

Brammer Standard Company, Inc.

Certificate of Analysis

BS 9842 (REVISION of BS 83H)

**Certified Reference Material¹ for Grade 310 Stainless Steel Alloy
(UNS Number S31000)**

	Certified Value²	Estimate of Uncertainty³		Certified Value²	Estimate of Uncertainty³
Analysis listed as percent by weight					
C	0.059	0.002	Nb	0.026	0.002
Mn	1.50	0.02	Sn	0.005	0.0005
P	0.025	0.002	Ti	0.003	0.001
S	0.0016	0.0005	V	0.075	0.002
Si	0.99	0.015	W	0.011	0.002
Cu	0.147	0.004	N	0.037	0.0012
Ni	20.02	0.04			
Cr	24.19	0.07			
Mo	0.111	0.004			
Al	0.014	0.002	Information Values⁴		
B	0.0025	0.0003	As	0.002	
Ca	0.0010	0.0002	O	0.0044	
Co	0.237	0.006			

¹ Brammer Standard Company, Inc., is accredited to ISO Guide 34 as a Reference Material Producer to produce Certified Reference Materials by A2LA (Certificate Number 656.02)

² The certified value listed is the present best estimate of the true value based on the results of an interlaboratory testing program.

³ The uncertainties listed are based on value judgments of the material inhomogeneity and the 95% confidence interval. The half-width confidence interval C(95%) is shown on page 2.

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

See the following pages for more information.

Certificate Number 9842-043001p1

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Analysis	*	C	* Mn	* P	* S	* Si	* Cu	* Ni	* Cr	* Mo
1	C	0.056	MnP 1.4604	XRF 0.0212	C 0.0011	XRF 0.939	XRF 0.14	AIC 19.97	TCr 24.08	XRF 0.105
2	C	0.0586	AES 1.485	AES 0.022	C 0.0012	AIC 0.970	AIC 0.140	GNI 19.97	XRF 24.084	AIC 0.105
3	C	0.0587	MnP 1.485	XRF 0.0225	C 0.0015	AA 0.970	AIC 0.142	GNI 19.98	AIC 24.09	XRF 0.1060
4	C	0.0588	AGX 1.49	AES 0.024	C 0.0016	GSI 0.9753	AA 0.142	AIC 19.98	AGX 24.11	AES 0.106
5	C	0.0588	AIC 1.49	AGX 0.0240	C 0.00161	XRF 0.978	MCB 0.144	GNI 20.00	XRF 24.155	AIC 0.108
6	C	0.059	AA 1.49	AIC 0.024	C 0.0017	GSI 0.982	XRF 0.146	AES 20.01	TCr 24.16	AES 0.1085
7	C	0.0591	AES 1.49	AIC 0.0241	C 0.0018	AIC 0.987	AGX 0.146	AIC 20.03	TCr 24.1603	AIC 0.110
8	C	0.0595	AIC 1.50	XRF 0.0245	IC 0.0019	AIC 0.990	AIC 0.147	GNI 20.03	TCr 24.17	AIC 0.111
9	C	0.0595	MnP 1.50	AIC 0.0248	C 0.002	AGA 0.993	AES 0.147	XRF 20.053	AES 24.17	XRF 0.111
10	C	0.0596	XRF 1.5015	AIC 0.0250	C 0.002	AIC 0.994	MCT 0.148	XRF 20.06	TCr 24.18	XRF 0.112
11	C	0.060	XRF 1.506	XRF 0.0250		AIC 0.995	XRF 0.149	XRF 20.075	AIC 24.18	AIC 0.112
12	C	0.060	XRF 1.51	MPH 0.0253		XRF 0.997	AIC 0.149	XRF 20.08	AES 24.18	AIC 0.113
13			AA 1.510	AIC 0.0255		GSI 0.998	AIC 0.150		XRF 24.236	AIC 0.113
14			AIC 1.515	XRF 0.026		AES 1.001	AIC 0.151		AIC 24.24	AGX 0.114
15			XRF 1.5215	AIC 0.0266		GSI 1.001	AA 0.151		AIC 24.26	MMT 0.114
16			AIC 1.53	AIC 0.027		XRF 1.0265	ECS 0.1529		TCr 24.27	XRF 0.115
17			XRF 1.53	AIC 0.0275		XRF 1.0265	XRF 0.154		XRF 24.272	AA 0.115
18				MPN 0.0280					XRF 24.28	AIC 0.1158
19									TCr 24.30	
Average		0.0590	1.501	0.0248	0.00164	0.990	0.1470	20.020	24.188	0.1108
Std Dev		0.0011	0.018	0.0018	0.00031	0.021	0.0043	0.041	0.069	0.0036
Certified		0.059	1.50	0.025	0.0016	0.99	0.147	20.02	24.19	0.111
t		2.201	2.1199	2.1098	2.2622	2.1199	2.1199	2.201	2.1009	2.1098
C (95%)		0.0007	0.009	0.0009	0.0002	0.011	0.0022	0.026	0.033	0.0018
BS 83H COA		0.059	1.51	0.025	0.002	0.99	0.15	20.03	24.18	0.11

Analysis	*	Al	* B	* Ca	* Co	* Nb	* Sn	* Ti	* V	* W
1	AIC	0.0116	AES 0.0021	AIC 0.00079	XRF 0.2225	XRF 0.023	AA 0.0044	AIC 0.001	XRF 0.071	AIC 0.008
2	AES	0.0127	AES 0.00218	AIC 0.0008	AA 0.230	XRF 0.0235	AIC 0.0044	AIC 0.002	XRF 0.0710	AIC 0.0088
3	AIC	0.0130	AES 0.0024	AIC 0.0009	XRF 0.232	AES 0.024	AAG 0.0045	AIC 0.002	XRF 0.072	XRF 0.009
4	AES	0.013	AIC 0.0024	AIM 0.0009	AGX 0.233	AIC 0.0240	AIM 0.0046	AIC 0.0025	AES 0.0727	MWC 0.0102
5	AIC	0.013	AIC 0.0024	AGA 0.0009	M5 0.233	AIC 0.025	MSn 0.0048	AIC 0.0026	AIC 0.0737	AES 0.0103
6	AAA	0.0136	AIC 0.0025	AIC 0.0010	AIC 0.235	MNb 0.0258	AIH 0.0048	AIC 0.0027	XRF 0.074	AIC 0.011
7	MCC	0.0138	AGX 0.0026	AIC 0.0011	XRF 0.235	AIC 0.0259	AES 0.0049	AES 0.003	AES 0.074	AIC 0.0112
8	AIC	0.0139	AIC 0.0026	AIC 0.0012	AA 0.235	AGX 0.026	AGA 0.005	AIC 0.003	AGX 0.074	AGA 0.012
9	AA	0.0146	AIC 0.0026	AAG 0.0013	AIC 0.236	AIC 0.026	AIC 0.0050	AES 0.0038	AIC 0.0744	XRF 0.013
10	AIC	0.0147	AES 0.00266	AIC 0.0014	AIC 0.237	AIC 0.026	AIC 0.005	AGX 0.004	MVE 0.0756	AES 0.013
11	AIC	0.015	AIC 0.0028		AIC 0.238	AES 0.0265	AIM 0.0052	AIC 0.0042	AIC 0.0756	AIC 0.013
12	AGX	0.015	MBD 0.0030		XRF 0.239	XRF 0.0265	AES 0.0055	AA 0.0042	AIC 0.076	AIC 0.013
13	XRF	0.016			AAA 0.2419	AIC 0.0269	AES 0.006	AES 0.005	AA 0.076	AIC 0.0138
14	AES	0.016			AES 0.244	AIC 0.028	AAG 0.0061	AIC 0.005	AIC 0.0766	
15	AIC	0.017			AIC 0.245	AIC 0.0288			AIC 0.0776	
16	AES	0.018			AIC 0.246				AIC 0.078	
17					AES 0.246				AIC 0.0782	
Average		0.0144	0.00252	0.00103	0.2370	0.0257	0.0050	0.0032	0.0747	0.0113
Std Dev		0.0017	0.00025	0.00021	0.0063	0.0016	0.0005	0.0012	0.0023	0.0019
Certified		0.014	0.0025	0.0010	0.237	0.026	0.005	0.003	0.075	0.011
t		2.1315	2.201	2.2622	2.1199	2.1448	2.1604	2.1604	2.1199	2.1788
C (95%)		0.0009	0.00016	0.00015	0.0032	0.0009	0.0003	0.0007	0.0012	0.0011
BS 83H COA		(0.014)	0.0026	0.0008	0.24	0.026	(0.004)	(0.004)	0.075	(0.012)

Analysis	*	N	* O	* As
1	FU	0.0358	FU 0.00347	AIC 0.0004
2	FU	0.0362	FU 0.0042	AES 0.0014
3	FU	0.0366	FU 0.0044	AES 0.002
4	FU	0.0368	FU 0.0044	AAG 0.0029
5	FU	0.0373	FU 0.0046	
6	FU	0.0374	FU 0.0054	
7	FU	0.0377		
8	FU	0.0380		
9	TN	0.0385		
10	FU	0.040		
Average		0.0374	0.00440	0.0017
Std Dev		0.0012	0.00061	0.0011
Certified		0.037	(0.0044)	(0.002)
t		2.2622	2.5706	3.1824
C (95%)		0.0009	0.0006	0.0017
BS 83H COA		0.037	0.0046	----

* Methods of analysis listed on page 3

Data in parentheses is not certified but is provided for information only

$C(95\%) = (t \times sd) / \sqrt{n}$ The half-width confidence interval, where t is the appropriate Student's t value, sd is the interlaboratory standard deviation, and n is the number of acceptable mean values. For further information regarding the confidence interval for the certified value see ISO Guide 35:1989 section 4.

Methods of Analysis

Code	Element	Method
AA		Flame Atomic Absorption Spectrometry
AAA		Flame Atomic Absorption - standard addition method
AAG		Electro-thermal atomization (graphite furnace) Atomic Absorption Spectrometry
AES		AES - Spark Source Optical Emission Spectrometry
AGA		AES - Spark Source and Glow Discharge Spectrometry average
AGX		Glow Discharge and X-Ray Fluorescence Spectrometry average
AIC		AES - ICP -Inductively Coupled Plasma Spectrometry
AIH		AES - ICP -Inductively Coupled Plasma Spectrometry after hydride generation
AIM		AES - ICP Mass Spectrometry addition method
C	C, S	Combustion-Infrared Absorption (ASTM E 1019) traceable to CRMs
ECS	Cu	Sulphide precipitation, electro- deposition, gravimetric
FU	N, O	Inert gas Fusion Method (ASTM E 1019) traceable to CRMs
GNI	Ni	Dimethylglyoxime gravimetric
GSi	Si	Gravimetry with perchloric acid
IC	S	Ion chromatography
M5	Co	MAS - 5-Cl-PADAB spectrophotometric
MBD	B	MAS - Distillation separation-curcumin photometric
MCB	Cu	MAS - Bicyclohexane oxalyldihydrazone photometric
MCC	Al	MAS - Chromazurol S photometric after separation with cupferron
MCT	Cu	MAS - Tetraethylthiuram disulphide
MMT	Mo	MAS - Thiocyanate photometric
MNb	Nb	MAS - Sulphochlorophenol S photometric
MnP	Mn	MAS - Periodate oxidation
MPH	P	MAS - Heteropoly molybdenum blue photometric
MPN	P	MAS - Butyl alcohol-trichloromethane extraction photometric
MSn	Sn	MAS - Phenylfluorone photometric
MVE	V	MAS - n-benzoyl phenylhydroxylamine extraction photometric
MWC	W	MAS - Chlorpromazine hydrochloride sodium thiocyanate - tri-chloromethane extraction
TCr	Cr	Persulfate oxidation, ferrous sulfate titrimetric
TN	N	Neutralization titrimetric after distillation separation
XRF		X-Ray Fluorescence spectrometry

AES = Atomic Emission Spectrometry

MAS = Molecular Absorption Spectrometry (photometric, spectrophotometric methods)

Co-operating Laboratories: The co-operating laboratories were:

Laboratory

Allvac, Lockport, New York
 Allvac, Monroe, North Carolina
 ANAREM, Prague, Czech Republic
 Brammer Standard Co., Inc., Houston, Texas
 China National Analysis Center for Iron and Steel, Beijing, China
 Crucible Specialty Steel, Syracuse, New York
 J. Dirats and Co., Inc., Westfield, Massachusetts
 IncoTest, Huntington, West Virginia
 LECO Corporation, St. Joseph, Michigan
 Shiva Analyticals (India) Ltd., Hoskote, Bangalore, India
 VHG Laboratories, Inc., Manchester, New Hampshire

Laboratory contact

Thomas Herdlein
 Patrick M. Cole
 Karel Bičovský
 Richard P. Beaumont
 Prof. Wang Haizhou
 William Mastroe
 Eric E. Dirats
 Melissa G. Staley
 Dennis Lawrenz
 Dr. T. V. Ramakrishna
 Julie M. McIntosh

Additional analytical data: This material was used as an unknown test specimen number 9842 in a nationally recognized Proficiency Testing Program (PTP) for stainless steel. Most of the participating laboratories used one or more of the ASTM Standard Test Methods E 327, E 572, E 1019, and E 1086. The PTP data was not used in calculating the certified values listed on pages 1 and 2. The data shown below are the results from the PTP.

Combustion Instrument Analysis using ASTM Standard Test Method E 1019

	C	S	N	O
Number of Labs	19	22	15	16
Grand Average	0.0581	0.0020	0.0375	0.0048
Standard Deviation	0.0021	0.0004	0.0008	0.0011

Optical Emission Spectrometric Analysis using ASTM Standard Test Method E 1086

	C	Mn	P	S	Si	Cu	Ni
Number of Labs	22	23	23	19	24	21	20
Grand Average	0.0579	1.4875	0.0257	0.0037	0.9784	0.1467	19.9385
Standard Deviation	0.0030	0.0313	0.0020	0.0018	0.0649	0.0146	0.1711

	Cr	Mo	Co	V	Sn
Number of Labs	19	21	7	6	5
Grand Average	24.2121	0.1158	0.2277	0.0725	0.0059
Standard Deviation	0.1785	0.0109	0.0167	0.0051	0.0013

X-ray Emission Spectrometric Analysis using ASTM Standard Test Method E 572

	Mn	P	Si	Cu	Ni	Cr	Mo	V	Co
Number of Labs	10	6	6	10	11	11	10	6	10
Grand Average	1.5143	0.0249	0.9899	0.1488	19.9914	24.2375	0.1079	0.0739	0.2349
Standard Deviation	0.0259	0.0012	0.0203	0.0089	0.1468	0.1054	0.0041	0.0030	0.0125

Certification Process: The requirements of ISO Guide 31, ISO Guide 34, ISO Guide 35, and ASTM Standard Guides E 1724 and E 1831 were followed for the preparation of this reference material and certificate of analysis. This is a Certified Reference Material as defined by ISO Guide 30.

Analysis: Chemical analyses were made on chips prepared by a lathe from the certified portion of the discs in accordance with ASTM Standard Practice E 1806. The laboratories participating in the testing normally followed the requirements of ISO Guide 25 and/or ISO Standard 17025. Individual values listed on page 2 are the average of each analyst's results. Methods of analysis are listed on page 3.

Outliers: Some outlying data was excluded from the data listed on page 2 due to technical assessment of the cooperating laboratories and statistical evaluation.

Traceability: The following Certified Reference Materials were used to validate the analytical data listed on page 2: SRM 15h, 32b, 126c, 131f, 166b, 343a, 345, 3103a, 3107, 3109a, 3161a; ECRM 284-1, 289-1, 295-1; BS CSN-1.

Homogeneity: This Certified Reference Material was tested for homogeneity using ASTM Standard Method E 826 and found acceptable. It was also examined by optical emission spectrometry using ASTM Standard Test Method E 1086 and found to be compatible with the following Reference Materials: SRM C1151, 1219, C1289, C2400; BS 17-4PH, 95, 95A, 96.

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. Whereas this material is in a solid form and stable, no expiration date is specified.

Source: This material was produced by Sanyo Special Steel Co., Ltd., Himeju, Japan. It was melted by an electric arc furnace, bottom poured into ingots, hot rolled, and annealed .

Form: This Certified Reference Material is in the form of a disc, approximately 38 mm (1.50 inches) diameter and 12 mm (0.50 inches) thick.

Use: This Certified Reference Material is intended for use in optical emission and x-ray spectrometric methods of analysis. Refer to ISO Guide 33 for information about the use of Reference Materials.

Certified area: The entire depth of the disc may be used.

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

Because this Reference Material contains a high percent of nickel and chromium, care must be taken in its application. Make certain that corrections are made for possible element interference and dilution effects.

Sample Preparation: For best analytical results, use the same method for preparing the analytical surface on all reference materials as you use for production specimens. Avoid overheating the disc during surface preparation.

Certificate Number: The unique identification number for this certificate of analysis is 9842-043001-px, where x indicates the page number. Refer to future Brammer Standard Company catalogs for information on any revisions to this or other Brammer Standard reference materials. You may also obtain information on revisions of certificates from the internet at brammerstandard.com.

Revision information: A new interlaboratory testing program (ITP) was initiated for this material when a replacement was tested. There was no dramatic change in analysis originally certified . The original values certified on July 18, 1994, are listed on page 2 at the bottom of each table. The original part number was BS 83H with certificate number 83H-071894.

Safety Notice: A Material Safety Data Sheet (MSDS) 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 brammerstandard.com e-mail bramstan@netropolis.net
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Certified by: _____ on April 30, 2001.
G. R. Brammer

Certificate Number 9842-043001p5

Brammer Standard Company, Inc., is accredited to ISO Guide 34 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials by A2LA (Certificate Number 656.02) The scope of accreditation is listed on the website: www.brammerstandard.com

By Certificate Number 10539, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9002:1994 by National Quality Assurance, U.S.A.

Brammer Standard Company's Chemical Laboratory is accredited to ISO Guide 25 by A2LA. (Certificate Number 656.01)

References:

ASTM documents available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Telephone: 610-832-9500 Fax: 610-832-9555 e-mail: service@astm.org Website: www.astm.org

E 327 - 94 Standard Test Method for Optical Emission Spectrometric Analysis of Stainless Type 18-8 Steels by the Point-to-Plane Technique

E 572 - 94 Standard Test Method for X-Ray Emission Spectrometric Analysis of Stainless Steel

E 826 - 85 (Reapproved 1996) Standard Practice for Testing Homogeneity of Materials for the Development of Reference Materials

E 1019 - 2000 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys

E 1086 - 94 Standard Test Method for Optical Emission Vacuum Spectrometric Analysis of Stainless Steel by the Point-to-Plane Excitation Technique

E 1724 - 95 Standard Guide for Testing and Certification of Metal and Metal-Related Reference Materials

E 1806 - 96 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

E 1831 - 96 Standard Guide for Preparing Certificates for Reference Materials Relating to Chemical Composition of Metals, Ores, and Related Materials.

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

ISO Standard 17025 (First edition, 1999), General requirements for the competence of calibration and testing laboratories.

ISO Guide 25 (Third edition, 1990), General requirements for the competence of calibration and testing laboratories.

ISO Guide 30 (Second edition, 1991), Terms and definitions used in connection with reference materials.

ISO Guide 31 (Second edition, 2000), Reference materials -Contents of certificates and labels.

ISO Guide 33 (Second edition, 2000), Uses of certified reference materials.

ISO Guide 34 (Second edition, 2000), General requirements for the competence of reference material producers.

ISO Guide 35 (Second edition, 1989), Certification of reference materials - General and statistical principles.

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

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