

Certificate of Analysis

REVISION OF BS 192

Certified Reference Material¹ for 17-7PH Stainless Steel Alloy
(UNS Number S17700)

	Certified Value ²	Estimate of Uncertainty ³	Certified Value ²	Estimate of Uncertainty ³
Analysis listed as percent by weight				
C	0.074	0.002	O	0.0014 0.0003
Mn	0.835	0.008	Nb	0.168 0.006
P	0.025	0.001	Sn	0.008 0.001
S	0.0005	0.00015	Ti	0.076 0.004
Si	0.387	0.010	V	0.124 0.003
Cu	0.412	0.007	W	0.05 0.01
Ni	7.11	0.05		
Cr	16.44	0.06		
Mo	0.430	0.010		
Al	1.17	0.015	Information Values⁴	
Ca	0.0007	0.0002	As	0.005
Co	0.104	0.004	B	0.0003
N	0.0290	0.0008	Ta	0.001

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 192REV-032901p1

Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo
1	C 0.072	AA 0.819	AIC 0.0233	C 0.0002	AIC 0.359	AIC 0.395	XRF 7.07	AES 16.37	AES 0.410
2	C 0.0726	MnP 0.824	AGA 0.0237	C 0.0002	XRF 0.368	XRF 0.402	AIC 7.07	AIC 16.37	AIC 0.415
3	C 0.073	AIC 0.825	AIC 0.024	C 0.0003	AES 0.375	AGX 0.406	AES 7.07	TCr 16.38	AES 0.418
4	C 0.073	AES 0.827	AES 0.0241	C 0.00042	GSi 0.381	AIC 0.408	AIC 7.07	XRF 16.389	XRF 0.418
5	C 0.073	MnP 0.8274	AIC 0.0243	C 0.0005	AIC 0.382	AIC 0.409	TNi 7.07	XRF 16.395	AIC 0.422
6	C 0.0734	AIC 0.828	XRF 0.0245	C 0.0006	AIC 0.383	AA 0.410	AIC 7.08	AES 16.40	AA 0.423
7	C 0.074	AGX 0.829	AIC 0.0248	C 0.0006	AES 0.383	ECS 0.4101	XRF 7.085	AIC 16.41	XRF 0.424
8	C 0.0741	AES 0.830	AES 0.025	IC 0.0006	AIC 0.386	MCT 0.412	XRF 7.097	XRF 16.423	AIC 0.424
9	C 0.0742	AIC 0.835	XRF 0.025	C 0.0007	AGA 0.386	MCB 0.412	GNI 7.10	TCr 16.43	XRF 0.428
10	C 0.0744	AIC 0.837	MPH 0.0251		AA 0.388	XRF 0.414	AES 7.10	XRF 16.44	AIC 0.430
11	C 0.0746	XRF 0.838	AIC 0.0255		GSi 0.389	XRF 0.415	XRF 7.10	AIC 16.44	GMO 0.432
12	C 0.0750	XRF 0.840	AIC 0.0259		XRF 0.39	AIC 0.416	GNI 7.119	TCr 16.46	AIC 0.433
13	AES 0.076	AIC 0.840	XRF 0.026		GSi 0.395	AES 0.42	AIC 7.12	TCr 16.47	AIC 0.433
14	C 0.076	AIC 0.843	AIC 0.0272		AES 0.396	AES 0.420	GNI 7.12	AGX 16.47	AGX 0.433
15	AES 0.0787	XRF 0.845	MPN 0.0284		XRF 0.396	AIC 0.422	TNi 7.13	AIC 16.48	AIC 0.439
16		AIC 0.846			GSi 0.398	AIC 0.424	AGA 7.14	XRF 16.565	XRF 0.44
17		MnP 0.846			GSi 0.400		AIC 7.177	AIC 16.57	MMT 0.456
18		AA 0.850			AIC 0.402		AIC 7.28		AIC 0.457
Average	0.0743	0.8350	0.0251	0.00046	0.3865	0.4122	7.111	16.439	0.4297
Std Dev	0.0017	0.0091	0.0013	0.00019	0.0112	0.0076	0.051	0.060	0.0126
Certified	0.074	0.835	0.025	0.0005	0.387	0.412	7.11	16.44	0.430
t	2.1448	2.1098	2.1448	2.306	2.1098	2.1315	2.1098	2.1199	2.1098
C(95%)	0.0009	0.0045	0.0007	0.00014	0.0056	0.0040	0.026	0.031	0.0063
COA 192-020195	0.075	0.84	0.025	0.001	0.38	0.41	7.10	16.42	0.42

Analysis	Al	Ca	Co	N	O	Nb	Sn	Ti	V
1	AA 1.136	AGA 0.0004	AIC 0.096	FU 0.0273	FU 0.0011	MNA 0.1483	AAG 0.0064	XRF 0.070	XRF 0.117
2	AIC 1.137	AIC 0.0004	AAA 0.0965	FU 0.0278	FU 0.0011	AIC 0.158	AIH 0.0069	AIC 0.0709	XRF 0.12
3	AES 1.14	AIC 0.0005	AIC 0.0992	FU 0.0282	FU 0.0014	AES 0.163	AGA 0.007	AAA 0.071	AIC 0.123
4	AES 1.14	AIM 0.00061	AIC 0.100	FU 0.0287	FU 0.00145	AIC 0.163	AES 0.00757	AIC 0.072	AIC 0.123
5	AGA 1.14	AIC 0.0007	AA 0.1006	FU 0.0287	FU 0.0015	AIC 0.166	AES 0.0078	AA 0.0734	XRF 0.123
6	AIC 1.149	AES 0.0008	AA 0.102	FU 0.0291	FU 0.00155	AIC 0.166	AA 0.008	MTD 0.0746	AIC 0.124
7	AAA 1.15	AIC 0.0008	M5 0.103	FU 0.0295	FU 0.0016	MNR 0.166	AIC 0.008	AES 0.075	MVE 0.124
8	AIC 1.15	AIC 0.0008	AIC 0.1038	FU 0.02954		AIC 0.168	AES 0.008	XRF 0.075	AIC 0.1250
9	TAl 1.15	AIC 0.0008	AGX 0.106	FU 0.0298		AIC 0.168	MSn 0.0082	AIC 0.075	AIC 0.1252
10	AES 1.17	AES 0.00084	AES 0.106	FU 0.0300		AES 0.170	AIC 0.0082	AIC 0.0762	AIC 0.126
11	XRF 1.176	AIC 0.0010	XRF 0.106	TN 0.0300		XRF 0.17	AES 0.0083	AIC 0.0764	AES 0.126
12	AIC 1.18		AES 0.106			AGX 0.170	AIC 0.0085	AIC 0.0771	AES 0.126
13	XRF 1.180		AIC 0.107			XRF 0.171	AIM 0.0086	AES 0.078	XRF 0.126
14	AIC 1.19		AIC 0.107			AES 0.172	AIC 0.0096	AIC 0.078	AGX 0.126
15	AIC 1.20		AIC 0.108			AIC 0.172	AIC 0.0097	AGX 0.079	AA 0.1270
16	AIC 1.202		XRF 0.108			AIC 0.173		AIC 0.079	AAA 0.129
17	AIC 1.21		XRF 0.110			XRF 0.176		AES 0.0791	
18			XRF 0.113			AIC 0.179		AIC 0.081	
19								XRF 0.082	
20								XRF 0.0835	
Average	1.165	0.00070	0.1043	0.02897	0.00139	0.1677	0.0081	0.0763	0.1244
Std Dev	0.025	0.00019	0.0046	0.00091	0.00021	0.0069	0.0009	0.0037	0.0029
Certified	1.17	0.0007	0.104	0.0290	0.0014	0.168	0.008	0.076	0.124
t	2.1199	2.2281	2.1098	2.2281	2.4469	2.1098	2.1448	2.093	2.1315
C(95%)	0.013	0.00013	0.0023	0.00061	0.00019	0.0034	0.0005	0.0018	0.0015
COA 192-020195	1.15	0.0007	0.104	0.029	(0.002)	0.17	0.009	0.078	0.13

Analysis	W	As	B	Ta
1	AIC 0.036	AIC 0.005	AES 0.0002	AIC 0.0008
2	XRF 0.044	AES 0.0051	MBD 0.00022	AES 0.0012
3	AES 0.0459	AA 0.0056	AIC 0.0003	AIC 0.002
4	AIC 0.046	AAG 0.0059	AIC 0.00031	
5	XRF 0.046		AES 0.00035	
6	AIC 0.0514		AES 0.0004	
7	XRF 0.052		AIC 0.0004	
8	XRF 0.071		AIC 0.0005	
Average	0.0490	0.0054	0.00034	0.0013
Std Dev	0.0101	0.0004	0.00010	0.0006
Certified	0.05	(0.005)	(0.0003)	(0.001)
t	2.3646			
C(95%)	0.008481			
COA 192-020195	0.04	(0.005)	(0.0004)	(<0.003)

* Methods of analysis listed on page 3

Data in parentheses are not certified but are 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
GMo	Mo	Gravimetry, Benzolnoxime
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
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
MNR	Nb	MAS - PAR photometric
MPH	P	MAS - Heteropoly molybdenum blue photometric
MPN	P	MAS - Butyl alcohol-trichloromethane extraction photometric
MSn	Sn	MAS - Phenylfluorone photometric
MTD	Ti	MAS - Diantipyrylmethane photometric
MVE	V	MAS - n-benzoyl phenylhydroxylamine extraction photometric
TAI	Al	EDTA titration method after separation with cupferron
TCr	Cr	Persulfate oxidation, ferrous sulfate titrimetric
TN	N	Neutralization titrimetric after distillation separation
TNi	Ni	EDTA titration
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
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 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 0012 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 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	20	14	16	13
Grand Average	0.0743	0.0004	0.0293	0.0017
Standard Deviation	0.0032	0.0002	0.0011	0.0007

Optical Emission Spectrometric Analysis using ASTM Standard Test Method E 1086

	C	Mn	P	S	Si	Cu	Ni	N*
Number of Labs	10	13	13	11	13	12	10	4
Grand Average	0.0772	0.8185	0.0242	0.0017	0.3800	0.4111	7.0796	0.0315
Standard Deviation	0.0044	0.0152	0.0017	0.0014	0.0189	0.0111	0.0778	0.0021
	Cr	Mo	Co*	V*	Nb*	Sn*	Ti*	Al*
Number of Labs	11	13	8	8	8	6	8	7
Grand Average	16.4291	0.4361	0.1076	0.1192	0.1717	0.0085	0.0732	1.2464
Standard Deviation	0.1358	0.0191	0.0042	0.0076	0.0082	0.0017	0.0052	0.1121

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

	Mn	P*	Si*	Cu	Ni	Cr	Mo
Number of Labs	14	9	8	13	13	14	12
Grand Average	0.8175	0.0249	0.3863	0.4098	7.0883	16.3884	0.4274
Standard Deviation	0.0160	0.0011	0.0100	0.0103	0.0424	0.0999	0.0083
	V*	Co	Nb	Sn*	Ti*	Al*	
Number of Labs	9	13	7	7	5	6	
Grand Average	0.1250	0.1081	0.1688	0.0084	0.0748	1.1747	
Standard Deviation	0.0068	0.0065	0.0041	0.0020	0.0032	0.1058	

* The elements are not listed in the Scope of the ASTM Standard Test Method but are reported for information.

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, 101g, 121d, 123c, 126c, 133b, 160b, 343a, 344, 345, 346a, 348a, 361, 864, 865, 868, 2171; ECRM 096-1, 284-1, 286-1, 289-1, 295-1; BCS 342, 351, 466/1, 467/1, 475; BAM 230-1.

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, C1152, C1153; BS CA304-2, 81G, 85D, 184, 184A.

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 AL Tech Specialty Steel Corporation, Dunkirk, New York. It was melted by an electric arc furnace, bottom poured into ingots, hot rolled, and finished with a normalized heat treatment .

Form: This Certified Reference Material is in the form of a disc, approximately 38 mm in diameter and 12 mm 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.

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 192REV-032901-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 February 1, 1995, are listed on page 2 at the bottom of each table.

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 March 29, 2001.
G. R. Brammer

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 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