Brammer Standard Company, Inc.

Certificate of Analysis

BS 1030A

Certified Reference Material for AISI 1030 - UNS Number G10300

Certified Values[3]

	Certified Value[1]	Estimate of Uncertainty[2]		Certified Value[1]	Estimate of Uncertainty[2]
Al	**0.0021**	0.0003	**O**	**0.0047**	0.0005
C	**0.34**	0.01	**P**	**0.0059**	0.0009
Co	**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
Mo	**0.029**	0.003	**V**	**0.0261**	0.0009
N	**0.0082**	0.0006	**Zn**	**0.0033**	0.0008
Ni	**0.141**	0.007			

Reference Values[3,4]

	Reference Value[1]	Estimate of Uncertainty[2]		Reference Value[1]	Estimate of Uncertainty[2]
As	**0.005**	0.001	**Nb**	**0.0007**	0.0006
B	**0.0003**	0.0002	**Sn**	**0.015**	0.003
Ca	**0.002**	0.001	**Ta**	**0.0010**	0.0006
H	**0.00014**	0.00005	**W**	**0.0011**	0.0008
Mg	**0.0003**	0.0002	**Zr**	**0.0003**	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.

Brammer Standard Company, Inc., 14603 Benfer Road, Houston, TX 77069-2895 USA
Telephone: (281) 440-9396 Fax (281) 440-4432 Website: www.brammerstandard.com

BS 1030A * Code for method Certified values listed as weight percent

Analysis	*	Al	*	C	*	Co	*	Cr	*	Cu	*	Fe	*	Mn	*	Mo	*	N	*	Ni
1	12	0.001333	1	0.338667	3	0.004533	3	0.105	4	0.17	13	97.7036667	4	0.721	12	0.0210	2	0.007667	3	0.1366667
2	11	0.0015	1	0.339	12	0.0048	10	0.105	10	0.178	3	97.9966667	4	0.746	4	0.024	2	0.007875	4	0.1384667
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	[98.01434]	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	3	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	14	0.002033	1	0.341	3	0.0059	4	0.110	3	0.186667	16	[98.031267]	10	0.758	3	0.028667	2	0.008	5	0.1393333
8	3	0.0022	1	0.344	5	0.005967	3	0.11	14	0.188333	4	98.0383	3	0.758	4	0.028733	2	0.008067	4	0.1398667
9	4	0.002233	1	0.344333	3	0.006	4	0.11	3	0.188667	16	[98.04767]	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	98.0766667	8	0.76	4	0.028867	2	0.008133	4	0.14
11	5	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	14	0.006333	3	0.111	10	0.189667	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	0.1413333
15	3	0.0024	1	0.348333	4	0.006667	4	0.1122	3	0.190			3	0.765333	14	0.029267	2	0.0088	4	0.1416
16	3	0.0025	1	0.348667	5	0.00667	4	0.1122667	4	0.1901			10	0.766	3	0.0293	2	0.009482	11	0.142
17			1	0.3491	4	0.006687	10	0.113	4	0.190667			3	0.766	10	0.03			3	0.142
18			11	0.351	10	0.007	3	0.113	4	0.190733			7	0.766333	4	0.0302			3	0.1423333
19			3	0.353	10	0.007	11	0.113	4	0.191			10	0.767	4	0.0309			10	0.143
20					4	0.007667	4	0.113	3	0.194			4	0.768967	10	0.032			4	0.144
21							4	0.115667	11	0.194			3	0.77	10	0.033433			3	0.145
22							10	0.123667	4	0.200333			4	0.77	4	0.035833			4	0.148667
23							4	0.124	4	0.213333			4	0.799067					4	0.149333
24													4	0.805333						
Average		0.002088		0.3447		0.006098		0.1122		0.189153		98.0153		0.762865		0.028773		0.00817		0.141291
Std Dev		0.000079		0.0034		0.000071		0.0020		0.000066		0.0067		0.000065		0.000067		0.00026		0.000066
H		0.00056		0.0060		0.00087		0.0034		0.0044		0.19		0.0093		0.0017		0.0010		0.0038
U_1		0.00057		0.0069		0.00088		0.0039		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_3		0.00030		0.0033		0.00041		0.0017		0.0019		0.12		0.0039		0.00077		0.00055		0.0016
Certified		**0.0021**		**0.34**		**0.0061**		**0.112**		**0.189**		**98.0**		**0.763**		**0.029**		**0.0082**		**0.141**
Uncertainty		0.0003		0.01		0.0009		0.004		0.009		0.1		0.009		0.003		0.0006		0.007
Tolerance		0.0012		0.03		0.0027		0.012		0.027		0.4		0.027		0.009		0.0018		0.021

Analysis	*	O	*	P	*	Pb	*	S	*	Sb	*	Si	*	Ti	*	V	*	Zn
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
2	2	0.004233	3	0.004633	5	0.0001	1	0.0146667	4	0.000833	6	0.25933333	4	0.000967	4	0.025	11	0.0027
3	2	0.0046	4	0.005	3	0.0001	1	0.0147333	4	0.000867	4	0.25966667	3	0.001033	4	0.025667	14	0.002867
4	2	0.0047	5	0.005033	9	0.0001	1	0.015	5	0.001233	4	0.26	4	0.001067	4	0.0257	3	0.003
5	2	0.004741	10	0.005133	12	0.000107	1	0.0150333	12	0.001333	14	0.26466667	14	0.0012	5	0.025767	4	0.003233
6	2	0.004767	4	0.005233	5	0.000117	3	0.0153333	9	0.0014	3	0.265	5	0.00128	3	0.0258	3	0.0035
7	2	0.004767	10	0.0054	5	0.000183	1	0.0155	5	0.0015	4	0.268	5	0.0013	4	0.0259	12	0.0038
8	2	0.004787	3	0.0056	11	0.0003	1	0.0156133	5	0.001533	3	0.27	11	0.0013	4	0.025933	5	0.003833
9	2	0.0048	4	0.005647	3	0.0003	1	0.0158667	5	0.001747	4	0.27266667	4	0.0014	3	0.026	5	0.0040
10	2	0.0049	7	0.005767			1	0.0159	10	0.0019	4	0.27566667	5	0.001533	10	0.026	5	0.00465
11	2	0.0050	3	0.0059			3	0.016	11	0.0022	3	0.27633333	4	0.0016	14	0.0262		
12	2	0.005	4	0.005933			1	0.0161667			11	0.28	3	0.0016	4	0.026533		
13			10	0.006			1	0.016425			13	0.28	3	0.0018	4	0.0266		
14			4	0.006033			10	0.0167			10	0.281	10	0.002	4	0.026667		
15			4	0.006033			3	0.0171			4	0.28153333	3	0.002	10	0.0269		
16			3	0.0061			11	0.0172			3	0.282			11	0.027		
17			7	0.006387			1	0.0174			3	0.284			3	0.0272		
18			4	0.006567			1	0.0176667			4	0.28476667			3	0.028		
19			11	0.0066			3	0.018			10	0.287						
20			4	0.006667			1	0.0180333			4	0.29366667						
21			3	0.007			1	0.018867			3	0.297						
22			3	0.007			1	0.019			4	0.298333						
23			4	0.0076														
Average		0.00472		0.00593		0.00016		0.016358		0.001359		0.275695		0.001383		0.02613		0.00332
Std Dev		0.00019		0.00021		0.00011		0.000067		0.000095		0.000067		0.000082		0.00077		0.00010
H		0.00079		0.00087		0.00023		0.0013		0.00048		0.0054		0.00048		0.0017		0.00044
U_1		0.00081		0.00089		0.00025		0.0013		0.00049		0.0054		0.00049		0.0018		0.00045
t-statistic		2.20		2.07		2.31		2.08		2.23		2.08		2.14		2.11		2.262157
U_2		0.0018		0.0018		0.00057		0.0028		0.0011		0.011		0.0010		0.0039		0.0010
U_3		0.00051		0.00038		0.00019		0.00060		0.00033		0.0024		0.00027		0.00091		0.00033
Certified		**0.0047**		**0.0059**		**0.0002**		**0.016**		**0.0014**		**0.28**		**0.0014**		**0.0261**		**0.0033**
Uncertainty		0.0005		0.0009		0.0001		0.002		0.0005		0.02		0.0005		0.0009		0.0008
Tolerance		0.0018		0.0027		0.0001		0.006		0.0013		0.06		0.0013		0.0039		0.0024

BS 1030A * Code for method Reference values listed as weight percent

Analysis	*	As	*	B	*	Ca	*	H	*	Mg	*	Nb	*	Sn	*	Ta	*	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
H		0.00081		0.00027		0.00052		0.00021		0.00029		0.00037		0.0013		0.00043		0.00044		0.00044
U_1		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:

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

*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 1030A * Code for analytical method Trace analysis listed as mg/kg (ppm)

Analysis	*	Bi	*	Ce	*	Cl	*	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 = 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
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

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: 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.

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 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.**

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 1030A-020922. 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
Fax: (281) 440-4432

Web: www.brammerstandard.com
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 17025:2017 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