

Certificate of Analysis

BS 9941

Certified Reference Material¹ for Grade 317L Stainless Steel Alloy
(UNS Number S31703)

	Certified Value ²	Estimate of Uncertainty ³	Certified Value ²	Estimate of Ucertainty ³
Analysis listed as percent by weight				
C	0.021	0.002	Nb	0.015 0.002
Mn	1.78	0.02	Sn	0.007 0.001
P	0.027	0.0015	V	0.062 0.002
S	0.024	0.0015	W	0.068 0.008
Si	0.33	0.01		
Cu	0.424	0.008	Information Values⁴	
Ni	13.68	0.08	As	0.010
Cr	18.48	0.10	Ca	0.0003
Mo	3.24	0.03	O	0.0058
Al	0.004	0.0005	Ti	0.002
B	0.0025	0.0002		
Co	0.178	0.006		
N	0.036	0.0015		

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.

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Data listed as mass fraction expressed as percent.

9941-071801p2

Analysis	*	C	* Mn	* P	* S	* Si	* Cu	* Ni	* Cr	* Mo
1	C	0.019	AGX 1.75	AIC 0.025	C 0.023	AIC 0.316	ECS 0.412	AIC 13.62	TCr 18.39	AIC 3.206
2	C	0.021	AA 1.757	MPH 0.0251	IC 0.0230	AES 0.317	AES 0.415	AIC 13.62	AES 18.40	XRF 3.21
3	C	0.0210	MnP 1.7574	AGA 0.0252	C 0.023	AES 0.32	XRF 0.415	XRF 13.628	AIC 18.42	XRF 3.216
4	C	0.0212	AES 1.76	AIC 0.0260	C 0.0230	XRF 0.324	AIC 0.423	TNi 13.63	AGX 18.44	MMT 3.23
5	C	0.022	XRF 1.768	AES 0.026	C 0.0230	GSI 0.326	AGX 0.424	GNI 13.638	AES 18.45	GMO 3.240
6	C	0.022	MnP 1.769	XRF 0.0266	C 0.024	GSI 0.327	AA 0.427	XRF 13.648	TCr 18.46	AES 3.24
7	C	0.0224	XRF 1.78	AIC 0.0267	C 0.0248	GSI 0.3319	AIC 0.428	AES 13.68	XRF 18.49	AGX 3.24
8			MnP 1.79	AES 0.027	C 0.0254	AGA 0.332	XRF 0.428	TN2 13.75	XRF 18.50	XRF 3.245
9			AIC 1.80	XRF 0.0272	C 0.0266	XRF 0.333	MCT 0.429	GNI 13.79	TCr 18.58	AIC 3.256
10			XRF 1.809	AIC 0.0278		GSI 0.336	MCB 0.430	AGX 13.80	AIC 18.63	AES 3.26
11			AIC 1.82	AIC 0.0282		AIC 0.341	AIC 0.430			AIC 3.28
12				MPN 0.0283						GMO 3.2852
Average		0.0212	1.778	0.0266	0.0240	0.328	0.4237	13.680	18.476	3.242
Std Dev		0.0011	0.023	0.0012	0.0013	0.008	0.0067	0.072	0.077	0.025
Certified		0.021	1.78	0.027	0.024	0.33	0.424	13.68	18.48	3.24
t		2.4469	2.2281	2.201	2.306	2.2281	2.2281	2.2622	2.2622	2.201
C(95%)		0.0010	0.0158	0.0007	0.0010	0.0054	0.0045	0.051	0.055	0.0160

Analysis	*	Al	B	Co	N	Nb	Sn	V	W
1	AIC	0.0030	AIC 0.0022	AAA 0.1678	TN 0.0338	AIC 0.013	AIH 0.0052	MVE 0.0598	AIM 0.0608
2	AAA	0.0032	AIC 0.0023	AGX 0.173	FU 0.0358	AIC 0.013	AGA 0.006	AIC 0.0605	AGA 0.062
3	AES	0.0035	AIC 0.0025	AES 0.174	FU 0.0365	AIC 0.0136	AIM 0.0061	AES 0.0608	AIC 0.064
4	AES	0.0036	AGA 0.0026	AIC 0.176	FU 0.0366	IC 0.0139	AAG 0.0061	XRF 0.061	AIC 0.0650
5	AES	0.0036	AIC 0.0026	M5 0.176	FU 0.0369	AES 0.0153	AIM 0.0070	XRF 0.0615	XRF 0.065
6	AES	0.004	AES 0.0026	AIC 0.177	FU 0.0373	AIC 0.0154	AIC 0.007	AAA 0.062	AES 0.066
7	AGA	0.004	AIC 0.0026	AIC 0.179		XRF 0.0155	MSn 0.0071	AIC 0.0630	AIC 0.067
8	AIC	0.004	MBD 0.0026	XRF 0.181		AIC 0.016	AES 0.0073	AIC 0.0635	XRF 0.071
9	AIC	0.0044	AES 0.00277	AIC 0.182		AGX 0.017	AIC 0.0076	AIC 0.0636	XRF 0.071
10			XRF 0.184				AIC 0.0078	AGX 0.064	XRF 0.073
11			AES 0.185						AIC 0.0780
12									MWC 0.0782
Average		0.0037	0.00253	0.1777	0.0362	0.0147	0.0067	0.0620	0.0684
Std Dev		0.0004	0.00017	0.0051	0.0013	0.0014	0.0008	0.0015	0.0058
Certified		0.004	0.0025	0.178	0.036	0.015	0.007	0.062	0.068
t		2.306	2.306	2.2281	2.5706	2.306	2.2622	2.2622	2.201
C(95%)		0.0003	0.0001	0.0035	0.0013	0.0011	0.0006	0.0011	0.0037

Analysis	*	As	Ca	O	Ti
1	AES	0.007	AIC 0.0002	FU 0.0054	AIC 0.0003
2	AES	0.007	AES 0.00027	FU 0.0058	AIC 0.0004
3	MAD	0.0118	AES 0.0005	FU 0.00584	XRF 0.002
4	AAG	0.0119		FU 0.0060	XRF 0.002
5	AES	0.0123			AES 0.003
6	AAH	0.0125			
Average		0.0104	0.0003	0.0058	0.0015
Std Dev		0.0027	0.0002	0.0003	0.0012
Information		(0.010)	(0.0003)	(0.0058)	(0.002)

* Methods of analysis listed on page 3

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

$C(95\%) = (t \times sd) / n$ 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
AAH		Flame Atomic Absorption Spectrometry with hydride generation
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
GMo	Mo	Gravimetry, Benzoinoxime
GNi	Ni	Dimethylglyoxime gravimetric
GSi	Si	Gravimetry with perchloric acid
IC	S, Nb	Ion chromatography
M5	Co	MAS - 5-Cl-PADAB spectrophotometric
MAD	As	MAS - Molybdenum blue photometric after separation by distillation
MBD	B	MAS - Distillation separation-curcumin photometric
MCB	Cu	MAS - Bicyclohexane oxalyldihydrazone photometric
MCT	Cu	MAS - Tetraethylthiuram disulphide
MMT	Mo	MAS - Thiocyanate 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

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 Bi ovsk
 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 9941 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	23	23	17	16
Grand Average	0.0214	0.0246	0.0367	0.0063
Standard Deviation	0.0020	0.0019	0.0009	0.0010

Optical Emission Spectrometric Analysis using ASTM Standard Test Method E 1086

	C	Mn	P	S	Si	Cu	Ni
Number of Labs	17	19	18	16	17	18	18
Grand Average	0.0216	1.7716	0.0264	0.0251	0.3439	0.4351	13.6046
Standard Deviation	0.0024	0.0264	0.0014	0.0020	0.0080	0.0150	0.1315

	Cr	Mo	Co	V	Sn	Al
Number of Labs	18	17	8	8	4	6
Grand Average	18.5304	3.2155	0.1806	0.0632	0.0069	0.0045
Standard Deviation	0.0877	0.0534	0.0048	0.0055	0.0006	0.0012

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

	Mn	P	Si	Cu	Ni	Cr	Mo	V	Co
Number of Labs	12	7	8	11	12	12	12	7	12
Grand Average	1.7753	0.0259	0.3385	0.4400	13.6034	18.5577	3.1898	0.0632	0.1781
Standard Deviation	0.0346	0.0016	0.0166	0.0157	0.0963	0.1288	0.0371	0.0023	0.0036

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, 125b, 166b, 343a, 3103a, 3107, 3109a, 3161a; ECRM 289-1, 295-1.

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 1155; SS 466/1, 467; BS CA316-3, 82E, 316A, 316B, and 317L.

Validity statement: ISO Guide 31 states that the certificates of analysis 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 melted by Avesta Sheffield in Sweden and rolled in Richburg, South Carolina. 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 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 9941-071801-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	web brammerstandard.com e-mail bramstan@netropolis.net
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Certified by: _____ on July 18, 2001.
G. R. Brammer

Certificate Number 9941-071801p5

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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