Brammer Standard Company, Inc.

Certificate of Analysis

BS 9841

Certified Reference Material[1] for Grade 310 Stainless Steel Alloy

(UNS Number S31000)

	Certified Value[2]	Estimate of Uncertainty[3]		Certified Value[2]	Estimate of Ucertainty[3]
			Analysis listed as percent by weight		
C	**0.067**	0.002	**Sn**	**0.006**	0.001
Mn	**1.69**	0.015	**V**	**0.070**	0.004
P	**0.024**	0.002	**W**	**0.06**	0.01
S	**0.024**	0.0015			
Si	**0.54**	0.01	**Information Values[4]**		
Cu	**0.356**	0.008	Al	<0.006	
Ni	**19.55**	0.10	As	0.003	
Cr	**24.30**	0.10	Ca	0.0002	
Mo	**0.57**	0.01	O	0.011	
B	**0.0026**	0.0003	Pb	0.001	
Co	**0.116**	0.006	Sb	0.006	
N	**0.064**	0.002	Ti	0.002	
Nb	**0.070**	0.008	Zr	0.002	

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

[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 9841-050301p1

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Analysis	*	C	*	Mn	*	P	*	S	*	Si	*	Cu	*	Ni	*	Cr	*	Mo
1	C	0.0659	AA	1.679	XRF	0.0215	C	0.023	AES	0.519	ECS	0.347	TNi	19.37	TCr	24.155	AES	0.559
2	C	0.066	AES	1.68	MPH	0.0227	C	0.0235	XRF	0.526	AES	0.353	AIC	19.42	AIC	24.20	AIC	0.5668
3	C	0.067	MnP	1.683	AIC	0.0229	C	0.0238	AES	0.532	MCT	0.353	XRF	19.48	TCr	24.28	AIC	0.568
4	C	0.067	AGX	1.69	AES	0.0235	C	0.0239	XRF	0.534	AIC	0.353	GNi	19.58	AIC	24.30	AGX	0.571
5	C	0.067	AIC	1.69	AES	0.0236	C	0.025	GSi	0.536	MCB	0.354	XRF	19.59	TCr	24.31	GMo	0.574
6	C	0.0674	MnP	1.69	XRF	0.024	C	0.0251	GSi	0.539	AIC	0.356	XRF	19.607	AES	24.32	AIC	0.574
7	C	0.0677	XRF	1.699	AIC	0.024	IC	0.0252	AGA	0.549	AIC	0.357	AES	19.61	AES	24.32	XRF	0.575
8			AES	1.70	AIC	0.0244	C	0.026	GSi	0.550	XRF	0.357	TN2	19.64	AGX	24.33	AIC	0.576
9			XRF	1.70	AIC	0.0246			AIC	0.552	AA	0.361	AGX	19.65	XRF	24.334	MMT	0.578
10			XRF	1.705	AGA	0.0246			AIC	0.554	AGX	0.362			XRF	24.36	XRF	0.58
11					AIC	0.0254					AES	0.366			TCr	24.44	AIC	0.581
12					XRF	0.026												
13					MPN	0.0262												
Average		0.0669		1.692		0.0241		0.0244		0.539		0.3563		19.550		24.304		0.573
Std Dev		0.0007		0.009		0.0013		0.0010		0.012		0.0052		0.101		0.076		0.006
Certified		0.067		1.69		0.024		0.024		0.54		0.356		19.55		24.30		0.57
t		2.4469		2.2622		2.1788		2.3646		2.2622		2.2281		2.306		2.2281		2.2281
C(95%)		0.0006		0.0065		0.0008		0.0009		0.0085		0.0035		0.0777		0.0509		0.0043

Analysis	*	B	*	Co	*	N	*	Nb	*	Sn	*	V	*	W
1	AES	0.0022	AIC	0.106	FU	0.0608	AES	0.0611	AGA	0.005	XRF	0.0645	AIM	0.0531
2	AIC	0.0023	XRF	0.11	FU	0.0630	MNA	0.0629	AIH	0.0053	XRF	0.066	AIC	0.054
3	AIC	0.0024	AA	0.111	FU	0.0633	XRF	0.063	AIM	0.0053	AES	0.0679	AES	0.055
4	AIC	0.0024	M5	0.113	FU	0.0640	AES	0.069	AES	0.0056	XRF	0.068	AIC	0.056
5	AIC	0.0025	AGX	0.114	FU	0.0645	AGX	0.070	AAG	0.0057	AIC	0.0693	AGA	0.057
6	AES	0.0026	AIC	0.114	TN	0.0650	AIC	0.072	AIC	0.0058	AIC	0.0693	AIC	0.059
7	AGA	0.0026	AIC	0.116	FU	0.0651	AIC	0.074	MSn	0.0058	AGX	0.070	XRF	0.063
8	MBD	0.0026	AES	0.118	FU	0.066	AIC	0.074	AES	0.0059	AIC	0.0710	XRF	0.065
9	AES	0.00264	XRF	0.119			XRF	0.075	AIC	0.0060	MVE	0.0718	AES	0.0658
10	AES	0.00271	AIC	0.120			AIC	0.0763	AIC	0.006	AAA	0.072	AIC	0.0660
11	AIC	0.0028	AAA	0.1219			MNb	0.0782	AIM	0.0062	AES	0.072	AIC	0.0672
12	AIC	0.0032	XRF	0.122					AES	0.0069	AIC	0.0722	XRF	0.068
13			AES	0.125							AIC	0.076	MWC	0.0686
Average		0.00258		0.1161		0.0640		0.0705		0.0058		0.0700		0.0614
Std Dev		0.00026		0.0055		0.0016		0.0059		0.0005		0.0030		0.0058
Certified		0.0026		0.116		0.064		0.070		0.006		0.070		0.06
t		2.201		2.1788		2.3646		2.2281		2.201		2.1788		2.1788
C(95%)		0.00017		0.0033		0.0013		0.0039		0.0003		0.0018		0.0035

Analysis	*	Al	*	As	*	Ca	*	O	*	Pb	*	Sb	*	Ti	*	Zr
1	AES	<0.001	AES	0.0024	AIC	0.0001	FU	0.00978	AES	0.0003	AES	0.003	AIC	0.0005	AES	0.0023
2	AES	0.0018	AES	0.0035	AES	0.0001	FU	0.0103	AES	0.0014	AES	0.0085	AIC	0.0010	AES	0.0024
3	AES	0.005	AAG	0.0042	AES	0.00029	FU	0.0112					AES	0.002		
4							FU	0.0115					AES	0.002		
5							FU	0.012					AES	0.0025		
Average				0.0034		0.00016		0.0110		0.0009		0.0058		0.0016		0.0024
Std Dev				0.0009		0.00011		0.0009		0.0008		0.0039		0.0008		0.0001
Information		(<0.006)		(0.003)		(0.0002)		(0.011)		(0.001)		(0.006)		(0.002)		(0.002)

* Methods of analysis listed on page 3

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

C(95%) = (t x sd)/ 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) traceble to CRMs
GMo	Mo	Gravimetry, Benzolnoxime
GNi	Ni	Dimethylglyoxime gravimetric
GSi	Si	Gravimetry with perchloric acid
IC	S	Ion chrometography
M5	Co	MAS - 5-Cl-PADAB spectrophotometric
MBD	B	MAS - Distillation separation-curcumin photometric
MCB	Cu	MAS - Bicyclohexane oxalyldihydrazone photometric
MCT	Cu	MAS - Tetraethylthiuram disulphide
MMT	Mo	MAS - Thiocyanate photometric
MNA	Nb	MAS - Absorptionmetric determination method with 4-(2-pyridylazo)-Resorcinol
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
TNi	Ni	EDTA titration
TN2	Ni	Titrimetry with EDTA, zinc sulfate
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	Laboratory contact
Allvac, Lockport, New York	Thomas Herdlein
Allvac, Monroe, North Carolina	Patrick M. Cole
ANAREM, Prague, Czech Republic	Karel Bi ovsk
Brammer Standard Co., Inc., Houston, Texas	Richard P. Beaumont
China National Analysis Center for Iron and Steel, Beijing, China	Prof. Wang Haizhou
Crucible Specialty Steel, Syracuse, New York	William Mastroe
J. Dirats and Co., Inc., Westfield, Massachusetts	Eric E. Dirats
IncoTest, Huntington, West Virginia	Melissa G. Staley
LECO Corporation, St. Joseph, Michigan	Dennis Lawrenz
Shiva Analyticals (India) Ltd., Hoskote, Bangalore, India	Dr. T. V. Ramakrishna
VHG Laboratories, Inc., Manchester, New Hampshire	Julie M. McIntosh

Additional analytical data: This material was used as an unknown test specimen number 9841 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	22	22	16	16
Grand Average	0.0674	0.0254	0.0641	0.0118
Standard Deviation	0.0028	0.0011	0.0013	0.0009

Optical Emission Spectrometric Analysis using ASTM Standard Test Method E 1086

	C	Mn	P	S	Si	Cu	Ni
Number of Labs	22	22	23	19	23	21	21
Grand Average	0.0661	1.6857	0.0249	0.0248	0.5524	0.3574	19.4778
Standard Deviation	0.0037	0.0498	0.0024	0.0021	0.0184	0.0198	0.2318

	Cr	Mo	Co	V	Sn
Number of Labs	20	22	8	6	5
Grand Average	24.3622	0.5427	0.1112	0.0680	0.0066
Standard Deviation	0.1701	0.0219	0.0090	0.0061	0.0017

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	1.7009	0.0241	0.5414	0.3611	19.5042	24.3570	0.5577	0.0677	0.1133
Standard Deviation	0.0282	0.0009	0.0080	0.0088	0.1202	0.1075	0.0085	0.0023	0.0102

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 Slater Steels Corporation, Fort Wayne Specialty Alloys Division, Fort Wayne, Indiana. 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 44 mm (1.75 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 9841-050301-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.

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

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Certified by: _____ on May 3, 2001.
G. R. Brammer

Certificate Number 9841-050301p5

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 Emissioin 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