

# Certificate of Analysis

BS 9942

Certified Reference Material<sup>1</sup> for Grade 317L Stainless Steel Alloy  
(UNS Number S31703)

	Certified Value <sup>2</sup>	Estimate of Uncertainty <sup>3</sup>	Certified Value <sup>2</sup>	Estimate of Uncertainty <sup>3</sup>
Analysis listed as percent by weight				
<b>C</b>	<b>0.021</b>	0.002	<b>N</b>	<b>0.071</b> 0.002
<b>Mn</b>	<b>1.84</b>	0.02	<b>Nb</b>	<b>0.005</b> 0.001
<b>P</b>	<b>0.025</b>	0.002	<b>Sn</b>	<b>0.006</b> 0.001
<b>S</b>	<b>0.006</b>	0.0005	<b>V</b>	<b>0.072</b> 0.002
<b>Si</b>	<b>0.49</b>	0.015	<b>W</b>	<b>0.032</b> 0.005
<b>Cu</b>	<b>0.305</b>	0.008		
<b>Ni</b>	<b>13.55</b>	0.06		
<b>Cr</b>	<b>18.21</b>	0.08		
<b>Mo</b>	<b>3.30</b>	0.03		
<b>Al</b>	<b>0.004</b>	0.001	<b>Information Values<sup>4</sup></b>	
<b>B</b>	<b>0.0014</b>	0.0002	As	0.004
<b>Ca</b>	<b>0.0014</b>	0.0002	O	0.0023
<b>Co</b>	<b>0.086</b>	0.006	Ti	0.002

<sup>1</sup> 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

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

<sup>3</sup> 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.

<sup>4</sup> Information values are not certified and are provided for information only.

See the following pages for more information.

Certificate Number 9942-071801p1

Analysis	*	C	* Mn	* P	* S	* Si	* Cu	* Ni	* Cr	* Mo
1	C	0.018	AIC 1.809	AIC 0.023	C 0.005	AIC 0.477	AIC 0.298	TNi 13.50	TCr 18.15	MMT 3.26
2	C	0.0197	AGX 1.82	AIC 0.0238	C 0.0057	AES 0.477	ECS 0.299	XRF 13.515	AIC 18.16	AIC 3.264
3	C	0.020	MnP 1.8291	XRF 0.024	IC 0.0058	AGA 0.483	AES 0.301	AIC 13.52	AES 18.18	AIC 3.28
4	C	0.0203	MnP 1.832	AES 0.024	C 0.0060	AIC 0.488	AIC 0.302	AIC 13.52	TCr 18.18	XRF 3.286
5	C	0.022	XRF 1.834	XRF 0.0244	C 0.006	XRF 0.500	MCT 0.303	XRF 13.539	XRF 18.21	XRF 3.291
6	C	0.022	AA 1.834	AIC 0.0246	C 0.0061	GSi 0.500	MCB 0.304	XRF 13.54	XRF 18.24	AGX 3.30
7	C	0.0226	MnP 1.84	AGA 0.0251	C 0.0062	AIC 0.500	AES 0.305	XRF 13.56	TCr 18.27	XRF 3.315
8			AIC 1.84	AES 0.0253	C 0.00646	GSi 0.5003	AIC 0.305	GNi 13.5798	XRF 18.325	AIC 3.316
9			AES 1.85	MPH 0.0256		AIC 0.502	XRF 0.306	AES 13.58		AES 3.32
10			XRF 1.855	AIC 0.0262		XRF 0.504	AA 0.310	TN2 13.61		AIC 3.329
11			AIC 1.88	AIC 0.0265		AIC 0.507	AGX 0.311			
12				MPN 0.0266			XRF 0.320			
Average		0.0207	1.838	0.0249	0.0059	0.494	0.3053	13.546	18.214	3.296
Std Dev		0.0016	0.019	0.0012	0.0004	0.011	0.0060	0.035	0.060	0.024
Certified		0.021	1.84	0.025	0.006	0.49	0.305	13.55	18.21	3.30
t		2.4469	2.2281	2.201	2.3646	2.2281	2.201	2.2622	2.3646	2.2622
C(95%)		0.0015	0.0126	0.0007	0.0004	0.0074	0.0038	0.025	0.050	0.017

Analysis	*	Al	* B	* Ca	* Co	* N	* Nb	* Sn	* V	* W
1		AIC 0.0032	AIC 0.0012	AIM 0.0012	AIC 0.080	FU 0.0684	AIC 0.0043	AIC 0.0046	AES 0.070	AIC 0.025
2		XRF 0.0034	AIC 0.0012	AIC 0.0013	AGX 0.081	TN 0.0688	XRF 0.0045	AIH 0.005	AES 0.0719	AIM 0.0278
3		AAA 0.0039	AGA 0.0013	AIC 0.0014	AIC 0.081	FU 0.0704	MNA 0.0048	AIM 0.0051	XRF 0.072	AIC 0.0295
4		AES 0.004	AIC 0.0013	AIC 0.0014	AES 0.0814	FU 0.0714	IC 0.0049	AGA 0.006	XRF 0.072	XRF 0.0305
5		AES 0.004	AES 0.0013	AES 0.00143	AAA 0.082	FU 0.0716	AIC 0.005	AIC 0.0060	AIC 0.0727	AIC 0.031
6		AES 0.0043	AES 0.00135	AIC 0.0015	AES 0.084	FU 0.0725	AGX 0.005	AIC 0.006	MVE 0.0728	AES 0.031
7		AES 0.0043	AES 0.00142	AGA 0.0016	AIC 0.084	FU 0.0740	AES 0.0054	AES 0.0061	AIC 0.0729	AIC 0.032
8		AIC 0.0045	AIC 0.0015	AIC 0.0016	XRF 0.084		AIC 0.006	MSn 0.0062	XRF 0.073	AGA 0.033
9		AGA 0.005	AIC 0.0016		M5 0.0856		AIC 0.006	AIC 0.0063	AAA 0.073	XRF 0.035
10		AIC 0.005			XRF 0.086			AIM 0.0063	AIC 0.0730	XRF 0.036
11					AIC 0.0884				AIC 0.0744	MWC 0.0374
12					XRF 0.095					AIC 0.0379
13					AIC 0.0960					
14					XRF 0.096					
Average		0.0042	0.00135	0.00143	0.0860	0.0710	0.0051	0.0058	0.0725	0.0322
Std Dev		0.0006	0.00013	0.00014	0.0057	0.0020	0.0006	0.0006	0.0011	0.0039
Certified		0.004	0.0014	0.0014	0.086	0.071	0.005	0.006	0.072	0.032
t		2.2622	2.306	2.3646	2.1604	2.4469	2.306	2.2622	2.2281	2.201
C(95%)		0.0004	0.00010	0.00012	0.0033	0.0018	0.0005	0.0004	0.0007	0.0025

Analysis	*	As	* O	* Ti
1		AES 0.0009	FU 0.0019	AIC 0.0003
2		AAG 0.0042	FU 0.0022	AIC 0.0005
3		AES 0.0054	FU 0.0024	XRF 0.002
4			FU 0.0028	XRF 0.002
5				AES 0.0029
Average		0.0035	0.00233	0.0015
Std Dev		0.0023	0.00038	0.0011
Information		(0.004)	(0.0023)	(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
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, Nb	Ion chromatography
M5	Co	MAS - 5-Cl-PADAB spectrophotometric
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
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 9942 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	22	18	16
Grand Average	0.0202	0.0063	0.0731	0.0030
Standard Deviation	0.0017	0.0006	0.0017	0.0006

Optical Emission Spectrometric Analysis using ASTM Standard Test Method E 1086

	C	Mn	P	S	Si	Cu	Ni
Number of Labs	18	19	18	16	16	18	19
Grand Average	0.0208	1.8372	0.0245	0.0063	0.4978	0.3131	13.5258
Standard Deviation	0.0030	0.0342	0.0015	0.0007	0.0103	0.0114	0.1020
	Cr	Mo	Co	V	Sn	Al	
Number of Labs	18	15	8	7	4	6	
Grand Average	18.2382	3.2617	0.0855	0.0737	0.0062	0.0060	
Standard Deviation	0.0751	0.0379	0.0040	0.0097	0.0007	0.0021	

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	8	8	11	12	12	12	7	12
Grand Average	1.8496	0.0228	0.4933	0.3156	13.5496	18.2448	3.2596	0.0758	0.0837
Standard Deviation	0.0395	0.0016	0.0126	0.0100	0.1128	0.1116	0.0404	0.0026	0.0046

**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 AL Tech Specialty Steel Corporation, Dunkirk, New York. 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 9942-071801-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](http://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](http://brammerstandard.com)  
e-mail [bramstan@netropolis.net](mailto:bramstan@netropolis.net)

Certified by: \_\_\_\_\_ on July 18, 2001.  
G. R. Brammer

**Certificate Number 9942-071801p5**

**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](http://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](mailto:service@astm.org) Website: [www.astm.org](http://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](http://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

**Certificate Number 9942-071801p6**