Brammer Standard Company, Inc.

Certificate of Analysis
BS 825G

Certified Reference Material for Incoloy 825 - UNS Number N08825

Certified Values[3]

	Certified Value[1]	Estimate of Uncertainty[2]			Certified Value[1]	Estimate of Uncertainty[2]
Al	0.116	0.006		Nb	0.047	0.005
As	0.0034	0.0006		Ni	40.2	0.6
B	0.0026	0.0004		O	0.0008	0.0003
C	0.013	0.002		P	0.015	0.002
Co	0.047	0.005		S	0.0005	0.0004
Cr	22.3	0.3		Sb	0.0005	0.0003
Cu	1.70	0.07		Si	0.23	0.02
Fe	30.7	0.7		Sn	0.0026	0.0007
H	0.0003	0.0001		Ta	0.003	0.001
Mn	0.71	0.04		Ti	0.84	0.04
Mo	2.94	0.08		V	0.047	0.004
N	0.0091	0.0009		W	0.016	0.003

Reference Values[3,4]

	Reference Value[1]	Estimate of Uncertainty[2]			Reference Value[1]	Estimate of Uncertainty[2]
Ca	<0.05			Pb	<0.005	
Mg	<0.05			Zr	<0.005	

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[1] 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 4 for more information on its calculation.

[2] For each element, the uncertainty listed is based on a statistical evaluation of the contributions of homogeneity and the interlaboratory testing program. See page 4 for more information on its calculation.

[3] Values are given in weight percent. Values in brackets are reported by difference.

[4] Reference values are not certified and are provided for information only.

Trace element information values for Ga, Ge, Ir, Os, Re, U, and Zn are shown on page 4.

The requirements of ISO Guides 30, and Standards 33401 and 33405 were followed for the preparation of this Certified Reference Material and certificate of analysis.

BS 825G   * Code for method   Certified values listed as weight percent

Analysis	*	Al	*	As	*	B	*	C	*	Co	*	Cr	*	Cu	*	Fe	*	H	*	Mn
1	4	0.07833333	3	0.002625	12	0.00213333	1	0.00983333	14	0.0363	4	22.06667	10	1.66	3	30.376667	2	0.00026667	4	0.660
2	10	0.10466667	5	0.0029333	4	0.00236667	1	0.010	11	0.0365	4	22.08667	11	1.6625	4	30.393333	2	0.00027	3	0.663333
3	4	0.107	9	0.0030	4	0.0024	1	0.01083333	4	0.0418	14	22.1	3	1.663333	14	30.4	2	0.00029	3	0.683333
4	3	0.10966667	5	0.0033333	11	0.0026	1	0.011	5	0.0438	3	22.1775	4	1.667333	10	30.47	2	0.00029	4	0.6900
5	11	0.112	5	0.0034367	5	0.00266667	1	0.01133333	10	0.044	10	22.20	14	1.67	4	30.5186	2	0.0003125	4	0.695
6	5	0.11466667	5	0.0034667	3	0.002675	1	0.01153667	4	0.0440667	4	22.2	4	1.688333	10	30.53	2	0.00034	4	0.700
7	14	0.116	12	0.0053	14	0.0027	1	0.01163333	3	0.0463333	3	22.21667	4	1.688667	4	30.534	2	0.00035333	4	0.703333
8	4	0.11633333			4	0.0027	1	0.01176667	4	0.047	4	22.23333	4	1.691	3	30.5725	2	0.00065	4	0.705
9	3	0.117			3	0.0027	1	0.01176667	4	0.0474667	4	22.2543	4	1.6916	3	30.573333			14	0.707
10	3	0.11775			3	0.00276667	1	0.01266667	4	0.0478	4	22.269	4	1.6949	4	30.678			4	0.707667
11	4	0.118			5	0.00277	1	0.0130	12	0.048	4	22.28033	5	1.696667	4	30.697233			4	0.717067
12	4	0.11803333			4	0.0028	3	0.013	4	0.0493	10	22.29	4	1.698333	10	30.7			10	0.72
13	10	0.119			4	0.0029	1	0.01333333	4	0.0554	4	22.2929	4	1.7000	11	30.82			4	0.720133
14	4	0.11996667			3	0.0032	1	0.014	3	0.05545	4	22.340	10	1.70	4	31.043333			10	0.721
15	4	0.12976667					11	0.01405	4	0.0583333	11	22.3525	4	1.723	4	31.116667			11	0.72475
16	4	0.131					3	0.016675			13	22.37	3	1.7675	13	31.126667			10	0.726333
17	4	0.14533333					1	0.0182			10	22.58667	4	1.773333	4	31.274667			7	0.726667
18											3	22.61667			4	31.3623			4	0.73
19																			3	0.748
Average		0.1159		0.00344		0.002608		0.0126		0.0472		22.273		1.6962		30.6949		0.000301		0.7146
Std Dev		0.0026		0.00087		0.000080		0.0022		0.0015		0.015		0.0062		0.0059		0.000020		0.0043
H		0.0034		0.00069		0.00062		0.0012		0.0022		0.071		0.015		0.087		0.00028		0.0090
U_1		0.0043		0.00070		0.00062		0.0012		0.0027		0.072		0.016		0.088		0.00028		0.0099
t-statistic		2.12		2.45		2.16		2.12		2.14		2.11		2.12		2.11		2.36		2.10
U_2		0.0092		0.0017		0.0013		0.0025		0.0057		0.15		0.034		0.18		0.00066		0.021
U_3		0.0022		0.00065		0.00036		0.00062		0.0015		0.036		0.0082		0.044		0.00023		0.0048
Certified		**0.116**		**0.0034**		**0.0026**		**0.013**		**0.047**		**22.3**		**1.70**		**30.7**		**0.0003**		**0.71**
Uncertainty		0.006		0.0006		0.0004		0.002		0.005		0.3		0.07		0.7		0.0001		0.04
Tolerance		0.018		0.0018		0.0012		0.006		0.015		0.9		0.21		2.1		0.0002		0.12

Analysis	*	Mo	*	N	*	Nb	*	Ni	*	O	*	P	*	S	*	Sb	*	Si	*	Sn
1	4	2.85966667	2	0.0072333	4	0.04366667	4	39.6164333	2	0.0005667	5	0.0127	11	0.000019	9	0.0001	4	0.20893333	5	0.001897
2	4	2.88566667	2	0.0081667	4	0.04416667	16	[39.800667]	2	0.0006	12	0.013667	1	0.000121	5	0.0004	4	0.209	12	0.002033
3	4	2.89766667	2	0.008375	5	0.0442	6	39.81	2	0.0006233	3	0.013867	1	0.00014	12	0.0004233	3	0.21433333	5	0.002033
4	4	2.89816667	2	0.00844	14	0.04466667	3	39.9933333	2	0.0006967	5	0.0140	1	0.0002	5	0.0004333	4	0.21466667	5	0.002133
5	4	2.9135	2	0.0088667	3	0.04485	4	40.0666667	2	0.0007	4	0.014033	1	0.000237	5	0.0004467	5	0.21533333	3	0.0029
6	10	2.91666667	2	0.0092333	5	0.04513333	16	[40.0875]	2	0.0007977	4	0.0147	1	0.000267	5	0.0004533	4	0.21766667	4	0.0029
7	10	2.92	2	0.0093667	4	0.04696667	10	40.26	2	0.0009333	3	0.015	1	0.000367	4	0.0008	4	0.22	4	0.0030
8	4	2.92666667	2	0.0094	4	0.047	4	40.3	2	0.001025	4	0.0150	1	0.00060	3	0.00105	3	0.22333333	4	0.0032
9	10	2.93	2	0.00958	10	0.04746667	4	40.329	2	0.0010467	11	0.0151	3	0.00075			3	0.22525	9	0.003267
10	4	2.945	2	0.0100667	4	0.0477	16	[40.3375]	2	0.0013	10	0.0152	1	0.001067			10	0.22666667		
11	3	2.95666667	2	0.0100767	4	0.04776667	16	[40.3749667]			14	0.0154	1	0.001367			4	0.228		
12	4	2.95766667	2	0.0104667	3	0.04833333	16	[40.5]			4	0.0155					10	0.23		
13	4	2.958			4	0.04846667	4	40.51			4	0.0155					4	0.23286667		
14	4	2.9600			11	0.049925	16	[40.59333]			10	0.016					14	0.23733333		
15	11	2.965			10	0.050	10	40.6			3	0.01625					11	0.23975		
16	14	2.97666667			12	0.05233333	14	40.7			4	0.016667					4	0.24633333		
17	3	2.99															4	0.24633333		
18	3	3.08																		
Average		2.9350		0.00911		0.0466		40.24		0.00083		0.01500		0.00047		0.00051		0.2258		0.00260
Std Dev		0.0079		0.00093		0.0015		0.32		0.00024		0.00056		0.00043		0.00029		0.0040		0.00056
H		0.020		0.0010		0.0022		0.10		0.00040		0.0013		0.00032		0.00033		0.0048		0.00062
U_1		0.022		0.0010		0.0026		0.10		0.00041		0.0014		0.00034		0.00035		0.0063		0.00063
t-statistic		2.11		2.20		2.13		2.13		2.26		2.13		2.23		2.36		2.12		2.31
U_2		0.046		0.0023		0.0056		0.22		0.00093		0.0030		0.00075		0.00083		0.013		0.0014
U_3		0.011		0.00066		0.0014		0.056		0.00029		0.00075		0.00023		0.00029		0.0032		0.00048
Certified		**2.94**		**0.0091**		**0.047**		**40.2**		**0.0008**		**0.015**		**0.0005**		**0.0005**		**0.23**		**0.0026**
Uncertainty		0.08		0.0009		0.005		0.6		0.0003		0.002		0.0004		0.0003		0.02		0.0007
Tolerance		0.24		0.0027		0.015		1.8		0.0007		0.006		0.0004		0.0004		0.06		0.0021

BS 825G * Code for method Certified values listed as weight percent

Analysis	*	Ta	*	Ti	*	V	*	W
1	5	0.00002	4	0.8013333	3	0.04445	4	0.01243333
2	4	0.0025	7	0.8096667	4	0.04496667	4	0.01343333
3	11	0.0026	4	0.8136667	4	0.04523333	5	0.01396667
4	4	0.003	4	0.8206667	4	0.0453	4	0.0141
5	3	0.0037	10	0.8236667	11	0.045975	11	0.01535
6	4	0.0043	4	0.8323333	3	0.046	14	0.01593333
7			4	0.8335333	5	0.04696667	4	0.0168
8			10	0.84	4	0.0470	4	0.01726667
9			3	0.84025	12	0.04733333	4	0.0180
10			4	0.8423333	4	0.04733333	4	0.01853333
11			4	0.8426667	10	0.048	12	0.019
12			11	0.84375	4	0.04836667	3	0.021525
13			4	0.8499667	10	0.04853333		
14			10	0.85	14	0.05006667		
15			3	0.8566667	4	0.05033333		
16			4	0.858	4	0.05086667		
17			3	0.860				
18			14	0.8603333				
Average		0.0027		0.8391		0.0473		0.01560
Std Dev		0.0015		0.0045		0.0020		0.00077
H		0.00062		0.010		0.0022		0.0013
U_1		0.00064		0.011		0.0022		0.0015
t-statistic		2.57		2.11		2.13		2.20
U_2		0.0016		0.023		0.0047		0.0034
U_3		0.00067		0.0054		0.0012		0.0010
Certified		**0.003**		**0.84**		**0.047**		**0.016**
Uncertainty		0.001		0.04		0.004		0.003
Tolerance		0.002		0.12		0.012		0.009

BS 825G * Code for method Reference values listed as weight percent

Analysis	*	Ca	*	Mg	*	Pb	*	Zr
1	12	0.000017	12	0.0016667	5	0.000023	5	0.000067
2	11	0.00030	4	0.0028	12	0.000026	12	0.00016
3	4	0.00030			5	0.000027	11	0.00025
4	3	0.00063			3	0.0001	4	0.0003
5	5	0.00227			9	0.00013667		
6					9	0.0003		
Average		0.000039		0.00167		0.0000272		0.000068
Std Dev		0.000016		0.00040		0.0000012		0.000010
H		0.00015		0.00052		0.00013		0.0013
U_1		0.00015		0.00065		0.00013		0.0013
t-statistic		2.78		12.71		2.57		3.18
U_2		0.00041		0.0083		0.00034		0.0042
U_3		0.00018		0.0059		0.00034		0.0021
Reference		**<0.05**		**<0.05**		**<0.005**		**<0.005**
Uncertainty								
Tolerance								

For each element, in accordance with the requirements of ISO 17034 and 33405, 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 its mean (M_L). The standard deviation (S) is calculated as the square root of the reciprocal of the sum of the weights. U_1 is the combined uncertainty from homogeneity and labs. U_2 is U_1 multiplied by the coverage factor (95 % t-statistic). U_3 is U_2 divided by the square root of the number of determinations (n). Thus:

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

*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 U_3 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 Standard 33405:2024 section 10.

BS 825G * Code for analytical method   Trace analysis listed as mg/kg (ppm)

Analysis	*	Ga	*	Ge	*	Ir	*	Os	*	Re	*	U	*	Zn				
1	12	25	12	2.5	12	0.12	12	0.09	12	1.8	12	0.02	12	11				
2	12	26	12	2.5	12	0.13	12	0.11	12	1.9	12	0.02	12	12				
3	12	27	12	2.5	12	0.13	12	0.14	12	1.9	12	0.02	12	12				

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		
6	Gravimetric	12	GD Mass Spectrometry		

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

Lab Name	Location	Registrar	Accreditation
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, 17034
NSL Analytical	Cleveland, OH	ANAB	17025
Elemental Analysis, Inc.	Lexington, KY	A2LA	17025
Anderson Laboratories, Inc.	Greendale, WI	A2LA	17025
Eurofins EAG Materials Science, LLC	Liverpool, NY	A2LA	17025
Vitkovice Testing Center	Hulvaky, Ostrava	Czech Accreditation Institute	17025
National Analysis Center For Iron And Steel	Beijing, China	CNAS	17025
TUV Rheinland Pvt Ltd	Bangalore, India	NABL	17025
Element Materials Technology	Glendale Heights, IL	A2LA	17025
Luvak Inc.	Boylston, MA	PRI	17025
APL, Inc	Milwaukee, WI	A2LA	17025
Instytut Metalurgii Zelaza	Gliwice, Poland	PCA	17025
Dirats Laboratories	Westfield, MA	ANAB	17025
Laboratory Testing, Inc.	Hatfield, PA	A2LA	17025

A2LA = American Association for Laboratory Accreditation
ANAB = ANSI-ASQ National Accreditation Board
CNAS = China National Accreditation Service
NABL = National Accreditation Board for Testing and Calibration Laboratories
PCA = Polish Center For Accreditation
PRI = Performance Review Institute

Analysis: Chemical analyses were made on solid pieces and chips prepared by an 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: 22X754D, 28X625M, 219X08825; AR 555, 614A, 637, 645, 647, 657, 659, 662, 668, 670, 673, 675, 869, 870, 881, 882, 946, 961, 1647, 1650, 1652, 1652; BAS 351, 377-2, 387; BS C-2000, G30, H230, H230A, H2, H3C, HON T, MP35N, 187C, 625F, 718D, 725, 800, 825, 825A, 825B, 825D, 825E, 825F, 925A; DSZU CA031; HRT Ni 2023; IARM 53D, 54B, 54H, 56A, 56C, 6H, 59A, 59D, 59E, 62E, 68C, 69A, 110C, 189A, 190A, 328B, 358A; LECO 501-529, 501-928, 502-060, 502-863, 502-903, 502-916, 502-918, 502-935, 502-938, 502-978, 503-514; SRM 50A, 349, 864, 866, 867, 882, 1247, 3109A, 3155, 3165, 3169.

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: BS 187C, 800, 825, 825A, 825B, 825D, 825F, 925A; HRT Ni 2013; SRM 1247.

Validity statement: ISO Standard 33401 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.

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

Source: The bar stock for this CRM was produced by Cogne Acciai Speciali, Italy.

Form: This CRM is machined in the form of a disc, approximately 38mm in diameter and 19mm 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 Standard 33403 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 825G-071725. 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.   **Phone: (281) 440-9396**   **Web: www.brammerstandard.com**
14603 Benfer Road
Houston, Texas   77069-2895 USA   **Fax: (281) 440-4432**   **Email: contact@brammerstandard.com**

Brammer Standard Company, Inc., is accredited by the American Association for Laboratory Accreditation (A2LA) to ISO Standard 17034:2016 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials (our current Certificate Number 656.02 expires 01/31/2027)

Brammer Standard Company's Chemical Laboratory is accredited by A2LA to ISO Standard 17025:2017. (Our current Certificate Number 656.01 expires 01/31/2027)

By current Certificate Number 10539 expiring 01/01/2027, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9001:2015 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 17025:2017   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 Standard 33401:2024 Reference materials - Contents of certificates, labels and accompanying documentation

ISO Standard 33403:2024   Reference materials – Requirements and recommendations for use

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

ISO Standard 33405:2024 Reference Materials – Approaches for characterization and assessment of homogeneity and stability

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 July 17, 2025.

Beau R. Brammer

President