082	3	0.0023
11	3	0.003	3	0.0978	3	0.0189	3	0.0003	3	0.0112	3	2.06	3	0.0479	3	0.0156	3	0.0082	3	0.0023
12	3	0.003	4	0.0978333	3	0.0189	3	0.0003	3	0.0114	3	2.06333	3	0.0479	3	0.0156	3	0.0082	3	0.0023
13	3	0.003	3	0.0979	3	0.0189	3	0.0003	3	0.0114	3	2.07	3	0.0479	3	0.0156	3	0.0082	3	0.0023
14	3	0.0031	3	0.098	3	0.0189	3	0.0003	3	0.0114	3	2.07	3	0.048	3	0.0157	3	0.0082	3	0.0023
15	3	0.0031	3	0.098	3	0.0189	3	0.0003	3	0.0114	3	2.07	3	0.048	3	0.0157	3	0.0082	3	0.0023
16	3	0.0031	3	0.098	3	0.019	3	0.0003	3	0.0115	14	2.07	3	0.0481	3	0.0157	3	0.0082	3	0.0023
17	3	0.0031	3	0.0981	3	0.019	3	0.0003	1	0.011667	3	2.07	3	0.0481	3	0.0157	3	0.0082	3	0.0023
18	3	0.0032	3	0.0981	3	0.0191	3	0.0004	3	0.0117	3	2.07	3	0.0482	3	0.0157	3	0.0082	3	0.0024
19	3	0.0032	3	0.0981	3	0.0191	3	0.0004	3	0.0118	3	2.07	3	0.0482	3	0.0158	3	0.0082	3	0.0024
20	3	0.0032	3	0.0982	3	0.0191	3	0.0004	3	0.0118	3	2.07	3	0.0482	3	0.0158	3	0.0082	3	0.0024
21	3	0.0032	3	0.0983	3	0.0191	3	0.0004	3	0.0118	3	2.07	3	0.0482	4	0.0158	3	0.0082	3	0.0024
22	3	0.0033	3	0.0983	3	0.0192	3	0.0004	3	0.0119	3	2.07	3	0.0483	3	0.0158	3	0.0082	3	0.0024
23	3	0.0033	3	0.0983	3	0.0193	3	0.0004	3	0.0119	3	2.07	3	0.0483	3	0.0158	3	0.0083	3	0.0024
24	3	0.0033	4	0.098333	3	0.0193	3	0.0004	3	0.0119	17	2.07027	3	0.0483	3	0.0158	3	0.0083	3	0.0024
25	3	0.0034	3	0.0984	3	0.0194	3	0.0004	3	0.0119	3	2.08	3	0.0483	3	0.0158	3	0.0083	3	0.0024
26	3	0.0034	3	0.0984	3	0.0194	3	0.0004	3	0.012	3	2.08	3	0.0483	3	0.0158	3	0.0083	3	0.0024
27	3	0.0034	3	0.0985	3	0.0194	3	0.0004	3	0.0121	3	2.08	3	0.0484	3	0.0158	3	0.0083	3	0.0024
28	3	0.0035	3	0.0985	3	0.0194	3	0.0005	3	0.0122	3	2.08	3	0.0484	3	0.0158	3	0.0083	3	0.0024
29	3	0.0035	3	0.0986	3	0.0194	3	0.0005	3	0.0122	3	2.08	3	0.0485	3	0.0158	3	0.0083	3	0.0024
30	3	0.0035	3	0.0987	3	0.0194	3	0.0005	3	0.0123	3	2.08	3	0.0485	3	0.0158	3	0.0083	3	0.0025
31	3	0.0036	3	0.0987	3	0.0195	3	0.0005	3	0.0123	3	2.08	3	0.0485	3	0.0158	3	0.0083	3	0.0025
32	3	0.0036	3	0.0987	3	0.0195	3	0.0005	3	0.012333	3	2.08	3	0.0487	3	0.0158	3	0.0083	3	0.0025
33	3	0.0036	3	0.0989	3	0.0195	3	0.0005	3	0.0125	3	2.08	3	0.0487	3	0.0158	3	0.0083	3	0.0025
34	3	0.0036	3	0.0989	3	0.0196	3	0.0005	3	0.0126	3	2.08	3	0.0487	3	0.0158	3	0.0083	3	0.0025
35	3	0.0037	14	0.098967	3	0.0196	3	0.0005	1	0.012767	3	2.08	3	0.0487	14	0.015833	3	0.0083	3	0.0025
36	3	0.0037	3	0.099	3	0.0196	3	0.0005	3	0.0128	3	2.08	3	0.0488	3	0.0159	3	0.0084	3	0.0026
37	3	0.0037	3	0.099	3	0.0197	3	0.0005	10	0.013	3	2.08	3	0.0488	3	0.0159	3	0.0084	3	0.0026
38	3	0.0038	3	0.0991	3	0.0197	10	0.0006	3	0.0132	3	2.08	3	0.0489	10	0.016	3	0.0084	3	0.0026
39	3	0.0039	3	0.0996	3	0.0198	3	0.0006	3	0.0138	3	2.08	10	0.049	3	0.016	3	0.0084	3	0.0026
40	3	0.0039	3	0.0998	3	0.0198	3	0.0006	3	0.0139	3	2.09	3	0.049	3	0.016	3	0.0084	3	0.0027
41	3	0.0043	3	0.1003	3	0.0198	3	0.0007	3	0.014	3	2.09	3	0.049	3	0.016	3	0.0084	3	0.0027
42	3	0.0045	3	0.104	4	0.0198	3	0.0007	3	0.0143	3	2.09	3	0.049	3	0.016	3	0.0085	3	0.0028
43			3	0.1008	3	0.0199	3	0.0007	1	0.014733	3	2.09	3	0.0491	3	0.016	4	0.0085	3	0.0028
44			3	0.1011	3	0.0199	3	0.0008	3	0.0149	3	2.09	3	0.0491	4	0.0161	3	0.008533		
45			3	0.1016	10	0.020	3	0.0008			4	2.10	3	0.0491	4	0.0161	5	0.008567		
46			3	0.1017	3	0.0201					3	2.11	3	0.0492	3	0.016233	5	0.0087		
47			3	0.103333	3	0.0201							4	0.0503	3	0.0163	10	0.0090		
48					3	0.0204							4	0.050467			10	0.009		
49													10	0.052433			3	0.0091		
Average		0.00327		0.0987		0.01933		0.000406		0.01185		2.068		0.04820		0.01577		0.00825		0.00242
Std Dev		0.00013		0.0015		0.00031		0.000047		0.00020		0.015		0.00073		0.00025		0.00018		0.00011
H		0.000605		0.0028		0.001284		0.00029		0.0010		0.016		0.0020		0.001171		0.00088		0.00054
U <sub>1</sub>		0.00062		0.0032		0.0013		0.00029		0.0011		0.022		0.0021		0.0012		0.00090		0.00055
t-statistic		2.02		2.01		2.01		2.02		2.02		2.01		2.01		2.01		2.01		2.02
U <sub>2</sub>		0.0012		0.0064		0.0027		0.00059		0.0021		0.045		0.0042		0.0024		0.0018		0.0011
U <sub>3</sub>		0.00019		0.00094		0.00038		0.000088		0.00032		0.0066		0.00061		0.00035		0.00026		0.00017
Certified		<b>0.0033</b>		<b>0.099</b>		<b>0.0192</b>		<b>0.0004</b>		<b>0.0118</b>		<b>2.07</b>		<b>0.0482</b>		<b>0.0158</b>		<b>0.0082</b>		<b>0.0024</b>
Uncertainty		0.0003		0.001		0.0005		0.0001		0.0008		0.02		0.0009		0.0004		0.0003		0.0002
Tolerance		0.0009		0.003		0.0015		0.0003		0.0024		0.06		0.0027		0.0012		0.0009		0.0006

Analysis	*	As	*	Co	*	Sb	*	W
1	3	0.0001	3	0.0011	10	0.0120	3	0.0004
2	3	0.0001	3	0.0016			5	0.0005667
3	3	0.0001	3	0.0017			5	0.0010333
4	3	0.0001	3	0.0018			3	0.0014
5	3	0.0002	3	0.002			3	0.0015
6	3	0.0002	3	0.0023			3	0.0019
7	3	0.0002	3	0.0024			4	0.0019333
8	3	0.0002	3	0.0025			3	0.002
9	3	0.0002	3	0.0025			3	0.0022
10	3	0.0002	3	0.0026			3	0.0024
11	3	0.0002	3	0.0027			4	0.0024333
12	3	0.0003	3	0.0028			10	0.0025
13	3	0.0003	3	0.0028			3	0.0026
14	3	0.0003	3	0.0029			3	0.0026
15	3	0.0003	14	0.0029667			3	0.0027
16	3	0.0003	3	0.0029667			3	0.0027
17	3	0.0003	3	0.003			3	0.0027
18	3	0.0003	4	0.003			3	0.0028
19	3	0.0003	3	0.0031			3	0.0029
20	3	0.0003	3	0.0031			3	0.0029
21	3	0.0003	3	0.0032			3	0.003
22	3	0.0004	3	0.0032			3	0.0031
23	3	0.0004	10	0.0033			3	0.0032
24	3	0.0004	3	0.0033			3	0.0033
25	3	0.0004	3	0.0033			3	0.0033
26	3	0.0004	3	0.0033			3	0.0034
27	3	0.0004	3	0.0034			3	0.0034
28	3	0.0004	3	0.0034			3	0.0034
29	3	0.0004	3	0.0034			3	0.0034
30	3	0.0004	5	0.003667			3	0.0034
31	3	0.0004	3	0.0037			3	0.0035
32	3	0.0004	3	0.0038			3	0.0036
33	3	0.0004	3	0.004			3	0.0038
34	3	0.0004	3	0.0041			3	0.0038
35	3	0.0005	4	0.004133			3	0.0038
36	3	0.0005	3	0.0042			3	0.0039
37	3	0.0005	5	0.004233			3	0.0039
38	3	0.0006	3	0.0043			3	0.004
39	3	0.0006	3	0.0043			3	0.004
40	5	0.000747	3	0.0046			3	0.0041
41	5	0.001833	3	0.0048			3	0.0042
42	5	0.0021	3	0.0049			3	0.0043
43	9	0.0024					3	0.0045
44	10	0.0028					3	0.0046
45							3	0.0057
Average		0.00051		0.0032		0.01		0.0030
Std Dev		0.00031		0.0077		0.28		0.0069
H		0.00031		0.0006		0.0009		0.0006
U <sub>1</sub>		0.00044		0.0077		0.28		0.0069
t-statistic		2.02		2.02		12.71		2.02
U <sub>2</sub>		0.00089		0.016		3.53		0.014
U <sub>3</sub>		0.00013		0.0024		3.53		0.0021
Certified		(0.0005)		(0.0032)		(0.01)		(0.0030)

For each element, in accordance with the requirements of ISO Guides 34 and 35, an effort must be made to account for the effects on the certified value of the uncertainty estimate from homogeneity testing (H) and the uncertainties of the contributing laboratories. The average (A) is calculated using a weighted mean where the reciprocal of the square of each laboratory's combined uncertainty (C<sub>L</sub>), calculated from its standard deviation (S<sub>L</sub>) and its uncertainty estimate (U<sub>L</sub>), is used as the weight (W<sub>L</sub>) for its mean (M<sub>L</sub>). The standard deviation (S) is calculated as the square root of the reciprocal of the sum of the weights. U<sub>1</sub> is the combined uncertainty from homogeneity and labs. U<sub>2</sub> is U<sub>1</sub> multiplied by the coverage factor (95 % t-statistic). U<sub>3</sub> is U<sub>2</sub> divided by the square root of the number of determinations (n). Thus:

$$C_L = \sqrt{S_L^2 + U_L^2} \quad W_L = \frac{1}{C_L^2} \quad A = \frac{\sum_{i=1}^n W_L M_L}{\sum_{i=1}^n W_L} \quad S = \frac{1}{\sqrt{\sum_{i=1}^n W_L}} \quad U_1 = \sqrt{H^2 + S^2} \quad U_2 = t \times U_1 \quad U_3 = \frac{U_2}{\sqrt{n}}$$

All but the final reported values are taken to two significant figures as determined by each quantity's uncertainty estimate. The final reported Uncertainty is  $U_3$  rounded to one significant figure and represents the half width of the 95 % confidence interval for the **Certified** value. The final reported **Certified** value is  $A$  rounded to the same decimal place as the Uncertainty. The Uncertainty is a measure of the quality of the **Certified** value.

The Tolerance is a measure of the expected performance of an analysis. This involves further expanding the sample uncertainty to include instrument and operator uncertainty, for those without access to such calculations.

For further information regarding the confidence interval for the certified value see ISO Guide 35:2006 section 6.

#### **Analytical Method Codes:**

1 Combustion (ASTM E1019)	7 Photometric	13 Titrimetric
2 Fusion (ASTM E1019)	8 Flame Atomic Absorption	14 DCP Atomic Emission
3 Spark Atomic Emission	9 GF Atomic Absorption	15 HG Atomic Fluorescence
4 ICP Atomic Emission	10 X-Ray Fluorescence	16 Difference
5 ICP Mass Spectrometry	11 GD Atomic Emission	17 Wet
6 Gravimetric	12 GD Mass Spectrometry	

ICP = Inductively Coupled Plasma      GF = Graphite Furnace      GD = Glow Discharge  
DCP = Direct Current Plasma      HG = Hydride Generation

Lab Name	Location	Registrar	Accreditation
NSL Analytical	Cleveland, OH	ANAB	17025
Exova	Santa Fe Spring, CA	A2LA	17025
Laboratory Testing, Inc.	Hatfield, PA	PRI	17025
Dirats Laboratories	Westfield, MA	ANAB	17025
Luvak Inc.	Boylston, MA	PRI	17025
Instytut Metalurgii Zelaza	Gliwice, Poland	PCA	17025
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, 17034

A2LA = American Association for Laboratory Accreditation

ANAB = ANSI-ASQ National Accreditation Board

PCA = Polish Center For Accreditation

PRI = Performance Review Institute

**Analysis:** Chemical analyses were made on solid pieces and chips from representative samples for the certified portion of the lot in accordance with ASTM Standard Practice E1806. The laboratories participating in the testing followed the requirements of ISO Standard 17025.

**Traceability:** The following Certified Reference Materials were used to validate the analytical data: 11XC1N, 11XC4Q, 11XC6U, 11XSG1A; AR 306, 323, 673; BAS 464/1; BS CI4, LF2B, 8, 29, 291, 291BB, 291DJ, 1026; CKD 234, 238, 239; CZ 20034 14A; LECO 501-024; SPL 2a, 3a, 8a, 15a; SRM 7G, 9F, 16F, 33D, 160B, 342A, 361, 362, 363, 365, 1140, 3109A, 3113, 8620C.

**Homogeneity:** This Certified Reference Material (CRM) was tested for homogeneity using ASTM Standard Method E826 and found acceptable. It was also examined by spark atomic emission spectrometry and found to be compatible with the following Reference Materials — BS CI4, 8, 29, 291, 291BB, 291DJ; CZ 20034 14A; SRM 1140.

**Validity statement:** ISO Guide 31 states that the certification should contain an expiration date for all materials where instability has been demonstrated or is considered possible, after which the certified value is no longer guaranteed by the certifying body. The certification of BS 291EG is valid indefinitely. The certification is nullified if this CRM is damaged, contaminated, or otherwise modified.

**Storage:** This CRM must be stored in a cool, dry, non-corrosive environment.

**Source:** The cast stock for this CRM was produced by Shijiazhuang Trump Scientific Co, LTD.; Shijiazhuang, China.

**Form:** This CRM is machined in the form of a disc, approximately 35 mm in diameter and ~ 30 mm thick by Brammer Standard Company, Inc.

**Use:** This CRM is intended for use in spark atomic emission, glow discharge, and x-ray spectrometric methods of analysis. Refer to ISO Guide 33 for information about the use of Certified Reference Materials.

**Certified Area:** The certified area of each disc is the portion extending upward 25 mm from the analytical surface.

**Sample Preparation:** For best analytical results, use the same method for preparing the analytical surface on all reference materials as used for production specimens. Avoid overheating the sample during surface preparation.

**Certificate Number:** The unique identification number for this certificate of analysis is 291EG-030618. You may obtain information on revisions of certificates from the internet at [www.brammerstandard.com](http://www.brammerstandard.com).

**Safety Notice:** A Safety Data Sheet (SDS) 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** Web: [www.brammerstandard.com](http://www.brammerstandard.com)

**Fax: (281) 440-4432** Email: [contact@brammerstandard.com](mailto:contact@brammerstandard.com)

**Brammer Standard Company, Inc., is accredited by the American Association For Laboratory Accreditation (A2LA) to ISO Standard 17034 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials (Certificate Number 656.02)**

**Brammer Standard Company's Chemical Laboratory is accredited by A2LA to ISO Standard 17025. (Certificate Number 656.01)**

**By Certificate Number 10539, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9001 by National Quality Assurance (NQA), U.S.A.**

**The scopes of accreditation are listed on the website: [www.brammerstandard.com](http://www.brammerstandard.com)**



## **References:**

Versions used were those available at the time of testing and characterization

- E826 Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry
- E1019 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques
- E1806 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

ISO Standard 17025:2005 General requirements for the competence of testing and calibration laboratories

ISO Standard 9001:2015 Quality Management Systems - Requirements

ISO Guide 30:2015 Terms and definitions used in connection with reference materials + 2008 amendment

ISO Guide 31:2015 Reference materials - Contents of certificates and labels

ISO Guide 33:2015 Uses of certified reference materials

ISO Standard 17034:2016 General requirements for the competence of reference material producers

ISO Guide 35:2006 Reference Materials - General and statistical principles for certification

*ASTM documents available from ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428.*

*ISO Guides and Standards available from Global Engineering - [www.global.ihs.com](http://www.global.ihs.com)*

*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

Certified by: \_\_\_\_\_ on March 6, 2018.

Beau R. Brammer  
President