

Brammer Standard Company, Inc.

Certificate of Analysis

BS 317L

Certified Reference Material for Stainless Steel Grade 317L - UNS Number S31703

	Certified Value ¹	Estimate of Uncertainty ²	Certified Values^{2,3,4}	Certified Value ¹	Estimate of Uncertainty ²	
Al	0.0044	0.0006		N	0.055	0.003
B	0.0012	0.0003		Nb	0.031	0.002
C	0.025	0.001		Ni	13.51	0.08
Ca	0.0017	0.0005		P	0.029	0.002
Co	0.14	0.01		S	0.0017	0.0005
Cr	18.2	0.1		Si	0.67	0.02
Cu	0.23	0.01		Sn	0.0049	0.0007
Fe	[62.8]	0.1		Ti	0.0034	0.0006
Mn	1.17	0.02		V	0.091	0.004
Mo	3.07	0.03		W	0.017	0.002

	Reference Value ¹	Estimate of Uncertainty ²	Reference Values^{2,3,4,5}	Reference Value ¹	Estimate of Uncertainty ²
As	0.003	0.001			

Informational Values^{4,6}

Mg (0.0004) O (0.006) Pb (0.0002) Sb (0.002) Ta (0.002)
Zr (0.004)

¹ This certificate is a revision. For more information on the nature and extent of the revision, see the revision statement on page 5.

² For each element, the certified value listed is the present best estimate of the true value based on the mean of the weighted results of an interlaboratory testing program. See page 3 for more information on its calculation.

³ For each element, the uncertainty listed is based on a statistical evaluation of the contributions of homogeneity and the interlaboratory testing program. See page 3 for more information on its calculation.

⁴ Values are given in weight percent. Values in brackets are reported by difference.

⁵ Reference values not certified and are provided for information only.

⁶ Values in parentheses are not certified and are provided for information only.

The requirements of ISO Guides 30, 31, and 35 were followed for the preparation of this Certified Reference Material and certificate of analysis.

Analysis	*	Al	*	B	*	C	*	Ca	*	Co	*	Cr	*	Cu	*	Fe	*	Mn	*	Mo
1	17	0.003	4	0.0005	1	0.0223	17	0.00082	3	0.133	4	18.097	4	0.216	16	[62.77]	3	1.15	3	3.03
2	3	0.0039	11	0.001	11	0.0239	4	0.0011	3	0.134	4	18.11	4	0.217	16	[62.78]	4	1.15	4	3.038
3	11	0.0046	4	0.0010	11	0.0242	3	0.0014	3	0.135	4	18.127	3	0.219	16	[62.79]	4	1.157	3	3.05
4	11	0.0046	4	0.00105	1	0.02426667	11	0.0014	11	0.139	17	18.13667	3	0.22	16	[62.79]	4	1.159	4	3.05
5	11	0.0048	3	0.0011	1	0.02436667	11	0.0014	11	0.139	3	18.14	3	0.221	16	[62.8]	3	1.16	3	3.05
6	3	0.0049	3	0.0011	11	0.0245	11	0.0015	11	0.139	3	18.15	4	0.222	16	[62.82]	11	1.16	4	3.056
7	3	0.005	11	0.0012	3	0.0246	3	0.0015	4	0.139	4	18.16	11	0.222	16	[62.82]	4	1.165	4	3.065
8	3	0.0051	4	0.0012	1	0.0248	3	0.00151	4	0.139	4	18.175	4	0.223	16	[62.86]	11	1.17	4	3.067
9	4	0.006	3	0.0012	3	0.025	3	0.0016	4	0.14	18	18.18	11	0.223			4	1.174	3	3.07
10			11	0.0012	3	0.025	3	0.00163	4	0.141	3	18.18	11	0.223			17	1.176667	4	3.08
11			3	0.00122	3	0.0251	4	0.0022	4	0.141	4	18.181	3	0.224			3	1.18	4	3.081
12			3	0.00125	1	0.0255	4	0.0024	17	0.142	3	18.19	3	0.224			4	1.18	11	3.09
13			4	0.0015	3	0.0262	4	0.003	17	0.142033	4	18.22	4	0.232			4	1.186	4	3.098
14			4	0.0015	1	0.0282			3	0.145	11	18.31	4	0.232			4	1.188	11	3.1
15			4	0.00168	1	0.0283			4	0.145	11	18.31	17	0.234			3	1.19	17	3.10333
16			4	0.0024	1	0.0295			4	0.145	4	18.32	4	0.237			11	1.19	11	3.11
17											11	18.32	4	0.238			3	1.2	4	3.13
18											4	18.32								
Average		0.00435		0.001201		0.02468		0.001651		0.1377		18.234		0.225118		62.804		1.172686		3.0661
Std Dev		0.00028		0.000061		0.00088		0.000088		0.0032		0.022		0.000077		0.059		0.000077		0.0083
H		0.00076		0.00046		0.0016		0.00052		0.0037		0.062		0.0048		0.14		0.012		0.021
U ₁		0.00081		0.00046		0.0018		0.00052		0.0049		0.066		0.0048		0.15		0.012		0.022
t-statistic		2.31		2.13		2.13		2.18		2.13		2.11		2.12		2.36		2.12		2.12
U ₂		0.0019		0.0010		0.0039		0.0011		0.010		0.14		0.010		0.36		0.025		0.047
U ₃		0.00062		0.00025		0.0010		0.00032		0.0026		0.033		0.0025		0.13		0.0061		0.011
Certified		0.0044		0.0012		0.025		0.0017		0.14		18.2		0.23		[62.8]		1.17		3.07
Uncertainty		0.0006		0.0003		0.001		0.0005		0.01		0.1		0.01		0.1		0.02		0.03
Tolerance		0.0019		0.0009		0.004		0.0015		0.03		0.3		0.03		0.4		0.06		0.09

Analysis	*	N	*	Nb	*	Ni	*	P	*	S	*	Si	*	Sn	*	Ti	*	V	*	W
1	2	0.0525	3	0.025	11	13.36	4	0.0255	11	0.0011	3	0.61	3	0.004	11	0.0025	4	0.076	4	0.009
2	2	0.0536	4	0.029	11	13.37	4	0.0265	1	0.0011	3	0.62	4	0.0042	11	0.003	11	0.0878	11	0.0142
3	2	0.0549	4	0.029	4	13.377	4	0.027	3	0.0012	17	0.644333	3	0.0044	11	0.0034	4	0.088	11	0.0154
4	2	0.055533	3	0.0295	17	13.38	3	0.0276	1	0.0012	4	0.651	3	0.0044	3	0.0034	3	0.0882	4	0.01565
5	2	0.0561	4	0.02995	11	13.43	3	0.0277	3	0.0013	4	0.651	3	0.0045	3	0.0035	3	0.0884	11	0.0173
6	2	0.0565	11	0.03	4	13.47	4	0.028	1	0.0014	4	0.66	4	0.0046	3	0.0037	11	0.0885	3	0.0173
7	2	0.0566	11	0.0307	6	13.48	3	0.0281	1	0.0015	11	0.663	17	0.0050	4	0.004	3	0.0887	4	0.018
8	2	0.0569	3	0.0307	4	13.48	11	0.0287	11	0.0015	4	0.670	11	0.0055	3	0.004	4	0.089	3	0.019
9	2	0.0570	4	0.031	4	13.52	4	0.0299	1	0.0016	11	0.672	11	0.0057			4	0.089	4	0.019
10			4	0.031	4	13.52	4	0.030	1	0.0016	4	0.673	11	0.006			11	0.0892	3	0.0191
11			11	0.0313	3	13.52	4	0.030	1	0.0017	11	0.675					4	0.090	4	0.020
12			3	0.0316	3	13.54	11	0.0301	11	0.0019	4	0.676					4	0.090	4	0.020
13			4	0.032	17	13.5566667	11	0.0304	3	0.002	17	0.679667					4	0.093	3	0.0202
14			4	0.037	3	13.56	4	0.0309	3	0.0021	3	0.682					4	0.0935	4	0.021
15					4	13.57	3	0.031	1	0.0026	3	0.683					3	0.098		
16					3	13.57	3	0.032	3	0.003	4	0.683					3	0.099		
17					3	13.59	4	0.0333			4	0.684					4	0.102		
18					4	13.66					3	0.691					17	0.102		
19					4	13.67														
Average		0.0552		0.0306		13.506509		0.0294		0.00169		0.6652		0.00488		0.00344		0.0906		0.01720
Std Dev		0.0035		0.0013		0.000073		0.0011		0.00011		0.0055		0.00019		0.00011		0.0024		0.00093
H		0.0024		0.0018		0.051		0.0018		0.00052		0.009		0.00080		0.00069		0.0030		0.0014
U ₁		0.0042		0.0022		0.051		0.0021		0.00053		0.010		0.00082		0.00070		0.0039		0.0017
t-statistic		2.31		2.16		2.10		2.12		2.13		2.11		2.26		2.36		2.11		2.16
U ₂		0.010		0.0047		0.11		0.0043		0.0011		0.022		0.0019		0.0017		0.0082		0.0036
U ₃		0.0032		0.0013		0.025		0.0011		0.00028		0.0051		0.00059		0.00058		0.0019		0.0010
Certified		0.055		0.031		13.51		0.029		0.0017		0.67		0.0049		0.0034		0.091		0.017
Uncertainty		0.003		0.002		0.08		0.002		0.0005		0.02		0.0007		0.0006		0.004		0.002
Tolerance		0.010		0.006		0.24		0.006		0.0016		0.06		0.0021		0.0017		0.012		0.006

Analysis	*	As																	
1	17	0.001967																	
2	4	0.0026																	
3	3	0.0028																	
4	3	0.0029																	
5	3	0.003																	
6	4	0.0038																	
7	3	0.004																	
Average		0.00299																	
Std Dev		0.00065																	
H		0.00065																	
U ₁		0.00092																	
t-statistic		2.45																	
U ₂		0.0022																	
U ₃		0.00085																	
Reference		0.003																	
Uncertainty		0.001																	
Tolerance		0.002																	

Analysis	*	Mg	*	O	*	Pb	*	Sb	*	Ta	*	Zr							
1	4	0.0004	2	0.0056	3	0.0000059	4	0.0003	3	0.002	3	0.004							
2			2	0.005667	17	0.000024	3	0.0012				3	0.004						
3			2	0.0061	3	0.0001	3	0.003											
4			2	0.0065	3	0.0001	3	0.003											
5			2	0.0074	11	0.0002													
6			2	0.0075	4	0.0006													
Average		0.0004		0.006		0.000172		0.002		0.002		0.004							
Std Dev		0.0013		0.054		0.000081		0.011		0.024		0.049							
H		0.0003		0.001		0.00023		0.001		0.001		0.001							
U ₁		0.0013		0.054		0.00024		0.011		0.024		0.049							
t-statistic		12.71		2.57		2.57		3.18		12.71		12.71							
U ₂		0.016		0.14		0.00063		0.034		0.31		0.62							
U ₃		0.016		0.056		0.00026		0.017		0.31		0.44							
Informational		(0.0004)		(0.006)		(0.0002)		(0.002)		(0.002)		(0.004)							

For each element, in accordance with the requirements of ISO 17034 and Guide 35, an effort must be made to account for the effects on the certified value of the uncertainty estimate from homogeneity testing (H) and the uncertainties of the contributing laboratories. The average (A) is calculated using a weighted mean where the reciprocal of the square of each laboratory's combined uncertainty (C_L), calculated from its standard deviation (S_L) and its uncertainty estimate (U_L), is used as the weight (W_L) for it's mean (M_L). The standard deviation (S) is calculated as the square root of the reciprocal of the sum of the weights. U₁ is the combined uncertainty from homogeneity and labs. U₂ is U₁ multiplied by the coverage factor (95 % t-statistic). U₃ is U₂ divided by the square root of the number of determinations (n). Thus:

$$C_L = \sqrt{S_L^2 + U_L^2} \quad W_L = \frac{1}{C_L^2} \quad A = \frac{\sum_{i=1}^n W_L M_L}{\sum_{i=1}^n W_L} \quad S = \frac{1}{\sqrt{\sum_{i=1}^n W_L}} \quad U_1 = \sqrt{H^2 + S^2} \quad U_2 = t \times U_1 \quad U_3 = \frac{U_2}{\sqrt{n}}$$

All but the final reported values are taken to two significant figures as determined by each quantity's uncertainty estimate. The final reported Uncertainty is U₃ rounded to one significant figure and represents the half width of the 95 % confidence interval for the **Certified** value. The final reported **Certified** value is A rounded to the same decimal place as the Uncertainty. The Uncertainty is a measure of the quality of the **Certified** value.

The Tolerance is a measure of the expected performance of an analysis. This involves further expanding the sample uncertainty to include instrument and operator uncertainty, for those without access to such calculations.

For further information regarding the confidence interval for the certified value see ISO Guide 35:2006 section 6.

Analytical Method Codes:

1 Combustion (ASTM E1019)	7 Photometric	13 Titrimetric
2 Fusion (ASTM E1019)	8 Flame Atomic Absorption	14 DCP Atomic Emission
3 Spark Atomic Emission	9 GF Atomic Absorption	15 HG Atomic Fluorescence
4 ICP Atomic Emission	10 X-Ray Fluorescence	16 Difference
5 ICP Mass Spectrometry	11 GD Atomic Emission	17 AAS
6 Gravimetric	12 GD Mass Spectrometry	18 Volumetric

ICP = Inductively Coupled Plasma GF = Graphite Furnace GD = Glow Discharge
DCP = Direct Current Plasma HG = Hydride Generation AAS = Atomic Absorption Spectrometry

Lab Name	Location	Registrar	Accreditation
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, 17034
Dirats Laboratories	Westfield, MA		
Analytical Associates	Detroit, MI		
Taussig Associates	Skokie, IL		
VHG Labs	Manchester, NH		
LECO Corporation	St. Joseph, MI		
Allegheny Ludlum	Brackenridge, PA		
ATI Allvac	Lockport, NY		
Anderson Laboratories, Inc.	Greendale, WI		

A2LA = American Association for Laboratory Accreditation

Analysis: Chemical analyses were made on solid pieces and chips prepared by end mill from representative samples for the certified portion of the lot in accordance with ASTM Standard Practice E1806. The laboratories participating in the testing followed the requirements of ISO Standard 17025.

Traceability: The following Certified Reference Materials were used to validate the analytical data: 13XNSA2G; AR 3160; BAS 466/1, 466/2, 467/1, 474, 475; BS CA316-1, CA316-2, 84J, 317L, 9631P, 9942; ECRM 284-1, 284-2D, 286-1, 292-1; IMZ 1.27/3, 153A; LECO 502-416, 502-869; NCS NS21006; SRM C1151, C1152, C1153, C1154, C1251, C1252, C1253, C1254, 73C, 101G, 121D, 133B, 160B, 345, 348A, 365; Y 41340B.

Homogeneity: This Certified Reference Material (CRM) was tested for homogeneity using ASTM Standard Method E826 and found acceptable. It was also examined by spark atomic emission spectrometry and found to be compatible with the following Reference Materials — 13XNSA2G; AR 3160; BAS 466/1, 466/2, 467/1, 474, 475; BS CA316-1, CA316-2, 84J, 317L, 9631P, 9942; ECRM 284-1, 284-2D, 286-1, 292-1; IMZ 1.27/3, 153A; LECO 502-416, 502-869; NCS NS21006; SRM C1151, C1152, C1153, C1154, C1251, C1252, C1253, C1254, 73C, 101G, 121D, 133B, 160B, 345, 348A, 365; Y 41340B.

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. The certification of BS 317L is valid indefinitely. The certification is nullified if this CRM is damaged, contaminated, or otherwise modified.

Storage: This CRM must be stored in a cool, dry, non-corrosive environment.

Source: The bar stock for this CRM was produced by Aichi Steel Works, Ltd., Aichi-Jen, Japan.

Form: This CRM is machined in the form of a disc, approximately 38 mm in diameter and 19 mm thick by Brammer Standard Company, Inc.

Use: This CRM is intended for use in spark atomic emission, glow discharge, and x-ray spectrometric methods of analysis. Refer to ISO Guide 33 for information about the use of Certified Reference Materials.

Certified Area: The entire depth of the CRM may be used.

Caution: As with any bar material, avoid spark atomic emission spectrometric burns in the center of the CRM (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 used for production specimens. Avoid overheating the sample during surface preparation.

Caution: CRM contains significant insoluble soft metal inclusions. Surface smearing may occur. Spark atomic emission spectrometers may require extended preburns to compensate.

Certificate Number: The unique identification number for this certificate of analysis is REV317L-110520. You may obtain information on revisions of certificates from the internet at www.brammerstandard.com.

Safety Notice: A Safety Data Sheet (SDS) 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 Web: www.brammerstandard.com

Fax: (281) 440-4432 Email: contact@brammerstandard.com

Revision: This certified reference material was originally certified as a reference material on March 22, 1993. A comprehensive homogeneity study, including additional information about its contribution to the uncertainty estimates, was performed. Revised values for all elements except Co, Cu, Mn, Mo, Nb, P, and Si are presented. The remaining values have been revised by concentration, uncertainty, certified, information, or trace.

Brammer Standard Company, Inc., is accredited by the American Association For Laboratory Accreditation (A2LA) to ISO Standard 17034 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials (Certificate Number 656.02)

Brammer Standard Company's Chemical Laboratory is accredited by A2LA to ISO Standard 17025. (Certificate Number 656.01)

By Certificate Number 10539, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9001 by National Quality Assurance (NQA), U.S.A.

The scopes of accreditation are listed on the website: www.brammerstandard.com

References:

Versions used were those available at the time of testing and characterization

- | | |
|-------|---|
| E826 | Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry |
| E1019 | Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques |
| E1806 | Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition |

ISO Standard 17025:2005 General requirements for the competence of testing and calibration laboratories

ISO Standard 9001:2015 Quality Management Systems - Requirements

ISO Guide 30:2015 Terms and definitions used in connection with reference materials + 2008 amendment

ISO Guide 31:2015 Reference materials - Contents of certificates and labels

ISO Guide 33:2015 Uses of certified reference materials

ISO Standard 17034:2016 General requirements for the competence of reference material producers

ISO Guide 35:2006 Reference Materials - General and statistical principles for certification

ASTM documents available from ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428.

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

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

Certified by: _____ on November 5, 2020.

Beau R. Brammer

President