Brammer Standard Company, Inc.

Certificate of Analysis

BS 9842

Certified Reference Material for Grade 310 Stainless Steel Alloy - UNS Number S31000

Certified Values[3]

	Certified Value[1]	Estimate of Uncertainty[2]		Certified Value[1]	Estimate of Uncertainty[2]
Al	**0.013**	0.003	**N**	**0.038**	0.002
As	**0.0019**	0.0006	**Nb**	**0.026**	0.003
B	**0.0025**	0.0006	**Ni**	**20.01**	0.09
C	**0.059**	0.002	**P**	**0.025**	0.002
Ca	**0.0011**	0.0005	**S**	**0.0019**	0.0007
Co	**0.238**	0.008	**Si**	**0.97**	0.03
Cr	**24.20**	0.06	**Sn**	**0.0051**	0.0008
Cu	**0.145**	0.005	**Ti**	**0.003**	0.001
Fe	**[52.6]**	0.3	**V**	**0.074**	0.003
Mn	**1.50**	0.02	**W**	**0.011**	0.002
Mo	**0.111**	0.005			

Reference Values[3,4]

	Reference Value[1]	Estimate of Uncertainty[2]		Reference Value[1]	Estimate of Uncertainty[2]
O	**0.005**	0.002	**Ta**	**<0.05**	
Pb	**<0.05**		**Zr**	**0.003**	0.001
Sb	**0.004**	0.002			

[1] This certificate is a revision. For more information on the nature and extent of the revision, see the revision statement on page 5.

[2] 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.

[3] 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.

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

The requirements of ISO Guides 30 and Standards 33401 and 33405 were followed for the preparation of this Certified Reference Material and certificate of analysis.

BS 9842 * Code for method Certified values listed as weight percent

Analysis	*	Al	*	As	*	B	*	C	*	Ca	*	Co	*	Cr	*	Cu	*	Fe	*	Mn
1	4	0.005	4	0.0004	12	0.0013	3	0.0575	3	0.00062	17	0.230	4	24.09	3	0.131	16	[52.515]	7	1.4604
2	12	0.005	3	0.0014	4	0.0014	1	0.0586	3	0.000625	3	0.231	12	24.11	3	0.132	16	[52.67]	3	1.48
3	4	0.01155	3	0.002	3	0.0021	1	0.0587	3	0.00078	3	0.2315	13	24.12	10	0.14	16	[52.68]	3	1.48
4	3	0.0127	3	0.002	3	0.00218	1	0.058767	4	0.00079	7	0.233	3	24.155	4	0.140	16	[52.71]	7	1.485
5	4	0.0130	3	0.0024667	3	0.00238	1	0.05885	17	0.0009	12	0.233	13	24.1603	17	0.142			12	1.49
6	3	0.013	9	0.0029	3	0.0024	3	0.05885	3	0.0009	17	0.235	3	24.17	4	0.142			3	1.49
7	7	0.0136			4	0.0024	3	0.059	4	0.0010	10	0.235	3	24.18	7	0.144			4	1.49
8	7	0.01375			5	0.0025	1	0.059	3	0.00102	4	0.235	4	24.18	3	0.146			17	1.491333
9	4	0.0139			3	0.00253	3	0.059	4	0.0011	4	0.236	18	24.18	12	0.146			4	1.50
10	3	0.014			4	0.00265	4	0.0591	4	0.0012	4	0.237	4	24.22	3	0.146			3	1.5
11	17	0.0146			3	0.00266	1	0.0596	17	0.0013	4	0.238	3	24.2325	4	0.147			7	1.505
12	4	0.0147			4	0.0028	1	0.060	4	0.00135	10	0.239	10	24.236	3	0.147			10	1.506
13	3	0.015			7	0.00305	1	0.06	4	0.00155	17	0.2419	4	24.24	7	0.148			17	1.510
14	3	0.016			5	0.0040	1	0.060	12	0.0016	3	0.243	3	24.24	10	0.149			3	1.51
15	10	0.016			4	0.0046			4	0.0017	3	0.244	4	24.26	4	0.149			4	1.515
16	4	0.017							4	0.0018	4	0.245	10	24.28	4	0.150			4	1.53
17	3	0.018									3	0.246	13	24.30	17	0.151			10	1.53
18											4	0.246	4	24.36	4	0.151			4	1.56
19															6	0.1529				
Average		0.01341		0.00186		0.00250		0.0588		0.00114		0.2377		24.200		0.1449		52.64		1.502
Std Dev		0.00069		0.00088		0.00010		0.0022		0.00038		0.0054		0.031		0.0060		0.10		0.023
H		0.0012		0.00054		0.00061		0.0024		0.00045		0.0050		0.075		0.0038		0.13		0.013625
U_1		0.0014		0.00056		0.00062		0.0033		0.00045		0.0050		0.081		0.0038		0.16		0.014
t-statistic		2.12		2.57		2.14		2.16		2.13		2.11		2.11		2.10		3.18		2.11
U_2		0.0030		0.0014		0.0013		0.0071		0.0010		0.010		0.17		0.0081		0.52		0.029
U_3		0.00073		0.00058		0.00034		0.0019		0.00024		0.0025		0.040		0.0018		0.26		0.0068
Certified		**0.013**		**0.0019**		**0.0025**		**0.059**		**0.0011**		**0.238**		**24.20**		**0.145**		**[52.6]**		**1.50**
Uncertainty		0.003		0.0006		0.0006		0.002		0.0005		0.008		0.06		0.005		0.3		0.02
Tolerance		0.009		0.0018		0.0018		0.007		0.0010		0.024		0.18		0.015		0.5		0.06

Analysis	*	Mo	*	N	*	Nb	*	Ni	*	P	*	S	*	Si	*	Sn	*	Ti	*	V
1	10	0.105	2	0.0362	10	0.023	4	19.65	10	0.0212	1	0.001	4	0.904	4	0.0029	10	0.001	3	0.071
2	4	0.105	2	0.0366	3	0.023	13	19.735	3	0.022	17	0.0012	3	0.91	17	0.0043667	4	0.002	10	0.072
3	3	0.106	2	0.0368	4	0.0240	6	19.762	3	0.023	1	0.0015	3	0.921	4	0.0044	4	0.002	3	0.0727
4	4	0.108	2	0.0373	3	0.024	10	19.92	11	0.024	1	0.0016	10	0.939	17	0.0045	4	0.0025	3	0.073
5	3	0.109	2	0.03735	7	0.02575	3	19.93	3	0.0240	1	0.001733	3	0.9675	5	0.0046	4	0.00255	3	0.073
6	3	0.109	2	0.0377	4	0.0259	3	19.96	4	0.024	1	0.0019	4	0.970	7	0.00475	4	0.0027	3	0.07395
7	4	0.110	13	0.0385	12	0.026	4	19.97	4	0.0241	1	0.00196	17	0.970333	4	0.0048	10	0.003	12	0.074
8	10	0.111	2	0.040	4	0.026	6	19.97	3	0.0245	1	0.002	6	0.9753	3	0.0049	3	0.003	10	0.074
9	3	0.1115			4	0.026	4	19.98	4	0.0249	1	0.002	10	0.978	11	0.0050	3	0.0038	4	0.07445
10	4	0.112			3	0.0265	4	19.99	3	0.02525	1	0.002	4	0.987	4	0.005	3	0.00395	4	0.07515
11	4	0.112			3	0.0265	3	20	7	0.0253	3	0.002	4	0.9895	4	0.005	17	0.00416667	4	0.0756
12	4	0.113			4	0.0265	6	20.03	4	0.0255	3	0.0024	6	0.9915	5	0.00525	4	0.0042	7	0.0756
13	7	0.114			4	0.0269	4	20.03	10	0.026	3	0.002575	11	0.993	3	0.0055	3	0.005	4	0.076
14	12	0.114			3	0.0284	3	20.0475	4	0.02665	3	0.003	4	0.994	3	0.005775	3	0.005	17	0.0762
15	17	0.115			4	0.0288	3	20.06	4	0.027			4	0.995	3	0.006			4	0.0776
16	4	0.1158			10	0.030	10	20.08	4	0.0275			3	0.997	3	0.006			4	0.078
17	3	0.11875					13	20.13	7	0.02805			6	0.9985	4	0.0061			4	0.0782
18							12	20.18					3	1.001						
19							4	20.20												
Average		0.1111		0.0376		0.0262		20.014		0.0249		0.00192		0.971		0.00508		0.0032		0.0741
Std Dev		0.0039		0.0012		0.0015		0.036		0.0019		0.00052		0.031		0.00025		0.0012		0.0026
H		0.0034		0.0020		0.0017		0.066		0.0016		0.00055		0.011		0.00081		0.00067		0.0027
U_1		0.0034		0.0020		0.0023		0.075		0.0016		0.00055		0.011		0.00085		0.00068		0.0038
t-statistic		2.12		2.36		2.13		2.10		2.12		2.16		2.11		2.12		2.16		2.12
U_2		0.0071		0.0047		0.0048		0.16		0.0035		0.0012		0.022		0.0018		0.0015		0.0080
U_3		0.0017		0.0017		0.0012		0.036		0.00084		0.00032		0.0053		0.00044		0.00039		0.0020
Certified		**0.111**		**0.038**		**0.026**		**20.01**		**0.025**		**0.0019**		**0.97**		**0.0051**		**0.003**		**0.074**
Uncertainty		0.005		0.002		0.003		0.09		0.002		0.0007		0.03		0.0008		0.001		0.003
Tolerance		0.015		0.006		0.009		0.27		0.006		0.0018		0.09		0.0024		0.002		0.009

BS 9842 * Code for method Certified values listed as weight percent

Analysis	*	W
1	4	0.0060
2	4	0.008
3	4	0.0088
4	10	0.009
5	7	0.0102
6	3	0.0103
7	3	0.01115
8	4	0.01125
9	3	0.012
10	12	0.012
11	4	0.012
12	10	0.013
13	3	0.013
14	4	0.013
15	5	0.0135
16	4	0.0138
Average		0.0111
Std Dev		0.0022
H		0.0011
U_1		0.0011
t-statistic		2.13
U_2		0.0024
U_3		0.00060
Certified		**0.011**
Uncertainty		0.002
Tolerance		0.006

BS 9842 * Code for method Reference values listed as weight percent

Analysis	*	O	*	Pb	*	Sb	*	Ta	*	Zr
1	2	0.00347	4	0.00005	3	0.002	3	0.002	3	0.0025
2	2	0.0042	3	0.001	3	0.003	3	0.0111	3	0.004
3	2	0.0044	3	0.002	4	0.0052			3	0.004
4	2	0.00465			3	0.0062				
5	2	0.006								
Average		0.00454		0.000051		0.0041		0.0110		0.00267
Std Dev		0.00093		0.000034		0.0019		0.0011		0.00024
H		0.001		0.00016		0.00074		0.0011		0.00062
U_1		0.037		0.00016		0.00076		0.0016		0.00067
t-statistic		2.78		4.30		3.18		12.71		4.30
U_2		0.10		0.00070		0.0024		0.020		0.0029
U_3		0.046		0.00040		0.0012		0.014		0.0017
Reference		**0.005**		**<0.05**		**0.004**		**<0.05**		**0.003**
Uncertainty		0.002				0.002				0.001
Tolerance		0.004				0.003				0.002

For each element, in accordance with the requirements of ISO 17034 and ISO 33405, 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 it's 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 Standard 33405 section 10.

Analytical Method Codes:

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

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

Lab Name	Location	Registrar	Accreditation
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, 17034
Analytical Associates Metal Testing Services	Detroit, MI		
Andrew S. McCreath & Son, Inc.	Harrisburg, PA	A2LA	17025
Dirats Laboratories	Westfield,MA	ANAB	17025
VHG Labs	Manchester, NH	A2LA	17025, Guide 34
Shiva Technologies	Syracuse, NY	PRI	17025
LECO Corporation	St. Joseph, MI	A2LA	17025
ATI Allvac	Lockport, NY	ANAB	17025
ATI Allvac	Monroe, NC	ANAB	17025
Inco Test	Huntington, WV		
Crucible Specialty Metals	Syracuse, NY		
National Analysis Center For Iron And Steel	Beijing, China	CNAS	17025
Anarem	Prauge		

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

Analysis: Chemical analyses were made on solid pieces and chips prepared by a lathe 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: BAS 342, 345, 346, 464, 466/1, 467/1, 475; BS 0141P, 0142P, 0321P, 0322P, 81H, 81J, 81K, 83B, 83C, 83D, 83E, 83G, 83H, 317L, 9841; ECRM 088-1, 284-1, 286-1, 292-1, 481-1; JK 37; JSS 653-8, 654-8; LECO 501-502, 501-504, 501-553, 501-643, 501-644, 501-645, 501-647, 501-674, 501-675, 501-676, 502-106, 502-255, 502-256; SRM C1151, C1152, C1153, C1154, C1251, C1252, C1253, C1254, C1287, 15H, 32B, 32E, 73C, 101G, 121D, 123C, 125B, 131F, 133B, 160B, 343A, 344, 345, 346A, 348A, 361, 362, 363, 367, 892, 1156, 3103A, 3107, 3109A, 3161A.

Homogeneity: This Certified Reference Material (CRM) was tested for homogeneity using ASTM Standard Method E826 and found acceptable. It was also examined by spark atomic emission spectrometry and found to be compatible with the following Reference Materials: BAS 464; BS 0141P, 0142P, 0321P, 0322P, 83B, 83C, 83D, 83E, 83G, 9841; JSS 653-8, 654-8; SRM C1151, C1152, C1153, C1154, C1251, C1252, C1253, C1254, C1287.

Validity statement: ISO Standard 33401 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 9842 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 Sanyo Special Steel Co., LTD., Himeju, Japan.

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 Standard 33403 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 9842-060326. 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

Revision: This reference material was originally certified as BS 83H on July 18, 1994. An interlaboratory study was performed and this was certified as certified reference material on April 30, 2001 with a new designation of BS 9842. BS 9842 was certified before ISO Guide 34 was updated to ISO standard 17034. This revision supplies uncertainty estimates for all certified elements. Additional testing testing was performed. The element Fe has been added to the certified list. As has been changed from informational to certified. O has been changed from informational to reference. Pb, Sb, Ta, and Zr have been added to the reference list. Revised values for all elements except B, C, Mn, Mo, Nb, P, Ti, and W are presented.

Brammer Standard Company, Inc., is accredited by the American Association for Laboratory Accreditation (A2LA) to ISO Standard 17034:2016 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials (our current Certificate Number 656.02 expires 01/31/2027)

Brammer Standard Company's Chemical Laboratory is accredited by A2LA to ISO Standard 17025:2017. (Our current Certificate Number 656.01 expires 01/31/2027)

By current Certificate Number 10539 expiring 01/01/2027, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9001:2015 by National Quality Assurance (NQA), U.S.A.

The scopes of accreditation are listed on the website: www.brammerstandard.com

References:

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

E826 Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry

E1019 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques

E1806 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

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

ISO Standard 9001:2015 Quality Management Systems - Requirements

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

ISO Standard 33401:2024 Reference materials - Contents of certificates, labels, and accompanying documentation

ISO Standard 33403:2024 Reference materials – Requirements and and recommendations for use

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

ISO Standard 33405:2024 Reference materials – Approaches for characterization and assessment of homogeneity and stability

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

*ISO Guides and Standards available from Global Engineering - **www.global.ihs.com***

Other useful documents available from NIST, U.S. Department of Commerce, Gaithersburg, MD 20899.

NIST Special Publication 260-100, Handbook for SRM Users

NIST Special Publication 829, Use of NIST Standard Reference Materials for Decisions on Performance of Analytical Chemical Methods and Laboratories

Certified by: _____ on June 3, 2026.

Beau R. Brammer

President