Brammer Standard Company, Inc.

Certificate of Analysis

BS 1030A

Certified Reference Material for AISI 1030 - UNS Number G10300

	Certified Value ¹	Estimate of Uncertainty ²	Certified Values ³		Certified Value ¹	Estimate of Uncertainty ²
ΑΙ	0.0021	0.0003		0	0.0047	0.0005
С	0.34	0.01		Ρ	0.0059	0.0009
Со	0.0061	0.0009		Pb	0.0002	0.0001
Cr	0.112	0.004		S	0.016	0.002
Cu	0.189	0.009		Sb	0.0014	0.0005
Fe	98.0	0.1		Si	0.28	0.02
Mn	0.763	0.009		Ti	0.0014	0.0005
Мо	0.029	0.003		V	0.0261	0.0009
Ν	0.0082	0.0006		Zn	0.0033	0.0008
Ni	0.141	0.007				
	Reference Value ¹	Estimate of Uncertainty ²	Reference Values	3,4	Reference Value ¹	Estimate of Uncertainty ²
As B Ca H Mg	0.005 0.0003 0.002 0.00014 0.0003	0.001 0.0002 0.001 0.00005 0.0002		Nb Sn Ta W Zr	0.0007 0.015 0.0010 0.0011 0.0003	0.0006 0.003 0.0006 0.0008 0.0002

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 3 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 3 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 Bi, Ce, Cl, Ga, Ge, La, Na, Re, and Rh are shown on page 4.

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

BS 1030A

* Code for method

Analysis	*	AI	*	С	*	Co	*	Cr	*	Cu	*	Fe	*	Mn	*	Мо	*	N	*	Ni
1		0.001333	1	0.338667	3	0.004533	3	0.105	4	0.17	_	97.7036667	4	0.721	12	0.0210	2	0.007667	3	0.136666
2	11		1	0.339	12	0.0048	10	0.105	10		3	97.9966667	4	0.746	4	0.024	2	0.007875	4	0.138466
3	5	0.00177	3	0.339	5	0.0050	3	0.106	4	0.18075	4	98.01	4	0.748333	5	0.024333	2	0.007977	3	0.139
4	4	0.001833	1	0.339433	11	0.0052	4	0.1083333	3	0.185	16		4	0.749	4	0.025667	2	0.0080	4	0.139
5	4	0.001833	1	0.34	4	0.005767	4	0.1098667	5	0.186	16	[98.02]	4	0.754	-	0.027333	2	0.0080	10	0.139
6	3	0.002	1	0.3410	4	0.0059	4	0.1099667	4	0.186333	16	[98.03]	3	0.755667	3	0.0286	2	0.008	4	0.1391
7	-	0.002033	1	0.341	3	0.0059	4	0.110	3	0.186667	_	[98.031267]	10	0.758	_	0.028667	2	0.008	5	0.13933
8	3	0.0022	1	0.344	5	0.005967	3	0.11	14		4	98.0383	3	0.758	4	0.028733	2	0.008067	4	0.13986
9	4	0.002233	1	0.344333	3	0.006	4	0.11	3	0.188667	16		11	0.76	4	0.0288	2	0.0081	10	0.140
10	4	0.002267	3	0.344667	3	0.006	5	0.1103333	4	0.188933	10		8	0.76	4	0.028867	2	0.008133	4	0.14
11	_	0.002333	3	0.345	4	0.006067	3	0.1103333	3	0.189	16	[98.0833]	3	0.762	4	0.028967	2	0.008167	3	0.140
12	3	0.002367	1	0.346	3	0.006167	8	0.111	10	0.189	16	[98.09]	14	0.763	3	0.029	2	0.008177	8	0.140
13	3	0.0024	1	0.346667		0.006333	3	0.111	10		14	98.1	4	0.7644	3	0.029	2	0.008287	4	0.140
14	4	0.0024	1	0.347	4	0.006633	14	0.112	8	0.19	_		4	0.765333	11	0.0291	2	0.008333	14	0.14133
15 16	3	0.0024	1	0.348555	4	0.00667	4	0.1122	4	0.190	_		10	0.765333	14	0.029267	2	0.009482	4	0.1410
17	3	0.0020	1	0.348007	4	0.006687	10		4	0.190667	_		3	0.766	10	0.0293		0.009462	3	0.142
18			11	0.3491	10	0.000087	3	0.113	4	0.190733	_		7	0.766333	4	0.0302	_		3	0.14233
19			3	0.353	10	0.007	11	0.113	4	0.190733	_		10	0.767	4	0.0302	_		10	0.14233
20				0.000		0.007667	4	0.113	3	0.194	_		4	0.768967	10	0.0303	-		4	0.143
20			_		-	0.007007	4	0.115667	11	0.194			3	0.700307	10	0.033433			3	0.144
21	-						4		4	0.194	_		4	0.77		0.033433	_		4	0.145
22							4	0.123007	4	0.200333	_		4	0.77		0.000000	_		4	0.14866
23	-							0.124	-	0.210000	_			0.805333			_		-	0.14000
47			_								_		-	0.0000000			_		_	
Average	-	0.002088	_	0.3447		0.006098		0.1122		0.189153		98.0153		0.762865		0.028773		0.00817	_	0.14129
std Dev	-	0.002088		0.3447		0.000098		0.1122		0.189153	_	0.0067	_	0.762865		0.028773	_	0.00817	_	0.14129
H	-	0.00056		0.0034		0.00087		0.0020		0.00066		0.0087		0.000085		0.000087		0.00026	_	0.0008
п U1		0.00058		0.0060		0.00087		0.0034		0.0044		0.19		0.0093		0.0017	_	0.0010		0.0038
t-statistic		2.13	_	2.10		2.09	_	2.07		2.07	_	2.18		2.07		2.08	_	2.13		2.07
U ₂		0.0012		0.014		0.0018		0.0082		0.0091		0.42		0.019		0.0036	_	0.0022		0.0079
U ₂		0.00030		0.0033		0.00041		0.0082		0.0091	_	0.42		0.0039		0.0030	_	0.00022		0.0079
Certified		0.00030		0.0033		0.00041		0.112		0.189	_	98.0		0.0039		0.00077	_	0.0082		0.0010
Uncertainty		0.00021	_	0.01		0.0009		0.004		0.009		0.1		0.009		0.003		0.0002		0.007
Tolerance		0.0012		0.03		0.0027		0.004		0.003	-	0.1		0.027		0.009	-	0.0000		0.001
		0.0012		0.00		0.0021		0.012		0.021		0.1		0.027		0.000		0.0010		0.021
	-	0					-		*					Ti	*	11		7		
Analysis	*	0	*	P	*	Pb	*	S		Sb	*	Si	*		^	V	*	Zn		
Analysis 1		0.004125	*	-	* 5	Pb 0.0001		S 0.0136667	3	Sb 0.0004		Si 0.24466667		0.000663		0.024667	*	0.0016		
-	2	_		-				-								-				
1	2	0.004125	12	0.0045	5	0.0001	12	0.0136667	3	0.0004	10	0.24466667	12	0.000663	3	0.024667	4	0.0016		
1 2	2 2	0.004125 0.004233	12 3	0.0045	5 5	0.0001 0.0001	12 1	0.0136667 0.0146667	3	0.0004 0.000833	10 6	0.24466667 0.25933333	12 4	0.000663 0.000967	3 4	0.024667 0.025	4	0.0016 0.0027		
1 2 3	2 2 2	0.004125 0.004233 0.0046 0.0047	12 3 4 5	0.0045 0.004633 0.005	5 5 3	0.0001 0.0001 0.0001 0.0001	12 1 1	0.0136667 0.0146667 0.0147333	3 4 4 5	0.0004 0.000833 0.000867	10 6 4 4	0.24466667 0.25933333 0.25966667	12 4 3	0.000663 0.000967 0.001033	3 4 4	0.024667 0.025 0.025667	4 11 14	0.0016 0.0027 0.002867		
1 2 3 4	2 2 2 2	0.004125 0.004233 0.0046 0.0047	12 3 4 5	0.0045 0.004633 0.005 0.005033	5 5 3 9	0.0001 0.0001 0.0001 0.0001	12 1 1 1	0.0136667 0.0146667 0.0147333 0.015	3 4 4 5	0.0004 0.000833 0.000867 0.001233	10 6 4 4	0.24466667 0.25933333 0.25966667 0.26	12 4 3 4	0.000663 0.000967 0.001033 0.001067	3 4 4 4	0.024667 0.025 0.025667 0.0257	4 11 14 3	0.0016 0.0027 0.002867 0.003		
1 2 3 4 5	2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741	12 3 4 5 10	0.0045 0.004633 0.005 0.005033 0.005133	5 5 3 9 12	0.0001 0.0001 0.0001 0.0001 0.000107	12 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333	3 4 4 5 12	0.0004 0.000833 0.000867 0.001233 0.001333	10 6 4 4 14	0.24466667 0.25933333 0.25966667 0.26 0.26466667	12 4 3 4 14	0.000663 0.000967 0.001033 0.001067 0.0012	3 4 4 4 5	0.024667 0.025 0.025667 0.0257 0.025767	4 11 14 3 4	0.0016 0.0027 0.002867 0.003 0.003233		
1 2 3 4 5 6	2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767	12 3 4 5 10 4	0.0045 0.004633 0.005 0.005033 0.005133 0.005233	5 5 3 9 12 5	0.0001 0.0001 0.0001 0.0001 0.000107 0.000117	12 1 1 1 1 1 3	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0153333	3 4 4 5 12 9	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014	10 6 4 4 14 3	0.24466667 0.25933333 0.25966667 0.26 0.26466667 0.265	12 4 3 4 14 5	0.000663 0.000967 0.001033 0.001067 0.0012 0.00128	3 4 4 4 5 3	0.024667 0.025 0.025667 0.025767 0.025767 0.0258	4 11 14 3 4 3	0.0016 0.0027 0.002867 0.003 0.003233 0.0035		
1 2 3 4 5 6 7	2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767	12 3 4 5 10 4 10	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.005233	5 5 3 9 12 5 5	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183	12 1 1 1 1 3 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0153333 0.0155	3 4 5 12 9 5	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015	10 6 4 4 14 3 4	0.24466667 0.25933333 0.25966667 0.26 0.26466667 0.265 0.268	12 4 3 4 14 5 5 5	0.000663 0.000967 0.001033 0.001067 0.0012 0.00128 0.0013	3 4 4 4 5 3 3 4	0.024667 0.025 0.025667 0.025767 0.025767 0.0258 0.0259	4 11 14 3 4 3 12	0.0016 0.0027 0.002867 0.003 0.003233 0.0035 0.0038		
1 2 3 4 5 6 7 8	2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787	12 3 4 5 10 4 10 3	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.0056	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	12 1 1 1 1 1 3 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0153333 0.0155 0.0156133	3 4 5 12 9 5 5	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533	10 6 4 4 14 3 4 3	0.24466667 0.25933333 0.25966667 0.26 0.26466667 0.265 0.268 0.268 0.27	12 4 3 4 14 5 5 5 11	0.000663 0.000967 0.001033 0.001067 0.0012 0.00128 0.0013 0.0013	3 4 4 5 3 4 4	0.024667 0.025 0.025667 0.025767 0.025767 0.0258 0.0259 0.025933	4 11 14 3 4 3 12 5	0.0016 0.0027 0.002867 0.003 0.003233 0.0035 0.0038 0.003833		
1 2 3 4 5 6 7 8 9	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048	12 3 4 5 10 4 10 3 4	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.0056 0.005647	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	12 1 1 1 1 3 3 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0153333 0.0155 0.0156133 0.0158667	3 4 5 12 9 5 5 5	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019	10 6 4 14 3 4 3 4 3 4 4	0.24466667 0.25933333 0.25966667 0.26 0.26466667 0.265 0.268 0.27 0.27266667	12 4 3 4 14 5 5 11 4	0.000663 0.000967 0.001033 0.001067 0.0012 0.00128 0.0013 0.0013 0.0013	3 4 4 5 3 4 4 4 3	0.024667 0.025667 0.025767 0.025767 0.0258 0.0259 0.025933 0.026	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.00367 0.003 0.003233 0.0035 0.0038 0.003833 0.0040		
1 2 3 4 5 6 7 8 9 10	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0048 0.0049 0.0050	12 3 4 5 10 4 10 3 4 7	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.0056 0.005647 0.005767 0.0059	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	12 1 1 1 1 3 1 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019	10 6 4 14 3 4 3 4 3 4 4	0.24466667 0.25933333 0.25966667 0.26 0.26466667 0.265 0.268 0.27 0.27266667 0.27566667	12 4 3 4 14 5 5 11 4 5	0.000663 0.000967 0.001033 0.001067 0.0012 0.00128 0.0013 0.0013 0.0014 0.001533	3 4 4 5 3 4 4 3 4 3 10 14	0.024667 0.025 0.025667 0.025767 0.025767 0.0258 0.02593 0.025933 0.026	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.00367 0.003 0.003233 0.0035 0.0038 0.003833 0.0040		
1 2 3 4 5 6 7 8 9 10 11	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0048 0.0049 0.0050	12 3 4 5 10 4 10 3 4 7 3	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.005647 0.005647 0.0059 0.00593 0.005933 0.006	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	12 1 1 1 3 1 1 1 1 1 1 1 3 3	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019	10 6 4 14 3 4 3 4 3 4 4 3 3	0.24466667 0.25933333 0.25966667 0.26 0.26466667 0.265 0.268 0.27 0.27266667 0.27266667 0.27566667	12 4 3 4 14 5 5 11 4 5 4	0.000663 0.000967 0.001033 0.001067 0.0012 0.00128 0.0013 0.0013 0.0014 0.001533 0.0016	3 4 4 5 3 4 4 3 4 3 10 14	0.024667 0.025 0.025667 0.025767 0.025767 0.02593 0.02593 0.0269 0.0262 0.0262 0.026533 0.0266	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.00367 0.003 0.003233 0.0035 0.0038 0.003833 0.0040		
1 2 3 4 5 6 7 8 9 10 11 12	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0048 0.0049 0.0050	12 3 4 5 10 4 10 3 4 7 3 4	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.005647 0.005647 0.0059767 0.005933 0.006 0.006033	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	12 1 1 1 3 1 1 1 1 1 1 3 1 1 3 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0153333 0.0155 0.0156133 0.0158667 0.0159 0.016 0.0161667 0.016425	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019	10 6 4 14 3 4 3 4 3 4 4 3 11 13 10	0.24466667 0.2593333 0.25966667 0.26 0.26466667 0.265 0.268 0.27 0.27266667 0.27566667 0.27566667 0.27566667 0.28 0.28 0.28 0.28	12 4 3 4 14 5 5 11 4 5 4 3	0.000663 0.000967 0.001033 0.001067 0.0012 0.00128 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016	3 4 4 5 3 4 4 3 10 14 4	0.024667 0.025 0.025667 0.025767 0.025867 0.0258 0.02593 0.025933 0.026 0.026 0.0262 0.026233	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.00367 0.003 0.003233 0.0035 0.0038 0.003833 0.0040		
1 2 3 4 5 6 7 7 8 9 10 11 12 13	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0048 0.0049 0.0050	12 3 4 5 10 4 10 3 4 7 3 4 7 3 4 10	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.005647 0.005647 0.0059 0.00593 0.005933 0.006	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	12 1 1 1 1 1 3 1 1 1 1 1 3 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0153333 0.0155 0.0156133 0.0158667 0.0169 0.016 0.0161667 0.016425	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019	10 6 4 14 3 4 3 4 3 4 4 3 11 13 10	0.24466667 0.25933333 0.25966667 0.26 0.26466667 0.265 0.27 0.2766667 0.2766667 0.2766667 0.2766667 0.27633333 0.28 0.28	12 4 3 4 14 5 5 11 4 5 4 3 3 3	0.000663 0.000967 0.001033 0.001067 0.0012 0.00128 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0018	3 4 4 5 3 4 4 4 3 10 14 4 4	0.024667 0.025 0.025667 0.025767 0.025767 0.02593 0.02593 0.0269 0.0262 0.0262 0.026533 0.0266	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.00367 0.003 0.003233 0.0035 0.0038 0.003833 0.0040		
1 2 3 4 5 6 7 8 9 10 11 11 12 13 14	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0048 0.0049 0.0050	12 3 4 5 10 4 10 3 4 7 3 4 10 4 10 4	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.005647 0.0059647 0.00593 0.005933 0.006 0.006033 0.006033 0.00613	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	12 1 1 1 1 3 1 1 1 1 3 1 1 1 1 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016 0.016667 0.016425 0.0167 0.0171	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019	10 6 4 14 3 4 3 4 3 4 4 3 11 13 10	0.24466667 0.2593333 0.25966667 0.26 0.26466667 0.265 0.268 0.27 0.27266667 0.27566667 0.27566667 0.27566667 0.28 0.28 0.28 0.28	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.001067 0.00128 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0018 0.0018	3 4 4 5 3 4 4 3 10 14 4 4 4 4 4	0.024667 0.025 0.025667 0.025767 0.02593 0.02593 0.025933 0.026 0.0262 0.0262 0.026633 0.026667	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.00367 0.003 0.003233 0.0035 0.0038 0.003833 0.0040		
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0048 0.0049 0.0050	12 3 4 5 10 4 10 3 4 7 3 4 10 4 10 4 4	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.005647 0.0059647 0.00593 0.005933 0.006 0.006033 0.006033	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	12 1 1 1 1 3 1 1 1 1 1 3 1 1 1 1 0 3	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016 0.016667 0.016425 0.0167 0.0171	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019	10 6 4 14 3 4 3 4 4 3 4 4 3 11 13 10 4	0.24466667 0.25933333 0.25966667 0.26 0.26486667 0.265 0.278 0.27266667 0.27566667 0.2763333 0.28 0.28 0.28 0.281 0.281 0.281 0.282 0.282 0.284	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.001067 0.00128 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0018 0.0018	3 4 4 5 3 4 4 3 10 14 4 4 4 4 10	0.024667 0.025 0.025667 0.025767 0.025767 0.0258 0.0259 0.025933 0.026 0.0262 0.0262 0.026667 0.026667 0.0269	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.00367 0.003 0.003233 0.0035 0.0038 0.003833 0.0040		
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0048 0.0049 0.0050	12 3 4 5 10 4 10 3 4 7 3 4 10 4 4 3	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.005647 0.0059647 0.00593 0.005933 0.006 0.006033 0.006033 0.00613	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	12 1 1 1 1 3 1 1 1 1 1 1 3 1 1 10 3 11	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016 0.0161667 0.0161667 0.0167 0.0167 0.0171 0.0172	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019	10 6 4 14 3 4 3 4 4 3 11 13 10 4 3 3	0.24466667 0.25933333 0.25966667 0.26 0.26466667 0.265 0.268 0.27 0.27266667 0.2766667 0.2763333 0.28 0.28 0.28 0.281 0.28153333 0.282	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.001067 0.00128 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0018 0.0018	3 4 4 5 3 4 4 3 10 14 4 4 4 4 10 11	0.024667 0.025 0.025667 0.025767 0.025767 0.0258 0.0259 0.0259 0.0269 0.026 0.026 0.026633 0.026667 0.02669 0.02669 0.0269	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.00367 0.003 0.003233 0.0035 0.0038 0.003833 0.0040		
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0048 0.0049 0.0050	122 3 4 5 10 4 10 4 10 3 3 4 4 10 4 4 4 3 3 7	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.0056 0.005647 0.0059 0.00593 0.00593 0.006033 0.006033 0.0061 0.006387	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	122 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016 0.0161667 0.016425 0.016425 0.01071 0.0171 0.0172 0.0174	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019	10 6 4 4 4 14 3 3 4 4 4 3 3 11 13 10 4 4 3 3	0.24466667 0.25933333 0.25966667 0.26 0.26486667 0.265 0.278 0.27266667 0.27566667 0.2763333 0.28 0.28 0.28 0.281 0.281 0.281 0.282 0.282 0.284	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.001067 0.00128 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0018 0.0018	3 4 4 5 3 3 4 4 4 3 10 14 4 4 4 4 10 11 3	0.024667 0.025 0.025667 0.025767 0.025767 0.0258 0.0259 0.02593 0.026 0.0262 0.026533 0.02663 0.026667 0.026667 0.0269 0.0272	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.00367 0.003 0.003233 0.0035 0.0038 0.003833 0.0040		
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0048 0.0049 0.0050	122 3 4 5 5 100 4 4 100 3 3 4 4 100 4 4 4 4 3 7 7 4	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.0056 0.005647 0.0059 0.00593 0.00593 0.006033 0.006033 0.0061 0.006387 0.006567	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	122 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016 0.0161667 0.016425 0.016425 0.0167 0.0171 0.0172 0.0174 0.0176667	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019	10 6 4 4 4 3 3 4 4 4 4 3 3 4 11 13 10 4 3 3 4	0.24466667 0.25933333 0.25966667 0.26 0.26466667 0.265 0.268 0.27 0.27266667 0.27566667 0.2763333 0.28 0.28 0.281 0.281333 0.282 0.281 0.2815333	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.001067 0.00128 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0018 0.0018	3 4 4 5 3 3 4 4 4 3 10 14 4 4 4 4 10 11 3	0.024667 0.025 0.025667 0.025767 0.025767 0.0258 0.0259 0.02593 0.026 0.0262 0.026533 0.02663 0.026667 0.026667 0.0269 0.0272	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.00367 0.003 0.003233 0.0035 0.0038 0.003833 0.0040		
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0048 0.0049 0.0050	122 3 4 5 5 100 4 4 100 3 3 4 4 100 4 4 4 3 7 7 4 4 111	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.0056 0.005647 0.0059 0.00593 0.00593 0.006033 0.006033 0.0061 0.006387 0.006567 0.0066	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	122 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0156333 0.0158667 0.0158667 0.0159 0.016 0.0161667 0.016425 0.0167 0.0172 0.0172 0.0174 0.0176667 0.018	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019	10 6 4 4 4 3 3 4 4 4 4 3 3 4 4 4 3 3 10 4 3 3 4 4 10	0.24466667 0.2593333 0.25966667 0.26 0.26466667 0.265 0.268 0.27 0.27266667 0.27566667 0.2763333 0.28 0.28 0.28 0.281 0.281 0.281 0.284 0.284 0.284	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.001067 0.00128 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0018 0.0018	3 4 4 5 3 3 4 4 4 3 10 14 4 4 4 4 10 11 3	0.024667 0.025 0.025667 0.025767 0.025767 0.0258 0.0259 0.02593 0.026 0.0262 0.026533 0.02663 0.026667 0.026667 0.0269 0.0272	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.00367 0.003 0.003233 0.0035 0.0038 0.003833 0.0040		
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0048 0.0049 0.0050	122 3 4 5 100 3 3 4 4 100 3 3 4 4 100 4 4 4 4 4 4 4 4	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.0056 0.005647 0.0059 0.00593 0.006033 0.006033 0.0061 0.006033 0.0061 0.006387 0.006567 0.006667	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	122 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016 0.0168667 0.016425 0.0167 0.016425 0.0167 0.0171 0.0172 0.0174 0.0176667 0.018 0.0180333	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019	10 6 4 4 3 3 4 4 4 3 3 111 133 10 4 4 3 3 4 4 10 4	0.24466667 0.2593333 0.25966667 0.26 0.266 0.265 0.268 0.27 0.27266667 0.27566667 0.2763333 0.28 0.28 0.28 0.281 0.281 0.28153333 0.28 0.282 0.284 0.284 0.284 0.284 0.284 0.284 0.284 0.284 0.287 0.284 0.284 0.287 0.284 0.287 0.284 0.287 0.284 0.287 0.284 0.284 0.287 0.284 0.287 0.297 0.2	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.001067 0.00128 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0018 0.0018	3 4 4 5 3 3 4 4 4 3 10 14 4 4 4 4 10 11 3	0.024667 0.025 0.025667 0.025767 0.025767 0.0258 0.0259 0.02593 0.026 0.0262 0.026533 0.02663 0.026667 0.026667 0.0269 0.0272	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.002867 0.003 0.003233 0.0035 0.0038 0.003833 0.0040		
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0048 0.0049 0.0050	12 3 4 5 10 4 10 3 3 4 4 7 7 3 4 4 10 4 4 4 3 7 7 4 4 3 3	0.0045 0.004633 0.005 0.005033 0.005233 0.0054 0.0056 0.005647 0.005767 0.00593 0.006933 0.006 0.006033 0.00613 0.00613 0.006387 0.006667 0.006667 0.007	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000117 0.000183 0.0003	122 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016 0.016425 0.016425 0.0167 0.0174 0.0171 0.0172 0.0174 0.0176667 0.018 0.0180333 0.018867	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.000867 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019	10 6 4 4 4 3 3 4 4 4 3 3 10 4 4 3 3 3 4 4 10 4 4 3 3	0.24466667 0.2593333 0.25966667 0.26 0.26 0.265 0.268 0.27 0.27566667 0.27566667 0.27566667 0.2763333 0.28 0.28 0.281 0.281 0.281 0.284 0.284 0.284 0.284 0.284 0.284 0.284 0.287 0.29366667 0.297	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.001067 0.00128 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0018 0.0018	3 4 4 5 3 3 4 4 4 3 10 14 4 4 4 4 10 11 3	0.024667 0.025 0.025667 0.025767 0.025767 0.0258 0.0259 0.02593 0.026 0.0262 0.026533 0.02663 0.026667 0.026667 0.0269 0.0272	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.002867 0.003 0.003233 0.0035 0.0038 0.003833 0.0040		
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.004787 0.004787 0.004787 0.004787 0.004787 0.004787 0.004787 0.0050 0.0050	12 3 4 5 10 4 10 3 4 4 7 3 3 4 4 10 4 4 3 3 7 7 4 4 11 11 4 3 3	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.0056 0.005647 0.0059 0.00593 0.006933 0.006033 0.006033 0.006387 0.006667 0.006667 0.006667 0.007 0.007 0.007	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000107 0.000183 0.0003 0.0003 0.0003 0.0003 0.0003	122 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016 0.0161667 0.016425 0.016425 0.016425 0.0167 0.0171 0.0172 0.0174 0.0176667 0.018 0.0180333 0.018867 0.019	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019 0.0022	10 6 4 4 4 3 3 4 4 4 3 3 10 4 4 3 3 3 4 4 10 4 4 3 3	0.24466667 0.25933333 0.25966667 0.26 0.26466667 0.265 0.278 0.27 0.27266667 0.2763333 0.28 0.28 0.281 0.281 0.28153333 0.282 0.284 0.284 0.28476667 0.297 0.298333 0.297 0.298333 0.29833 0.298333 0.29833 0.29833 0.29833 0.29833 0.29833 0.29833 0.29833 0.2985 0.297 0.29833 0.2985 0.297 0.29833 0.2985 0.297 0.29833 0.2985 0.297 0.29833 0.2985 0.297 0.29833 0.2985 0.297 0.2985 0.297 0.2985 0.297 0.2985 0.297 0.2985 0.297 0.2985 0.297 0.2985 0.297 0.2985 0.297 0.2985 0.297 0.2985 0.297 0.2985 0.297 0.297 0.2985 0.297 0.2985 0.297 0.2985 0.297 0.2985 0.297 0.2985 0.297 0.2985 0.297 0.2985 0.295	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.001067 0.0012 0.0012 0.0013 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0016 0.0018 0.002 0.002 0.002 0.002	3 4 4 5 3 3 4 4 4 3 10 14 4 4 4 4 10 11 3	0.024667 0.025 0.025667 0.025767 0.0258 0.0259 0.02593 0.026 0.026 0.026 0.026533 0.0266 0.026667 0.026867 0.026867 0.0272 0.0272 0.0272 0.028 0.028	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.002867 0.003 0.003233 0.0035 0.0038 0.003833 0.0040 0.00465		
1 2 3 4 5 6 7 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 Average	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0049 0.0050 0.0050 0.005 0.005	12 3 4 5 10 4 10 3 4 4 7 3 3 4 4 10 4 4 3 3 7 7 4 4 11 11 4 3 3	0.0045 0.004633 0.005033 0.005133 0.005233 0.005233 0.0054 0.0056 0.005647 0.0059 0.00593 0.006933 0.006 0.006033 0.0061 0.006387 0.006667 0.006667 0.006667 0.0076 0.0076 0.0076	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000107 0.000183 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.00016	122 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016 0.0161667 0.016425 0.0167 0.0171 0.0172 0.0174 0.0176667 0.018867 0.018867 0.019 0.019	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019 0.0022 0.0022 0.0022 0.001359	10 6 4 4 4 3 3 4 4 4 3 3 10 4 4 3 3 3 4 4 10 4 4 3 3	0.24466667 0.25933333 0.25966667 0.26 0.26486667 0.265 0.275 0.27566667 0.27566667 0.2763333 0.28 0.28 0.281 0.281 0.281 0.281 0.284 0.284 0.284 0.284 0.284 0.284 0.287 0.29366667 0.297 0.2936667 0.297 0.295695 0.275695	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.001067 0.0012 0.00128 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0016 0.0018 0.002 0.002 0.002 0.002 0.001383	3 4 4 5 3 3 4 4 4 3 10 14 4 4 4 4 10 11 3	0.024667 0.025 0.025767 0.025767 0.0259 0.0259 0.0259 0.02633 0.026 0.0262 0.026637 0.026667 0.026667 0.0269 0.0272 0.0	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.002867 0.003 0.003233 0.0035 0.0038 0.003833 0.0040 0.00465 0.00465 0.00465 0.00465 0.00465 0.00465 0.00465 0.00465 0.00332		
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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 Average Std Dev H	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0049 0.0050 0.0050 0.005 0.005 0.005	12 3 4 5 10 4 10 3 4 4 7 3 3 4 4 10 4 4 4 3 3 7 7 4 11 11 4 3 3	0.0045 0.004633 0.005 0.005033 0.005233 0.0054 0.0056 0.005647 0.005647 0.00593 0.00593 0.006033 0.006033 0.00613 0.006133 0.00613 0.006687 0.006667 0.0076 0.0066 0.006667 0.007 0.0076 0.0076 0.00593 0.00021 0.00087	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.000107 0.000107 0.000183 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0001 0.00016 0.00011 0.00023	122 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0155333 0.0155 0.0156133 0.0155 0.0156133 0.0159 0.0159 0.0159 0.016 0.016425 0.0167 0.0171 0.0174 0.0174 0.0174 0.0176667 0.0174 0.0178 0.018833 0.018867 0.019 0.016358 0.000067 0.0013	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.000867 0.001233 0.0014 0.0015 0.0015 0.001533 0.001747 0.0019 0.0022 0.001747 0.0019 0.0022 0.001359 0.00095 0.00048	10 6 4 4 4 3 3 4 4 4 3 3 10 4 4 3 3 3 4 4 10 4 4 3 3	0.24466667 0.25933333 0.25966667 0.26 0.268 0.27 0.27266667 0.27566667 0.27566667 0.27568667 0.27568667 0.281 0.281 0.281 0.281 0.284 0.284 0.284 0.284 0.284 0.287 0.29366667 0.297 0.2936667 0.297 0.2936667 0.297 0.29365 0.000067 0.0054	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.001067 0.00128 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0016 0.0018 0.002 0.002 0.002 0.002 0.002 0.001383 0.000082 0.00048	3 4 4 5 3 3 4 4 4 3 10 14 4 4 4 4 10 11 3	0.024667 0.025 0.025667 0.025767 0.02593 0.02593 0.02593 0.0269 0.0260 0.0266 0.026667 0.0269 0.02667 0.0269 0.0272 0.0272 0.0272 0.028 0.0272 0.028 0.02613 0.00077 0.0017	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.002867 0.003 0.0035 0.0038 0.00383 0.0040 0.00465 0.00465 0.00465 0.00465 0.00465 0.00465 0.00465 0.00465 0.00465 0.00465 0.0010 0.00044		
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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 Average Std Dev H U1 c-statistic U2	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.0047 0.004741 0.004767 0.004767 0.004787 0.0048 0.0049 0.0050 0.0050 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.00019 0.00081 2.20 0.0018	12 3 4 5 10 4 10 3 4 4 7 3 3 4 4 10 4 4 3 3 7 7 4 4 11 11 4 3 3	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.005647 0.0059 0.00593 0.00593 0.006033 0.006033 0.0061 0.006033 0.006637 0.006667 0.006667 0.006667 0.007 0.007 0.007 0.007 0.007 0.007 0.007 0.007 0.007 0.007 0.007 0.007 0.0089 2.07 0.0018	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000107 0.000183 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.00016 0.00016 0.00016 0.00016 0.00016 0.00015 2.31 0.00057	122 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016 0.0161667 0.0161667 0.0171 0.0172 0.0174 0.0174 0.0176667 0.018807 0.018867 0.019 0.016358 0.000067 0.0013 2.08 0.0028	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.001233 0.001333 0.0014 0.0015 0.001533 0.001747 0.0019 0.0022 0.0022 0.0022 0.001359 0.00095 0.00048 0.00049 2.23 0.0011	10 6 4 4 4 3 3 4 4 4 3 3 10 4 4 3 3 3 4 4 10 4 4 3 3	0.24466667 0.25933333 0.25966667 0.26 0.26 0.26 0.26 0.27 0.27266667 0.2766667 0.2763333 0.28 0.29 0.29 0.29 0.29 0.205695 0.00067 0.0054 2.08 0.011	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.001067 0.0012 0.0012 0.0013 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0018 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.001383 0.00082 0.00048 0.00049 2.14 0.0010	3 4 4 5 3 3 4 4 4 3 10 14 4 4 4 4 10 11 3	0.024667 0.025 0.025667 0.025767 0.025767 0.0259 0.0259 0.0259 0.026 0.026 0.02663 0.02667 0.02667 0.02667 0.02667 0.0272 0.028 0.02613 0.00077 0.0017 0.0017 0.0017 0.0039 0.0039 0.026 0.0	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.002867 0.003 0.003233 0.0035 0.0038 0.00405 0.00465 0.00465 0.00465 0.00465 0.00465 0.0032 0.00332 0.00010 0.00044 0.00045 2.262157 0.0010		
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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 Average Std Dev H U1 t-statistic U2 U3	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.004741 0.004767 0.004767 0.004787 0.0048 0.0049 0.0050 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.00472 0.00019 0.00079 0.00081 2.20 0.0018 0.00051 0.00047	12 3 4 5 10 4 10 3 4 4 7 3 3 4 4 10 4 4 4 3 3 7 7 4 11 11 4 3 3	0.0045 0.004633 0.005033 0.005133 0.005233 0.0054 0.0056 0.005647 0.0059 0.00593 0.00593 0.006033 0.006033 0.006033 0.006337 0.006667 0.006667 0.006667 0.006667 0.0076 0.00776 0.00776 0.00776 0.00776 0.00776 0.00776 0.00776 0.00776 0.00770 0.00776 0.00770 0.00776 0.000770 0.007700 0.00770 0.007700 0.007700 0.007700 0.007700000000	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000183 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.00016 0.00016 0.00016 0.00016 0.00016 0.00016 0.00017 0.00025 2.31 0.00027 0.00019 0.00022	122 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016 0.0161667 0.016425 0.0167 0.016425 0.0167 0.0171 0.0172 0.0174 0.0176667 0.018867 0.018867 0.018867 0.019 0.016358 0.000067 0.0013 0.0013 0.0013 0.0013 0.0028 0.00060 0.0166 0.00060 0.0166 0.00060 0.0016 0.0016 0.00060 0.0016 0.00060 0.0016 0.00060 0.0016 0.00060 0.0016 0.00060 0.0016 0.00060 0.0016 0.0016 0.00060 0.0016 0.00060 0.0016 0.00060 0.0016 0.00060 0.0016 0.00060 0.0016 0.00060 0.0016 0.00060 0.0016 0.00060 0.0016 0.00060 0.00060 0.0016 0.00060 0.00060 0.00060 0.0016 0.00060 0.00060 0.00060 0.0016 0.00060 0.00060 0.00060 0.0016 0.00060 0.0016 0.00060 0.00060 0.0016 0.00060 0.00060 0.00060 0.00060 0.00060 0.00060 0.00060 0.00060 0.00060 0.00060 0.0016 0.0016 0.0016 0.0016 0.0016 0.0016 0.0016 0.0016 0.0016 0.0016 0.0016 0.0016 0.0016 0.0016 0.0016 0.0016 0.0016 0.00067 0.0013 0.0013 0.0028 0.00060 0.000060 0.000060 0.000000 0.0000000000	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.001233 0.001333 0.001333 0.0015 0.001533 0.001747 0.0019 0.0022 0.0022 0.001359 0.000359 0.00048 0.00049 2.23 0.0011 0.00033 0.0014	10 6 4 4 4 3 3 4 4 4 3 3 10 4 4 3 3 3 4 4 10 4 4 3 3	0.24466667 0.25933333 0.25966667 0.26 0.26466667 0.265 0.276 0.2766667 0.27566667 0.2763333 0.28 0.28 0.281 0.281 0.28153333 0.282 0.284 0.28476667 0.297 0.29366667 0.297 0.29366667 0.297 0.295695 0.000067 0.0054 0.0054 0.0054 2.08 0.011 0.0024 0.28 0.28 0.28 0.21 0.225695 0.000067 0.0054 0.0054 0.0054 0.0054 0.0054 0.0054 0.0024 0.28 0.011 0.0024 0.28 0.28 0.28 0.28 0.011 0.0024 0.28 0.28 0.28 0.28 0.0024 0.28 0.0024 0.28 0.0024 0.28 0.0024 0.0024 0.28 0.28 0.0024 0.0024 0.28 0.0024 0.0024 0.0024 0.28 0.0024 0.0024 0.0024 0.0024 0.28 0.0024 0.0024 0.0024 0.0024 0.28 0.0024 0.0025 0.0025 0.00	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.001067 0.0012 0.0012 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0016 0.0018 0.002 0.002 0.002 0.002 0.001383 0.00048 0.00048 0.00048 0.00049 2.14 0.0010 0.00027 0.00014	3 4 4 5 3 3 4 4 4 3 10 14 4 4 4 4 10 11 3	0.024667 0.025 0.025667 0.025767 0.025767 0.0259 0.0259 0.0269 0.026 0.0262 0.02663 0.026667 0.026667 0.02689 0.0272 0.0272 0.0272 0.0272 0.028 0.02613 0.00077 0.0017 0.0017 0.0017 0.0017 0.0018 2.11 0.0039 0.0091 0.00261	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.002867 0.003 0.003233 0.0035 0.0038 0.00383 0.0040 0.00465 0.00465 0.00465 0.00465 0.00465 0.00465 0.0032 0.00032 0.00044 0.00044 0.00044 0.00045 2.262157 0.0010 0.00033 0.00003 0.00003 0.00003 0.00000 0.000000 0.000000 0.000000 0.00000000		
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 Average Std Dev H U1 c-statistic U2 U3	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.004125 0.004233 0.0046 0.004741 0.004767 0.004767 0.004787 0.0048 0.0049 0.0050 0.0050 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.00079 0.00079 0.00081 2.20 0.0018 0.00051	12 3 4 5 10 4 10 3 4 4 7 3 3 4 4 10 4 4 4 3 3 7 7 4 11 11 4 3 3	0.0045 0.004633 0.005 0.005033 0.005133 0.005233 0.0054 0.0056 0.005647 0.0059 0.00593 0.006033 0.006033 0.00633 0.00633 0.006667 0.006667 0.006667 0.006667 0.0076 0.0076 0.0070 0.007 0.0070 0.00070 0.00089 0.00087 0.00087 0.00089 0.00087 0.00088 0.00088 0.00018 0.00018 0.00018 0.00018 0.00018 0.00018 0.00018 0.00018 0.00018 0.00018 0.00018 0.00018 0.00018 0.00018 0.00010 0.000000	5 5 3 9 12 5 5 5 11	0.0001 0.0001 0.0001 0.000107 0.000107 0.000183 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.0003 0.00016 0.00016 0.00016 0.00016 0.00011 0.00025 2.31 0.00057 0.00019	122 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.0136667 0.0146667 0.0147333 0.015 0.0150333 0.0155 0.0156133 0.0158667 0.0159 0.016 0.0161667 0.0161667 0.016425 0.0167 0.0171 0.0172 0.0174 0.0174 0.0176667 0.018 0.018867 0.018 0.018333 0.018867 0.019 0.016358 0.000067 0.0013 0.0013 2.08 0.00028 0.00060	3 4 5 12 9 5 5 5 5 10	0.0004 0.000833 0.001233 0.001333 0.001333 0.0015 0.0015 0.0015 0.0015 0.001747 0.0019 0.0022 0.0022 0.0022 0.001359 0.00048 0.00048 0.00048 0.00049 2.23 0.0011 0.00033	10 6 4 4 4 3 3 4 4 4 3 3 10 4 4 3 3 3 4 4 10 4 4 3 3	0.24466667 0.25933333 0.25966667 0.26 0.26 0.26 0.26 0.27 0.27266667 0.2766667 0.2763333 0.28 0.28 0.28 0.28 0.281 0.281 0.28153333 0.28 0.28 0.281 0.28476667 0.297 0.00067 0.00054 0.0011 0.0024	12 4 3 4 14 5 5 11 4 5 4 3 3 10	0.000663 0.000967 0.001033 0.00120 0.0012 0.0013 0.0013 0.0013 0.0013 0.0014 0.001533 0.0016 0.0016 0.0018 0.002 0.002 0.002 0.002 0.001383 0.00082 0.00048 0.00049 2.14 0.0010 0.00027	3 4 4 5 3 3 4 4 4 3 10 14 4 4 4 4 10 11 3	0.024667 0.025 0.025767 0.025767 0.025767 0.0259 0.0259 0.0269 0.026 0.026 0.02663 0.02667 0.02667 0.02667 0.0272 0.0272 0.0272 0.0272 0.0272 0.0272 0.0272 0.02613 0.02613 0.00077 0.0017 0.0017 0.0017 0.0018 2.11 0.0039 0.00091	4 11 14 3 4 3 12 5 5	0.0016 0.0027 0.002867 0.003 0.003233 0.0035 0.0038 0.00383 0.0040 0.00465 0.00465 0.00465 0.00465 0.00465 0.00322 0.00010 0.00044 0.00045 2.262157 0.0010 0.00033		

Brammer Standard Company, Inc., 14603 Benfer Road, Houston, TX 77069-2895 USA Telephone: (281) 440-9396 Fax (281) 440-4432 Website: <u>www.brammerstandard.com</u> Certificate Number 1030A-020922 Page 2/6 **BS 1030A**

* Code for method

Analysis	*	As	*	в	*	Ca	*	H	*	Mg	*	Nb	*	Sn	*	Та	*	W	*	Zr
1	10	0.0032	5	0.0001	14	0.0008	2	0.000069	4	0.0002	12	0.0000737	12	0.011667	5	0.00010	12	0.00025	5	0.0001033
2	12	0.003767	4	0.0002	4	0.001033	2	0.000089	11	0.0002	5	0.0001	9	0.012167	5	0.0004	11	0.0003	12	0.000130
3	3	0.0040	12	0.000250	12	0.001153	2	0.0001233	3	0.0002	5	0.00012667	5	0.0128	4	0.001033	5	0.0004	5	0.00013
4	4	0.004233	3	0.000267	4	0.001233	2	0.0001333	12	0.00025	5	0.00029667	4	0.013333	4	0.001133	5	0.00049	4	0.0001333
5	5	0.0043	11	0.0003	11	0.0014	2	0.00015	5	0.000333	10	0.0005	5	0.014933	3	0.0012	5	0.000587	11	0.0003
6	3	0.0044	3	0.0003	3	0.0016	2	0.00019	5	0.000497	3	0.0006	11	0.015	11	0.0017	4	0.000967	3	0.0005
7	5	0.004967	7	0.00033	4	0.001857	2	0.000196	4	0.000603	4	0.00066667	4	0.015667			3	0.000967	4	0.0005333
8	4	0.005033	3	0.00044	4	0.001867					3	0.001	3	0.0158			4	0.001167		
9	15	0.005153			3	0.002					4	0.001	5	0.015833			3	0.0022		
10	5	0.005543			5	0.0027					4	0.0011	4	0.0159			4	0.002867		
11	4	0.0057			4	0.003167					4	0.0011	4	0.015967						
12	9	0.0059									3	0.0013	10	0.016						
13	10	0.006									11	0.0013	10	0.016						
14	5	0.006167											4	0.0165						
15	11	0.0083											3	0.0166						
16													3	0.016667						
17													4	0.016833						
18													4	0.017						
19													3	0.017						
20													3	0.018						
Average		0.00511		0.00027		0.001710		0.000126		0.00033		0.000705	_	0.015483	_	0.001005		0.001112		0.00026
Std Dev		0.00021		0.00011		0.000095		0.000011		0.00012		0.000088		0.000071		0.000045		0.000051		0.00012
н		0.00081		0.00027		0.00052		0.00021		0.00029		0.00037		0.0013		0.00043		0.00044		0.00044
U1		0.00084		0.00029		0.00053		0.00021		0.00031		0.00038		0.0013		0.00043		0.00045		0.00046
t-statistic		2.14		2.36		2.23		2.45		2.45		2.18		2.09		2.57		2.26		2.4469119
U ₂		0.0018		0.00069		0.0012		0.00051		0.00076		0.00084		0.0028		0.0011		0.0010		0.0011
U ₃		0.00046		0.00024		0.00036		0.00019		0.00029		0.00023		0.00062		0.00045		0.00032		0.00042
Reference		0.005		0.0003		0.002		0.00014		0.0003		0.0007		0.015		0.0010		0.0011		0.0003
Uncertainty		0.001		0.0002		0.001		0.00005		0.0002		0.0006		0.003		0.0006		0.0008		0.0002
Tolerance		0.003		0.0002		0.001		0.00013		0.0002		0.0006		0.009		0.0009		0.0010		0.0002

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:

$$C_{L} = \sqrt{S_{L}^{2} + U_{L}^{2}} \qquad W_{L} = \frac{1}{C_{L}^{2}} \qquad A = \frac{\sum_{i=1}^{n} W_{L} M_{L}}{\sum_{i=1}^{n} W_{L}} \qquad S = \frac{1}{\sqrt{\sum_{i=1}^{n} W_{L}}} \qquad U_{1} = \sqrt{H^{2} + S^{2}} \qquad U_{2} = t \times U_{1} \qquad U_{3} = \frac{U_{2}}{\sqrt{n}}$$

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.

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* Code for analytical method

Trace analysis listed as mg/kg (ppm)

Analysis	*	Bi	*	Ce	*	CI	*	Ga	*	Ge	*	La	*	Na	*	Re	*	Rh
1	12	0.01	12	0.008	12	0.01	12	6.5	12	12.0	12	0.007	12	0.02	12	0.03	12	0.93
2	12	0.01	12	0.02			12	6.6	12	12.0	12	0.01	12	0.02	12	0.03	12	0.96
3	12	0.01	12	0.03			12	7.1	12	13.0	12	0.01	12	0.02	12	0.03	12	0.99

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

ICP = Inductively Coupled Plasma	GF = G	raphite Furnace	GD = Glow Discharge
DCP = Direct Current	Plasma	HG = Hydride Ge	neration

Lab Name	Location	Registrar	Accreditation		
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, 17034		
LECO Corporation	St. Joseph, MI	A2LA	17025		
Vitkovice Testing Center	Hulvaky, Ostrava	Czech Accreditation Institute	17025		
NSL Analytical	Cleveland, OH	ANAB	17025		
Eurofins EAG Materials Science, LLC	Liverpool, NY	A2LA	17025		
Elemental Analysis, Inc.	Lexington, KY	A2LA	17025		
Dirats Laboratories	Westfield,MA	ANAB	17025		
Element Materials Technology	Glendale Heights, IL	A2LA	17025		
Instytut Metalurgii Zelaza	Gliwice, Poland	PCA	17025		
Laboratory Testing, Inc.	Hatfield, PA	PRI	17025		
APL, Inc	Milwaukee, WI	A2LA	17025		
TUV Rheinland Pvt Ltd	Bangalore, India	NABL	17025		
Andrew S. McCreath & Son, Inc.	Harrisburg, PA	A2LA	17025		
Luvak Inc.	Boylston, MA	PRI	17025		
Shiva Analyticals Private Limited	Hoskote, Bangalore	NABL	17025		
National Analysis Center For Iron And Steel	Beijing, China	CNAS	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

<u>Analysis:</u> 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: 12X19965A, 12X349C, 12X52986A, 12X61500A, 12XLA50; AR 546, 612, 614, 619, 644, 645, 654, 657, 659, 668, 673, 675, 875, 881, 892, 931, 960, 1650, 1651; BAS 290/2, 410/2, 461, 464/1; BS 45B, 54G, 55G, 56H, 61G, 63A, 63B, 70B, 181, 406, 1016, 1018, 1020, 1026, 1030, 1144A, 1290, 1765, 2931, 2931A, 3941, 4130, 4140C, 4142SE, 4820A, 4931; CKD 165A, 166A, 184A, 186A, 244C, 249C, CZ2005A; DSZU CA08, CA012, CA013; ECRM 195-1; IARM 20A, 30C, 209A, 209C, 2999; IMZ 113, 119; IPT 12A, 31, 39, 43, 97; JSM M402-4; JSS GS-1d; LECO 501-506, 501-643, 501-644, 501-676, 501-677, 502-060, 502-712, 502-856, 502-890, 502-893, 502-903, 502-916, 502-935, 502-990, 502-991, 503-501, 503-520, 762-747; NCS NS11043, NS20035B; SRM 160B, 361, 363, 1269, 3155, 3168A, 3169.

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 54G, 56H, 63A, 63B, 1020, 1026, 1030, 3941.

<u>Validity statement:</u> 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 1030A 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 bar stock for this CRM was produced by Gerdau; Saint Paul, Mn.

Form: This CRM is machined in the form of a disc, approximately 38mm in diameter and 19mm 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 entire depth of the CRM may be used.

Caution: As with any bar material, avoid spark atomic emission spectrometric burns in the center of the CRM (5 mm radius), as some segregation may be present.

<u>Sample Preparation</u>: 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.

<u>Certificate Number</u>: The unique identification number for this certificate of analysis is 1030A-020922. You may obtain information on revisions of certificates from the internet at <u>www.brammerstandard.com</u>.

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) 440-9396	Web: www.brammerstandard.com
14603 Benfer Road		
Houston, Texas 77069-2895 USA	Fax: (281) 440-4432	Email: <u>contact@brammerstandard.com</u>

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 17025:2017 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 February 9, 2022.

Beau R. Brammer President