

Brammer Standard Company, Inc.

Certificate of Analysis

BS 291HD

Certified Reference Material for Chill Cast Iron

	Certified Value ¹	Estimate of Uncertainty ²	Certified Values ³	Certified Value ¹	Estimate of Uncertainty ²
Al	0.035	0.002	Mo	0.030	0.003
B	0.0144	0.0009	N	0.0064	0.0006
C	3.35	0.05	Ni	0.101	0.009
Ca	0.0010	0.0004	P	0.024	0.002
Cr	0.035	0.003	S	0.008	0.002
Cu	0.212	0.009	Si	2.31	0.05
Fe	93.19	0.08	Sn	0.057	0.002
H	0.0005	0.0002	Ti	0.0223	0.0009
Mg	0.040	0.001	V	0.0206	0.0009
Mn	0.535	0.009	Zr	0.0019	0.0007
	Reference Value ¹	Estimate of Uncertainty ²	Reference Values ^{3,4}	Reference Value ¹	Estimate of Uncertainty ²
As	0.004	0.001	Sb	0.006	0.003
Co	0.004	0.002	Ta	<0.05	
Nb	0.002	0.001	W	0.003	0.002
O	0.0012	0.0008	Zn	<0.05	
Pb	<0.005				

¹ 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 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 4 for more information on its calculation.

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

⁴ Reference values are not certified and are provided for information only.

Trace element information values for Ba, Be, Ce, Cl, Dy, Er, Ga, Gd, Ge, Hf, La, Li, Nd, Pr, Re, Sm, Te, Th, U, Y, Yb, and Zn are shown on page 5.

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	*	H	*	Mg	*	Mn
1	3	0.034	12	0.0100	1	3.15	4	0.0003	4	0.0306667	5	0.188	4	93.0366667	2	0.0001667	3	0.040	4	0.46533333
2	3	0.034	4	0.013667	1	3.2366667	12	0.000633	3	0.031375	10	0.199	3	93.11	2	0.000180	3	0.040	4	0.506175
3	3	0.034	3	0.013667	3	3.2925	14	0.0007	14	0.0317667	4	0.2040667	16	[93.14]	2	0.0002875	3	0.040	4	0.524
4	3	0.034	4	0.013733	3	3.3	4	0.000717	4	0.0320	3	0.209	16	[93.14]	2	0.000422	3	0.040	3	0.527
5	3	0.034	3	0.01375	11	3.3133333	3	0.0009	3	0.032	4	0.2093333	16	[93.16]	2	0.0004333	3	0.040	4	0.528
6	3	0.035	4	0.013967	3	3.3166667	3	0.0009	4	0.0323333	4	0.2096667	16	[93.16]	2	0.0004367	3	0.040	4	0.52836667
7	3	0.035	3	0.014	4	3.32	2	0.001	3	0.0331667	10	0.210	16	[93.1606334]	2	0.00048	3	0.040	3	0.529
8	3	0.035	4	0.014043	11	3.33	4	0.001	4	0.0334	4	0.21	3	93.17	2	0.0004833	3	0.040	11	0.52966667
9	3	0.035	14	0.0141	3	3.33	4	0.001	3	0.0336667	3	0.21	16	[93.17]	2	0.0005	3	0.040	4	0.53
10	3	0.035	4	0.014133	11	3.34	11	0.001033	10	0.034	14	0.2100	16	[93.17]	2	0.0005333	3	0.040	10	0.53
11	3	0.035	11	0.0144	2	3.34	4	0.0011	3	0.034	10	0.21	16	[93.18]	2	0.00054	3	0.040	4	0.53
12	3	0.035	11	0.0145	3	3.3454667	11	0.0011	11	0.0348	4	0.2102333	16	[93.18667]	2	0.0008167	3	0.040	2	0.53
13	3	0.036	4	0.0146	3	3.35	11	0.0011	11	0.0349	11	0.2106667	16	[93.18667]			3	0.040	4	0.5309
14	3	0.036	4	0.0146	11	3.35	4	0.0011	11	0.035	4	0.2107333	16	[93.2]			3	0.040	4	0.531
15	3	0.037	11	0.0146	11	3.35	11	0.0011	11	0.035	11	0.211	16	[93.2094334]			3	0.040	3	0.532
16	3	0.037	3	0.0146	1	3.3515333	11	0.0011	4	0.0353	3	0.211	16	[93.21]			3	0.040	3	0.53233333
17	3	0.037	11	0.0146	1	3.3526667	11	0.0011	3	0.0353	11	0.211	4	93.21173333			3	0.040	11	0.534
18			11	0.0146	11	3.36	3	0.001467	10	0.0354	11	0.211	16	[93.2181667]					4	0.534
19			3	0.014667	1	3.36	4	0.001475	11	0.0354	11	0.211	10	93.27666667					3	0.53466667
20			4	0.014667	1	3.375857	4	0.001567	11	0.0354	3	0.211	13	93.314					10	0.535
21			4	0.0147	1	3.36775			4	0.0356	3	0.211667	16	[93.35333]					11	0.535
22			3	0.0147	1	3.376			4	0.0356	4	0.212	16	[93.46667]					11	0.536
23			3	0.0147	4	3.38			3	0.035733	11	0.212							11	0.536
24			11	0.0147	3	3.38			3	0.036	4	0.213							11	0.536
25			4	0.01495	1	3.38			5	0.036067	3	0.213							4	0.536333
26			7	0.0161	1	3.391667			4	0.036533	4	0.213							4	0.5366633
27			4	0.016467	1	3.4			4	0.0366	4	0.214933							3	0.540
28			5	0.016767	1	3.401167			3	0.037	4	0.215333							3	0.54
29					1	3.47667			4	0.037	4	0.2158							3	0.543
30					1	3.586			4	0.037667	4	0.217667							10	0.547
31									4	0.0379	3	0.21775							4	0.556667
32									4	0.0397	3	0.22							4	0.579333
33									4	0.221667									4	0.594
34									8	0.227										
Average		0.04		0.014428		3.3524		0.000957		0.034884		0.2124		93.190		0.0004788		0.04		0.5354
Std Dev		0.19		0.000060		0.0063		0.000028		0.000056		0.0020		0.023		0.0000069		0.21		0.0027
H		0.0020		0.0013		0.022		0.00042		0.0019		0.0047		0.18		0.00033		0.0020		0.0076
U ₁		0.19		0.0013		0.023		0.00042		0.0019		0.0051		0.19		0.00033		0.21		0.0081
t-statistic		2.12		2.05		2.05		2.09		2.04		2.03		2.08		2.20		2.12		2.04
U ₂		0.41		0.0026		0.046		0.00088		0.0039		0.010		0.39		0.00072		0.45		0.017
U ₃		0.099		0.00049		0.0085		0.00020		0.00069		0.0018		0.082		0.00021		0.11		0.0029
Certified		0.035		0.0144		3.35		0.0010		0.035		0.212		93.19		0.0005		0.040		0.535
Uncertainty		0.002		0.0009		0.05		0.0004		0.003		0.009		0.08		0.0002		0.001		0.009
Tolerance		0.006		0.0027		0.15		0.0009		0.009		0.027		0.24		0.0004		0.003		0.027

Analysis	*	Mo	*	N	*	Ni	*	P	*	S	*	Si	*	Sn	*	Ti	*	V	*	Zr
1	5	0.0256667	2	0.005723	4	0.0861	12	0.0170	1	0.0044333	10	2.23	4	0.050133333	5	0.0201333	12	0.01433333	12	0.00029667
2	12	0.02633333	2	0.005733	12	0.0863333	10	0.0199	12	0.0055667	3	2.258	12	0.051	4	0.021	5	0.01713333	5	0.0004
3	4	0.0276667	2	0.005967	7	0.093	4	0.0201	1	0.0063	3	2.27	3	0.0544	10	0.021	3	0.0191	5	0.00045
4	3	0.027675	2	0.0061	4	0.0953333	5	0.0216	1	0.0064167	6	2.2793333	3	0.0547	4	0.02155	3	0.01955	3	0.0015
5	14	0.02823333	2	0.006157	10	0.096	7	0.022567	1	0.007	6	2.29	3	0.054833333	11	0.0218	3	0.0199	4	0.00166667
6	4	0.02833333	2	0.0063	14	0.0962	4	0.023175	1	0.0072	3	2.3	3	0.055	3	0.0219	3	0.0199	4	0.0017
7	10	0.029	2	0.006333	10	0.0973333	3	0.0233	1	0.0073467	4	2.3039	4	0.0551	3	0.022	3	0.02	3	0.0017
8	2	0.029	2	0.0065	3	0.0973333	11	0.0238	1	0.0075	3	2.3066667	4	0.0552	3	0.022	4	0.02	3	0.001775
9	5	0.0290667	2	0.006575	4	0.0994333	3	0.0238	3	0.0076	4	2.3084333	4	0.0554	5	0.022	4	0.02025	4	0.0018
10	4	0.029075	2	0.0068	4	0.0999333	4	0.023867	1	0.0076	6	2.3098333	11	0.0557	4	0.0221	3	0.02033333	10	0.0018
11	11	0.0293	2	0.007033	10	0.10	11	0.0239	1	0.0076667	4	2.3099667	4	0.055966667	11	0.0221	14	0.0205	3	0.00193333
12	3	0.02933333	2	0.007333	4	0.1001333	13	0.024	3	0.0077	11	2.31	4	0.056075	3	0.0221	3	0.0205	4	0.002
13	11	0.02933333			4	0.1002	4	0.024	1	0.0079	11	2.31	11	0.0563	11	0.0221	5	0.02053333	4	0.00206667
14	4	0.02953333			3	0.101	11	0.0241	2	0.008	11	2.31	4	0.056666667	4	0.0221	14	0.02066667	3	0.0022
15	11	0.0297			11	0.101	3	0.0241	1	0.008	11	2.31	4	0.056733333	3	0.0221667	11	0.0207	11	0.0023
16	4	0.0297667			11	0.101	11	0.0241	3	0.0082	11	2.31	3	0.0568	11	0.0222	11	0.0207	11	0.0023
17	7	0.0297667			3	0.1013333	11	0.0242	4	0.0082	7	2.3104667	11	0.0569	4	0.0222	11	0.0208	11	0.0023
18	11	0.0298			11	0.1013333	4	0.0243	1	0.0085333	14	2.3133333	4	0.0571	11	0.0223	11	0.0209	11	0.0023
19	11	0.0298			4	0.1013333	4	0.0243	1	0.0089667	3	2.3166667	3	0.057333333	4	0.0224333	3	0.0209	11	0.0023
20	11	0.0299			4	0.102	4	0.0244	10	0.009	4	2.3175	4	0.0574	4	0.022533	3	0.02091	4	0.0024
21	10	0.03			4	0.102	4	0.024433	11	0.009	4	2.32	9	0.0574	3	0.022575	4	0.0210	11	0.0024
22	4	0.030067			4	0.102	4	0.0245	11	0.009	3	2.32	11	0.057867	7	0.0226	10	0.021	4	0.0024
23	4	0.0302			11	0.102	11	0.024733	11	0.0091	4	2.32	11	0.0581	4	0.022633	11	0.021	4	0.0035
24	4	0.0302			11	0.102	4	0.024933	11	0.0091	11	2.3233333	4	0.058467	3	0.022667	4	0.0211		
25	4	0.0305			11	0.102	4	0.024933	11	0.0092	6	2.325	4	0.0585	3	0.022667	4	0.0211		
26	3	0.0309			8	0.102333	7	0.025033	3	0.0095	6	2.325725	5	0.058667	14	0.022667	4	0.021167		
27	3	0.031			4	0.1025	3	0.025567	1	0.009533	4	2.33	3	0.060	4	0.022733	11	0.0213		
28	4	0.0312			4	0.1026	3	0.025775	11	0.009833	4	2.33	3	0.060575	3	0.023	4	0.021333		
29	4	0.0313			3	0.103	4	0.026133	3	0.010	4	2.332	10	0.063567	4	0.0230	4	0.021567		
30	4	0.0314			3	0.103	3	0.026667	3	0.0101	4	2.358	4	0.063867	4	0.023367	4	0.022033		
31	3	0.0315			3	0.104	10	0.027	4	0.011025					10	0.023867	3	0.022633		
32	3	0.0317			3	0.10425	3	0.027	1	0.0136							10	0.025433		
33	3	0.032			4	0.106667	4	0.028333												
34	4	0.0348			5	0.107333	3	0.0309												
35					4	0.108667														
36					3	0.11														
Average		0.02975		0.00641		0.1014		0.02431		0.008379		2.3093		0.0568		0.02225		0.02059		0.001891
Std Dev		0.00073		0.00020		0.0016		0.00053		0.000056		0.0037		0.0011		0.00050		0.00047		0.000066
H		0.0018		0.00089		0.0032		0.0016		0.0010		0.017		0.0024		0.0015		0.0015		0.00054
U ₁		0.0019		0.00092		0.0036		0.0017		0.0010		0.018		0.0027		0.0016		0.0016		0.00055
t-statistic		2.03		2.20		2.03		2.03		2.04		2.05		2.05		2.04		2.04		2.07
U ₂		0.0039		0.0020		0.0072		0.0035		0.0020		0.037		0.0054		0.0033		0.0032		0.0011
U ₃		0.00067		0.00058		0.0012		0.00059		0.00036		0.0067		0.0010		0.00060		0.00056		0.00024
Certified		0.030		0.0064		0.101		0.024		0.008		2.31		0.057		0.0223		0.0206		0.0019
Uncertainty		0.003		0.0006		0.009		0.002		0.002		0.05		0.002		0.0009		0.0009		0.0007
Tolerance		0.009		0.0018		0.027		0.006		0.006		0.15		0.006		0.0027		0.0027		0.0018

Analysis	*	As	*	Co	*	Nb	*	O	*	Pb	*	Sb	*	Ta	*	W	*	Zn
1	12	0.0030333	11	0.0011	12	0.0002833	2	0.000427	5	0.000020	5	0.0005567	5	0.000088	12	0.0002533	12	0.000273
2	5	0.0032667	11	0.0013	5	0.0003933	2	0.00045	12	0.000023	12	0.0005667	5	0.00027	5	0.0003267	5	0.000417
3	4	0.00335	11	0.0023	5	0.00057	2	0.0006	11	0.000061	5	0.0005733	4	0.0022	5	0.0004067	10	0.001000
4	4	0.0035333	5	0.0025	3	0.0013	2	0.000703	9	0.0001	9	0.0047667	4	0.002233	4	0.0012	4	0.0013
5	15	0.0039433	5	0.002733	3	0.0014	2	0.00078	11	0.0001	11	0.0053	4	0.002375	11	0.002	4	0.001667
6	10	0.0040333	12	0.002767	2	0.0015	2	0.001	4	0.0001	3	0.0054333	4	0.0025	11	0.0021	4	0.0054
7	5	0.00409	4	0.00299	4	0.0017667	2	0.00116	11	0.0001	3	0.0057	3	0.0025	11	0.0028	4	0.008967
8	4	0.0044	10	0.003	16	0.0019	2	0.001433	4	0.0002	4	0.0059			3	0.0028	4	0.011433
9	4	0.0045	5	0.003003	3	0.0019333	2	0.001633	4	0.0003	4	0.0061			14	0.0031		
10	4	0.0045167	11	0.0034	4	0.0020333	2	0.001733	4	0.0004	11	0.0061			4	0.0031		
11	3	0.0046	14	0.0035	4	0.0020333	2	0.001833	11	0.0004667	4	0.0062667			3	0.0033		
12	4	0.0048	8	0.003697	4	0.00205	2	0.002067	3	0.0005	4	0.0064			3	0.0033		
13	4	0.0048667	3	0.004	4	0.0020667					3	0.0066			3	0.0034		
14	4	0.005	4	0.0041	4	0.0020667					4	0.00625			4	0.0037		
15	4	0.005	11	0.0041	14	0.0021					4	0.0069			3	0.0052		
16	4	0.0050333	11	0.0043	11	0.0027					4	0.0070333			11	0.0058		
17	3	0.0051	4	0.004667	11	0.0027					11	0.0091667			4	0.0060333		
18	9	0.0053	4	0.004967	11	0.0028					11	0.0092			4	0.0060667		
19	10	0.0055	3	0.0051	11	0.0029					11	0.0095			4	0.0062		
20	3	0.0067	4	0.005133	11	0.0031					11	0.0103			4	0.0063		
21			4	0.0052	11	0.0031												
22			4	0.005225														
23			4	0.005267														
24			4	0.0055														
25			3	0.005567														
26			3	0.005925														
27			4	0.006														
28			3	0.0061														
Average		0.00447		0.00408		0.001926		0.001152		0.0001912		0.005949		0.0017		0.003369		0.004
Std Dev		0.00016		0.00014		0.000069		0.000091		0.0000022		0.000071		0.0072		0.000071		0.023
H		0.00077		0.00074		0.00055		0.00045		0.00024		0.00087		0.000521		0.00068		0.000734
U ₁		0.00078		0.00075		0.00055		0.00046		0.00024		0.00087		0.0072		0.00069		0.023
t-statistic		2.09		2.05		2.09		2.20		2.20		2.09		2.45		2.09		2.36
U ₂		0.0016		0.0015		0.0012		0.0010		0.00053		0.0018		0.018		0.0014		0.054
U ₃		0.00037		0.00029		0.00025		0.00029		0.00015		0.00041		0.0067		0.00032		0.019
Reference		0.004		0.004		0.002		0.0012		<0.005		0.006		<0.05		0.003		<0.05
Uncertainty		0.001		0.002		0.001		0.0008				0.003				0.002		0.019
Tolerance		0.003		0.003		0.001		0.0011				0.005				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. U₁ is the combined uncertainty from homogeneity and labs. U₂ is U₁ multiplied by the coverage factor (95 % t-statistic). U₃ is U₂ 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 U₃ 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.

Analysis	*	Ba	*	Be	*	Ce	*	Cl	*	Dy	*	Er	*	Ga	*	Gd	*	Ge	*	Hf
1	12	0.25	12	0.005	12	300	12	0.01	12	0.03	12	0.01	12	8.7	12	0.11	12	5.2	12	0.05
2	12	0.38	12	0.005	12	310	12	0.02	12	0.03			12	9.5	12	0.11	12	5.2	12	0.05
3	12	1.4	12	0.005	12	360	12	0.02	12	0.04			12	9.6	12	0.12	12	5.3	12	0.09
														5	2.2					
Analysis	*	La	*	Li	*	Nd	*	Pr	*	Re	*	Sm	*	Te	*	Th	*	U	*	Y
1	12	80	12	0.008	12	5.4	12	1.7	12	0.1	12	6.4	12	140	12	2.5	12	0.1	12	2.8
2	12	80	12	0.008	12	5.6	12	1.8	12	0.1	12	6.6	12	140	12	2.429	12	0.11	12	2.9
3	12	95	12	0.009	12	6.7	12	2.1	12	0.1	12	7.8	12	150	12		12	0.12	12	3.3
Analysis	*	Yb	*	Zn																
1	12	0.01	12	2.7																
2	12	0.01	12	2.7																
3			12	2.8																

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 | | |
| 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
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, 17034
NSL Analytical	Cleveland, OH	ANAB	17025
Elemental Analysis, Inc.	Lexington, KY	A2LA	17025
Element Materials Technology	Glendale Heights, IL	A2LA	17025
Dirats Laboratories	Westfield, MA	ANAB	17025
Vitkovice Testing Center	Hulvaky, Ostrava	Czech Accreditation Institute	17025
Shiva Analyticals Private Limited	Hoskote, Bangalore	NABL	17025
TUV Rheinland Pvt Ltd	Bangalore, India	NABL	17025
Eurofins EAG Materials Science, LLC	Liverpool, NY	A2LA	17025
National Analysis Center For Iron And Steel	Beijing, China	CNAS	17025
Raghavendra Spectro Metallurgical Laboratory	Karnataka, India	NABL	17025
Lucid Laboratories Pvt Ltd	Telanagana, India	NABL	17025
Laboratory Testing, Inc.	Hatfield, PA	A2LA	17025
Luvak, Inc.	Boylston, MA	PRI	17025
Analytical Process Laboratories, Inc.	Milwaukee, WI	A2LA	17025
Instytut Metalurgii Zelaza	Gilwice, Poland	PCA	17025

A2LA = American Association for Laboratory Accreditation
 ANAB = ANSI-ASQ National Accreditation Board
 CNAS = China National Accreditation Service
 NABL = National Accreditation Board for Testing and Calibration Laboratories
 PCA = Polish Center for Accreditation
 PRI = Performance Review Institute

Analysis: Chemical analyses were made on solid pieces and chips prepared by an end mill 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: 11X0331.1G, 11XC3AD, 11XC4A, 1XC5Y, 11XC7P, 11XC8U, 11XC8V; AR 215A, 307, 309, 310, 555, 614A, 644, 645, 668, 673, 780, 868, 892, 1650, 1652, 1657; BAS 236, 464/1, 535, 668-9, 673; BS XX-11B, CC-2, CI4, HON T, 7A, 8, 291, 291EB, 291F, 291FH, 291G, 291GH, 291GI; CKD 236, 244C; CZ 02033 1G, 02033 8A, 2016A; DSZU CA031; ECRM 480-1; IPT 16-4; JSS GS-1D, GS-6B; LECO 501-024, 501-504, 501-919, 502-899, 502-903, 502-928, 502-935, 502-947, 502-963, 762-747; NCS NS 11079; SPL 1B, 3A, 14A, 31A, 36A; SRM 5L, 6F, 82B, 122H, 122I, 160B, 342A, 361, 363, 365, 892, 1140, 1141A, 1754, 3107.

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, 7A, 8, 291, 291EB, 291GI; SPL 17 31A, 17 36A; SRM 1140, 1141A.

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 291HD 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 SPL-LABMAT s.r.o.; Bohumin, Czechia.

Form: This CRM is machined in the form of a disc, approximately 35mm in diameter and 30mm 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 several mm inward from each 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.

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.

Caution: CRM contains significant insoluble soft metal inclusions. Surface smearing may occur. Spark atomic emission spectrometers may require extended preburns to compensate.

Certificate Number: The unique identification number for this certificate of analysis is 291HD-043024. 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.
14603 Benfer Road
Houston, Texas 77069-2895 USA

Phone: (281) 440-9396

Web: www.brammerstandard.com

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 (our current Certificate Number 656.02 expires 01/31/2025)

Brammer Standard Company's Chemical Laboratory is accredited by A2LA to ISO Standard 17025. (Our current Certificate Number 656.01 expires 01/31/2025)

By current Certificate Number 10539 expiring 01/01/2027, 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 17025:2017 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 35:2017 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 April 30, 2024.

Beau R. Brammer
President