Brammer Standard Company, Inc.

Certificate of Analysis

BS CA304-4

Certified Reference Material for Stainless Steel Calcium Treated

Certified Values[3]

	Certified Value[1]	Estimate of Uncertainty[2]		Certified Value[1]	Estimate of Uncertainty[2]
Al	**0.017**	0.001	**Nb**	**0.063**	0.002
As	**0.0063**	0.0003	**Ni**	**8.77**	0.04
B	**0.0031**	0.0002	**O**	**0.013**	0.001
C	**0.096**	0.002	**P**	**0.0205**	0.0006
Ca	**0.0075**	0.0005	**Pb**	**0.0008**	0.0001
Cr	**18.26**	0.03	**S**	**0.0070**	0.0009
Cu	**0.143**	0.004	**Si**	**0.887**	0.007
Fe	**70.7**	0.2	**Sn**	**0.0024**	0.0003
Mg	**0.00024**	0.00009	**Ti**	**0.0046**	0.0002
Mn	**0.783**	0.009	**V**	**0.0686**	0.0008
Mo	**0.0041**	0.0007	**W**	**0.0056**	0.0006
N	**0.061**	0.003	**Zr**	**0.0036**	0.0002

Informational Values[3,4]

Co (0.007) Sb (0.0002) Ta (0.002)

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 6 for more information on its calculation.

[2] For each element, the uncertainty listed is based on a statistical evaluation of the contributions of homogeneity and the interlaboratory testing program. See page 6 for more information on its calculation.

[3] Values are given in weight percent. Values in brackets are reported by difference.

[4] Values in parentheses are not certified and are provided for information only.

Trace element information values for Bi, Ce, Ga, Ge, Hf, La, Na, Nd, Os, Pr, Pt, Re, Sc, Se, Te, Th, U, and Zn are shown on page 6.

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

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BS CA304-4 * Code for method Certified values listed as weight percent

Analysis	*	Al	*	As	*	B	*	C	*	Ca	*	Cr	*	Cu	*	Fe	*	Mg	*	Mn
1	12	0.009467	9	0.0054333	12	0.0025	1	0.09183	12	0.005533	4	18.16333	12	0.1000	16	70.56	5	0.0002	3	0.768
2	4	0.011133	3	0.0056	11	0.0027	3	0.0932	3	0.006523	10	18.20	18	0.105667	16	70.68	3	0.00022	3	0.769
3	10	0.01415	3	0.0058	3	0.00303	3	0.0933	4	0.00677	4	18.226	3	0.139	14	70.7	5	0.0002233	3	0.77
4	4	0.014767	3	0.0058	3	0.00305	3	0.0936	11	0.0068	3	18.23	3	0.14	16	70.72203	3	0.00023	3	0.772
5	3	0.0161	3	0.006	3	0.00306	3	0.0938	3	0.006943	3	18.23	3	0.141	13	70.79	3	0.00023	3	0.773
6	11	0.0163	3	0.006	3	0.00307	3	0.094	3	0.006945	3	18.24	14	0.143	16	70.82	3	0.00023	4	0.7739
7	3	0.0166	3	0.006	3	0.00307	1	0.094	3	0.006975	18	18.242	3	0.143	4	71.07	3	0.00023	3	0.774
8	3	0.0166	3	0.0061	3	0.00307	3	0.094	3	0.00707	3	18.25	3	0.143			3	0.00024	3	0.774
9	3	0.0166	3	0.0061	3	0.00308	3	0.0941	3	0.007073	3	18.25	4	0.143667			3	0.00024	3	0.774
10	3	0.0167	3	0.0061	3	0.00309	3	0.0943	3	0.007075	3	18.25	3	0.144			3	0.00024	3	0.774
11	3	0.0167	3	0.0062	3	0.0031	1	0.09433	3	0.007213	3	18.26	3	0.144			3	0.00024	3	0.775
12	3	0.0168	3	0.0062	3	0.00312	1	0.09433	3	0.007223	3	18.26	3	0.144			3	0.00024	3	0.775
13	3	0.0169	4	0.0062333	3	0.00312	3	0.0944	3	0.007375	3	18.26	3	0.144			3	0.00024	3	0.775
14	3	0.017	3	0.0063	3	0.00313	3	0.09443	3	0.007463	3	18.26	3	0.144			3	0.00024	3	0.775
15	3	0.017	3	0.0063	3	0.00313	3	0.0945	3	0.007493	3	18.26	3	0.144			3	0.00024	3	0.776
16	3	0.017	3	0.0063	3	0.00313	3	0.0946	3	0.0075	3	18.26	4	0.144567			3	0.00024	3	0.776
17	3	0.017233	3	0.0064	14	0.003133	3	0.0947	3	0.007545	3	18.26	4	0.144933			3	0.00024	3	0.776
18	3	0.0173	3	0.0064	3	0.00315	3	0.0952	3	0.007578	3	18.26	3	0.145			3	0.00024	3	0.776
19	3	0.0173	3	0.0065	3	0.00316	3	0.0952	3	0.007598	3	18.26	3	0.145			4	0.0002467	3	0.776
20	3	0.0174	3	0.0065	3	0.00316	3	0.0952	3	0.007698	3	18.27	3	0.145			3	0.00025	3	0.777
21	3	0.0174	3	0.0065	3	0.00318	3	0.0954	3	0.007728	3	18.27	3	0.145			3	0.00025	3	0.777
22	3	0.0175	3	0.0065	3	0.00318	1	0.09577	3	0.007738	3	18.27	3	0.145			3	0.00025	3	0.777
23	3	0.0176	3	0.0065	3	0.00318	3	0.0958	3	0.007743	3	18.27	3	0.145			3	0.00025	3	0.778
24	3	0.0176	3	0.0065	3	0.00319	3	0.0961	3	0.007758	3	18.27	3	0.145			3	0.00025	3	0.778
25	3	0.0176	4	0.0065	3	0.00319	3	0.0961	14	0.007767	13	18.27467	10	0.145167			3	0.00025	3	0.779
26	14	0.017633	3	0.0066	3	0.00319	3	0.0962	3	0.007795	3	18.28	10	0.146			3	0.00025	3	0.779
27	3	0.0177	3	0.0066	3	0.0032	3	0.0965	3	0.007873	3	18.28	3	0.146			3	0.00025	3	0.779
28	3	0.0178	3	0.0066	3	0.00322	3	0.0965	3	0.008008	3	18.28	3	0.146			3	0.00025	3	0.779
29	4	0.017867	3	0.0067	3	0.00322	3	0.0968	3	0.008028	3	18.28	3	0.146			3	0.00025	3	0.781
30	3	0.0179	3	0.0067	3	0.00323	3	0.0969	3	0.008063	17	18.2802	3	0.146			3	0.00025	3	0.781
31	3	0.018	3	0.0067	4	0.003233	3	0.097	4	0.008167	4	18.29	3	0.147			3	0.00026	3	0.782
32	3	0.0181	3	0.0067	3	0.00325	3	0.0972	3	0.008178	3	18.29	3	0.147			3	0.00026	3	0.785
33	3	0.0181	3	0.0068	3	0.00325	11	0.0975	3	0.00826	3	18.29	3	0.147			3	0.00026	3	0.786
34	3	0.0182	3	0.0068	3	0.00327	3	0.0975	3	0.008325	3	18.29	3	0.147			3	0.00026	14	0.791333
35	3	0.0184	10	0.007	3	0.00328	3	0.0975	3	0.008478	14	18.3	3	0.147			3	0.00027	10	0.800
36	3	0.0184	3	0.0073	3	0.0033	3	0.0977	3	0.008575	3	18.31	3	0.147					4	0.800367
37	3	0.0184			7	0.003457	3	0.0984	3	0.008985	3	18.31	3	0.148					10	0.805233
38	3	0.0187			3	0.0036	1	0.1000			3	18.31	3	0.148					3	0.806333
39	3	0.0192			4	0.003967	3	0.1006			3	18.32	3	0.149					4	0.811667
40	3	0.0194					3	0.1008			3	18.32	3	0.15					8	0.813
41	5	0.0223					1	0.10233			3	18.33667	8	0.153667					4	0.817
42													11	0.154					4	0.81933
43													3	0.156						
Average		0.01738		0.00632		0.00307		0.0961		0.00750		18.26		0.1433		70.730		0.000239		0.782956
Std Dev		0.00030		0.00015		0.00011		0.0015		0.00018		0.081		0.0022		0.080		0.000011		0.000049
H		0.0012		0.00079		0.00059		0.0028		0.00085		0.07		0.0035		0.19		0.00025		0.0090
U_1		0.0013		0.00081		0.00060		0.0032		0.00087		0.11		0.0041		0.20		0.00025		0.0090
t-statistic		2.02		2.03		2.02		2.02		2.03		2.02		2.02		2.45		2.03		2.02
U_2		0.0026		0.0016		0.0012		0.0064		0.0018		0.22		0.0082		0.50		0.00050		0.018
U_3		0.00040		0.00027		0.00020		0.0010		0.00029		0.034		0.0013		0.19		0.000085		0.0058
Certified		**0.017**		**0.0063**		**0.0031**		**0.096**		**0.0075**		**18.26**		**0.143**		**70.7**		**0.00024**		**0.783**
Uncertainty		0.001		0.0003		0.0002		0.002		0.0005		0.03		0.004		0.2		0.00009		0.009
Tolerance		0.003		0.0016		0.0012		0.006		0.0015		0.22		0.012		0.5		0.00024		0.027

BS CA304-4 * Code for method Certified values listed as weight percent

Analysis	*	Mo	*	N	*	Nb	*	Ni	*	O	*	P	*	Pb	*	S	*	Si	*	Sn
1	3	0.0027	2	0.0598667	12	0.0560	4	8.69267	2	0.01178	12	0.015333	5	0.0006	12	0.0052	3	0.866	10	0.00055
2	3	0.0029	2	0.060	3	0.059	3	8.72667	2	0.012333	3	0.019333	3	0.0007	3	0.006	3	0.87	3	0.0019
3	3	0.003	2	0.0601367	3	0.0593	13	8.72867	2	0.01262	3	0.0195	3	0.0007	1	0.006067	3	0.873	3	0.0019
4	10	0.003	2	0.0604	4	0.0601	3	8.73	2	0.013	3	0.0196	3	0.0007	3	0.0061	3	0.874	3	0.0021
5	3	0.0032	2	0.0614333	3	0.0604	10	8.74	2	0.013133	3	0.0196	3	0.0007	3	0.0062	3	0.874	3	0.0021
6	3	0.0032	2	0.062	3	0.0607	3	8.75	2	0.013733	3	0.0199	3	0.0007	10	0.0063	3	0.877	3	0.0021
7	3	0.0033	2	0.0620233	3	0.061	3	8.75	2	0.0166	3	0.0199	3	0.0007	3	0.0063	3	0.879	3	0.0021
8	3	0.0034			3	0.061	3	8.76			18	0.02	3	0.0007	3	0.0063	3	0.88	3	0.0022
9	3	0.0035			3	0.061	11	8.76			10	0.02	3	0.0008	3	0.0064	3	0.88	3	0.0022
10	3	0.0035			3	0.0611	3	8.76			3	0.02	3	0.0008	3	0.0064	3	0.88	3	0.0023
11	3	0.0036			3	0.0612	4	8.76833			3	0.02	3	0.0008	3	0.0064	3	0.88	3	0.0023
12	3	0.0036			3	0.0614	3	8.77			3	0.02	3	0.0008	1	0.006467	3	0.88	9	0.002333
13	3	0.0036			3	0.0614	3	8.77			3	0.02	3	0.0008	2	0.0065	3	0.882	3	0.0024
14	3	0.0036			3	0.0615	3	8.77			3	0.0201	3	0.0008	3	0.0065	14	0.8826667	3	0.0024
15	3	0.0038			3	0.0616	3	8.78			3	0.0201	3	0.0008	3	0.0065	3	0.883	3	0.0024
16	3	0.0038			3	0.0616	3	8.78			3	0.0201	3	0.0008	3	0.0065	3	0.883	3	0.0024
17	3	0.0038			3	0.0617	3	8.78			3	0.0201	3	0.0009	3	0.0065	3	0.883	3	0.0024
18	3	0.0038			3	0.0617	4	8.782			3	0.0202	3	0.0009	1	0.006533	3	0.883	3	0.0025
19	3	0.0039			3	0.0618	14	8.78667			3	0.0202	3	0.0009	3	0.0066	3	0.883	3	0.0025
20	3	0.0039			3	0.0618	3	8.79			3	0.0203	3	0.0009	3	0.0066	3	0.884	3	0.0025
21	3	0.004			3	0.0618	3	8.79			10	0.0203	3	0.0009	3	0.0066	3	0.884	3	0.0025
22	3	0.004			3	0.0619	3	8.79			3	0.0204	3	0.0009	3	0.0066	17	0.8845	3	0.0025
23	3	0.004			3	0.0619	3	8.79			4	0.020467	3	0.0009	3	0.0067	3	0.885	3	0.0026
24	3	0.004			3	0.062	3	8.79			3	0.0205	3	0.0009	3	0.0068	3	0.885	3	0.0026
25	3	0.004			3	0.062	3	8.79			3	0.0205	3	0.0009	3	0.007	3	0.886	3	0.0026
26	3	0.004			4	0.062067	4	8.79443			3	0.0205	3	0.0009	3	0.007	3	0.888	3	0.0026
27	3	0.0041			3	0.0621	3	8.8			3	0.0205	3	0.0009	3	0.007	3	0.888	3	0.0026
28	3	0.0042			3	0.0621	3	8.8			14	0.020567	3	0.0009	3	0.007133	3	0.889	3	0.0027
29	3	0.0043			3	0.0623	3	8.8			3	0.0206	3	0.0009	3	0.0073	3	0.89	3	0.0027
30	4	0.0044			3	0.0625	3	8.81			3	0.0207	3	0.001	1	0.0075	3	0.891	3	0.0027
31	3	0.0046			3	0.0626	3	8.81			3	0.0207	3	0.001	3	0.0076	3	0.891	3	0.0027
32	3	0.0046			3	0.0628	3	8.81			3	0.0208	3	0.001	1	0.007683	11	0.894	3	0.0028
33	3	0.0046			3	0.0628	3	8.81			3	0.0208	3	0.001	3	0.0077	3	0.898	3	0.0028
34	3	0.0048			14	0.062867	3	8.81			3	0.021			3	0.0077	3	0.899	3	0.0029
35	14	0.0048			10	0.0632	4	8.81			3	0.0211			3	0.0077	4	0.901667	3	0.003
36	11	0.0055			3	0.0632	18	8.81967			3	0.0212			1	0.007767	10	0.9028		
37	12	0.005867			3	0.0635	3	8.82			3	0.0213			3	0.0078	4	0.903267		
38	5	0.006623			4	0.064867	3	8.82			4	0.021367			11	0.0079	3	0.905		
39	5	0.0070			5	0.069833	3	8.82			4	0.021433			3	0.0079	10	0.91		
40	4	0.0078			18	0.077	3	8.83			3	0.0218			3	0.008	4	0.913333		
41					11	0.0909	3	8.83			3	0.0222			3	0.0086	3	0.915		
42							10	8.83233			11	0.0225			3	0.0089				
43							3	8.84			5	0.029933			3	0.009				
44							3	8.88												
Average		0.00410		0.0609		0.0628		8.771		0.01305		0.02055		0.000803		0.00699		0.887323		0.00240
Std Dev		0.00014		0.0025		0.0010		0.015		0.00078		0.00036		0.000062		0.00016		0.000049		0.00010
H		0.00067		0.0022		0.0023		0.042		0.0011		0.0013		0.00036		0.00083		0.0097		0.00054
U_1		0.00068		0.0033		0.0025		0.044		0.0013		0.0014		0.00037		0.00084		0.0097		0.00055
t-statistic		2.02		2.45		2.02		2.02		2.45		2.02		2.04		2.02		2.02		2.03
U_2		0.0014		0.0082		0.0050		0.090		0.0033		0.0028		0.00075		0.0017		0.020		0.0011
U_3		0.00022		0.0031		0.00078		0.014		0.0012		0.00042		0.00013		0.00026		0.0031		0.00019
Certified		**0.0041**		**0.061**		**0.063**		**8.77**		**0.013**		**0.0205**		**0.0008**		**0.0070**		**0.887**		**0.0024**
Uncertainty		0.0007		0.003		0.002		0.04		0.001		0.0006		0.0001		0.0009		0.007		0.0003
Tolerance		0.0021		0.008		0.006		0.12		0.003		0.0018		0.0003		0.0027		0.021		0.0009

BS CA304-4 * Code for method Certified values listed as weight percent

Analysis	*	Ti	*	V	*	W	*	Zr
1	4	0.002733	12	0.0616667	12	0.003933	5	0.0023
2	10	0.002967	11	0.0638	5	0.00449	3	0.0036
3	10	0.0031	4	0.0665667	14	0.0048	3	0.0036
4	11	0.0044	3	0.0674	3	0.0049	3	0.0036
5	3	0.0044	3	0.0676	3	0.0049	3	0.0036
6	3	0.0044	10	0.068	3	0.005	3	0.0036
7	3	0.0044	3	0.0681	3	0.005	3	0.0036
8	3	0.0045	10	0.0681333	3	0.0051	3	0.0036
9	3	0.0045	3	0.0682	3	0.0051	3	0.0036
10	3	0.0045	3	0.0682	3	0.0052	3	0.0036
11	3	0.0045	3	0.0682	3	0.0052	3	0.0036
12	5	0.004533	3	0.0683	3	0.0053	3	0.0036
13	3	0.0046	3	0.0683	3	0.0054	3	0.0036
14	3	0.0046	3	0.0683	3	0.0054	3	0.0036
15	3	0.0046	4	0.0683333	3	0.0055	3	0.0036
16	3	0.0046	3	0.0684	3	0.0056	3	0.0036
17	14	0.004633	3	0.0684	3	0.0058	3	0.0037
18	3	0.0047	3	0.0684	3	0.0058	3	0.0037
19	3	0.0047	3	0.0684	3	0.0058	3	0.0037
20	3	0.0047	14	0.0684667	3	0.0058	3	0.0037
21	3	0.0047	3	0.0685	4	0.005867	3	0.0037
22	3	0.0047	3	0.0685	3	0.0059	3	0.0037
23	3	0.0047	3	0.0685	3	0.0059	3	0.0037
24	3	0.0047	3	0.0685	4	0.005933	3	0.0037
25	3	0.0047	3	0.0685	10	0.006	3	0.0037
26	3	0.0048	3	0.0685	3	0.006	3	0.0037
27	3	0.0048	3	0.0686	3	0.0061	3	0.0037
28	3	0.0048	3	0.0676	3	0.0061	3	0.0038
29	3	0.0048	3	0.0687	3	0.0062	3	0.0038
30	3	0.0048	3	0.0687	3	0.0063	3	0.0038
31	3	0.0048	3	0.0687	3	0.0063	3	0.0039
32	3	0.0048	3	0.0687	3	0.0063	3	0.004
33	3	0.0048	3	0.0688	3	0.0063	3	0.0041
34	3	0.0048	3	0.0688	3	0.0063		
35	3	0.0049	3	0.0688	3	0.0064		
36	3	0.005	3	0.0688	3	0.0064		
37	3	0.005	3	0.0689	3	0.0065		
38	3	0.005	3	0.0689	3	0.0067		
39			4	0.068933				
40			3	0.069				
41			3	0.0691				
42			18	0.079				
43			5	0.084267				
Average		0.00465		0.0686		0.00559		0.00360
Std Dev		0.00014		0.0011		0.00015		0.00016
H		0.00070		0.0024		0.00075		0.00063
U_1		0.00071		0.0026		0.00077		0.00065
t-statistic		2.03		2.02		2.03		2.04
U_2		0.0014		0.0052		0.0016		0.0013
U_3		0.00023		0.00080		0.00025		0.00023
Certified		**0.0046**		**0.0686**		**0.0056**		**0.0036**
Uncertainty		0.0002		0.0008		0.0006		0.0002
Tolerance		0.0014		0.0052		0.0018		0.0013

BS CA304-4 * Code for method Informational values listed as weight percent

Analysis	*	Co	*	Sb	*	Ta
1	3	0.0003	12	0.000203	10	0.002
2	3	0.0005				
3	3	0.0007				
4	3	0.0008				
5	3	0.0008				
6	3	0.001				
7	3	0.0011				
8	3	0.0012				
9	3	0.0012				
10	3	0.0012				
11	3	0.0012				
12	3	0.0012				
13	3	0.0012				
14	3	0.0012				
15	3	0.0012				
16	3	0.0013				
17	3	0.0013				
18	3	0.0013				
19	3	0.0014				
20	3	0.0014				
21	3	0.0014				
22	3	0.0015				
23	3	0.0015				
24	3	0.0015				
25	3	0.0015				
26	3	0.0016				
27	3	0.0016				
28	3	0.0016				
29	3	0.0016				
30	3	0.0016				
31	3	0.0017				
32	3	0.0018				
33	14	0.0198				
34	4	0.024667				
35	10	0.0256				
36	4	0.025867				
37	8	0.0286				
38	4	0.0296				
39	14	0.029933				
40	12	0.0310				
41	5	0.040867				
Average		0.007		0.00020		0.002
Std Dev		0.024		0.00029		0.024
H		0.0008		0.00023		0.001
U_1		0.024		0.00037		0.024
t-statistic		2.02		12.71		12.71
U_2		0.048		0.0048		0.31
U_3		0.0075		0.0048		0.31
Informationa		(0.007)		(0.0002)		(0.002)

For each element, in accordance with the requirements of ISO 17034 and Guide 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_L), calculated from its standard deviation (S_L) and its uncertainty estimate (U_L), is used as the weight (W_L) for its mean (M_L). The standard deviation (S) is calculated as the square root of the reciprocal of the sum of the weights. U_1 is the combined uncertainty from homogeneity and labs. U_2 is U_1 multiplied by the coverage factor (95 % t-statistic). U_3 is U_2 divided by the square root of the number of determinations (n). Thus:

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

*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.

BS CA304-4 * Code for analytical method Trace analysis listed as mg/kg (ppm)

Analysis	*	Bi	*	Ce	*	Ga	*	Ge	*	Hf	*	La	*	Na	*	Nd	*	Os	*	Pr
1	12	0.51	12	0.46	12	18	12	4.9	12	0.04	12	0.06	12	0.01	12	0.04	12	0.02	12	0.01
2	12	0.52	12	0.52	12	19	12	5	12	0.04	12	0.07	12	0.03	12	0.05	12	0.03	12	0.01
3	12	0.54	12	0.55	12	20	12	5	12	0.04	12	0.07			12	0.06	12	0.03	12	0.01

Analysis	*	Pt	*	Re	*	Sc	*	Se	*	Te	*	Th	*	U	*	Zn
1	12	0.06	12	0.01	12	0.006	12	0.14	12	0.1	12	0.01	12	0.007	12	21
2	12	0.08	12	0.05	12	0.007	12	0.17	12	0.13	12	0.02	12	0.007	12	21
3	12	0.09			12	0.007	12	0.23	12	0.13	12	0.02	12	0.007	12	22

Analytical Method Codes:

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

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

Lab Name	Location	Registrar	Accreditation
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, 17034
NSL Analytical	Cleveland, OH	ANAB	17025
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, 17034
National Analysis Center For Iron And Steel	Beijing, China	CNAS	17025
Luvak Inc.	Boylston, MA	PRI	17025
Instytut Metalurgii Zelaza	Gliwice, Poland	PCA	17025
Laboratory Testing, Inc.	Hatfield, PA	PRI	17025
Elemental Analysis, Inc.	Lexington, KY	A2LA	17025
Evans Analytical Group	Liverpool, NY	A2LA	17025

A2LA = American Association for Laboratory Accreditation
ANAB = ANSI-ASQ National Accreditation Board
CNAS = China National Accreditation Service
PCA = Polish Center For Accreditation
PRI =Performance Review Institute

Analysis: Chemical analyses were made on solid pieces 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: 13X17002E, 13X18002D; AR 654, 670, 875, 892, 950, 1648, 1652, 1653; BAS 464/1, 466/1; BS A2, CA-2, CA304-1, CA304-3, HICAL, HON U, SS3951, 81G, 304, 304A, 304B, 3951, 9722; ECRM 292-1D; IARM 2E, 2G, 2H, 3B, 6H, 6H; IMZ 152; JK 37, 655-13; LECO 501-320, 501-501, 501-502, 501-504, 501-644, 501-646, 501-676, 501-993, 502-197, 502-416, 502-855; NCS NS 11019, NS 21006; SRM C1153, 101A, 101C, 121D, 133A, 160B, 346A, 361, 363, 365, 1413, 2159, 2166, 3109A, 3134.

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 — BAS 466/1; BS CA2, CA304-3, HICAL, HON U, SS3951, 9722; ECRM 292-1D; LECO 501-676, 502-416; NCS NS 11019, NS 21006; SRM C1153, 121D, 346A.

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 CA304-4 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 Tianjin D&C Technology Development; Tianjin, China.

Form: This CRM is machined in the form of a disc approximately 38 mm in diameter and 38 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 CA304-4-060118. You may obtain information on revisions of certificates from the internet at **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. **Phone: (281) 440-9396Web: www.brammerstandard.com**
14603 Benfer Road
Houston, Texas 77069-2895 USA **Fax: (281) 440-4432** **Email: 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

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***

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 June 1, 2018.

Beau R. Brammer

President