

Brammer Standard Company, Inc.
Certificate of Analysis

BS 625A

Certified Reference Material for Inconel 625 - UNS Number N06625¹

	Certified Value ²	Estimate of Uncertainty ³		Certified Value ²	Estimate of Uncertainty ³
Certified values⁴					
Al	0.215	0.003	O	0.0013	0.0004
As	0.0012	0.0001	P	0.0065	0.0005
B	0.0015	0.0001	Pb	0.00003	0.00001
C	0.0241	0.0006	S	0.00049	0.00004
Ca	0.00012	0.00004	Sb	0.00018	0.00002
Co	0.066	0.002	Si	0.080	0.002
Cr	21.71	0.08	Sn	0.0008	0.0001
Cu	0.073	0.002	Ta	0.0034	0.0003
Fe	3.06	0.03	Ti	0.287	0.004
Mg	0.0042	0.0002	V	0.0151	0.0005
Mn	0.068	0.002	W	0.066	0.002
Mo	9.23	0.04			
N	0.0112	0.0007			
Nb	3.60	0.02			
Ni	61.3	0.3			

Informational values^{4,5}

Zr (0.001)

¹ This certificate is a revision. For more information on the nature and extent of the revision, see the revision statement on page 6.

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.

⁵ Values in parentheses are not certified and are provided for information only.

Trace element information values for Ag, Au, Ba, Be, Bi, Br, Cd, Ce, Cl, Cs, Dy, Er, Eu, F, Ga, Gd, Ge, Hf, Hg, Ho, I, In, Ir, K, La, Li, Lu, Na, Nd, Os, Pd, Pr, Pt, Rb, Re, Rh, Ru, Sc, Se, Sm, Sr, Tb, Te, Th, Tl, Tm, U, Y, Yb, and Zn are shown on page 4.

The requirements of ISO Guides 31, 34, and 35 were followed for the preparation of this certified reference material and certificate of analysis. This is a Certified Reference Material as defined by ISO Guide 30.

Brammer Standard Company, Inc., 14603 Benfer Road, Houston, TX 77069-2895

Telephone: (281) 440-9396

Fax: (281) 440-4432

Website: www.brammerstandard.com

Analysis	*	Al	* As	* B	* C	* Ca	* Co	* Cr	* Cu	* Fe	* Mg
1	4	0.197	9 0.00060	4 0.0012	1 0.0209	12 0.000011	4 0.058	4 21.59	3 0.070	4 2.89	4 0.0037
2	10	0.200	1 0.00080	5 0.0012	1 0.0226	12 0.000017	3 0.059	8 21.60	4 0.071	4 2.90	4 0.0040
3	4	0.205	12 0.00094	4 0.0012	1 0.0228	4 0.000050	4 0.059	10 21.65	4 0.071	4 2.98	8 0.0040
4	3	0.206	5 0.00108	7 0.0013	1 0.0233	4 0.00010	10 0.060	4 21.66	8 0.071	10 3.02	3 0.0041
5	4	0.209	17 0.00111	12 0.0013	1 0.0240	3 0.00013	3 0.061	4 21.67	8 0.072	4 3.02	4 0.0041
6	10	0.210	12 0.00120	5 0.0014	1 0.0241	4 0.00020	12 0.063	13 21.68	4 0.072	4 3.04	4 0.0041
7	1	0.210	5 0.00149	5 0.0015	1 0.0242	4 0.00025	1 0.064	13 21.69	10 0.072	4 3.06	3 0.0042
8	4	0.210	3 0.00153	7 0.0015	1 0.0243	4 0.00031	5 0.065	4 21.71	4 0.073	8 3.07	4 0.0043
9	4	0.211	5 0.00160	4 0.0015	1 0.0244		4 0.066	4 21.76	5 0.073	4 3.08	5 0.0044
10	3	0.216		4 0.0018	1 0.0247		4 0.066	10 21.77	4 0.073	3 3.08	4 0.0046
11	4	0.218		3 0.0018	1 0.0250		8 0.066	3 21.77	4 0.074	4 3.08	5 0.0047
12	8	0.220		3 0.0018	3 0.0252		10 0.066	3 21.78	4 0.074	3 3.09	12 0.0048
13	4	0.225		3 0.0020	1 0.0255		4 0.071	4 21.82	3 0.075	4 3.11	
14	4	0.229			3 0.0270		8 0.075		3 0.077	6 3.13	
15	10	0.232			1 0.0278		10 0.077			10 3.22	
16	5	0.240					4 0.079				
Average		0.2152	0.00116	0.00148	0.02411	0.000118	0.0659	21.713	0.0725	3.064	0.00424
Std dev		0.0034	0.00010	0.00016	0.00069	0.000050	0.0023	0.071	0.0021	0.043	0.00017
H		0.0039	0.00008	0.00010	0.0008	0.000015	0.0016	0.12	0.0017	0.028	0.00021
U ₁		0.0052	0.00013	0.00019	0.0010	0.000052	0.0029	0.14	0.0028	0.052	0.00027
t-statistic		2.13	2.31	2.18	2.14	2.36	2.13	2.18	2.16	2.14	2.20
U ₂		0.0028	0.00010	0.00011	0.00057	0.000043	0.0015	0.085	0.0016	0.029	0.00017
Certified		0.215	0.0012	0.0015	0.0241	0.00012	0.066	21.71	0.073	3.06	0.0042
Uncertainty		0.003	0.0001	0.0001	0.0006	0.00004	0.002	0.08	0.002	0.03	0.0002

Analysis	*	Mn	* Mo	* N	* Nb	* Ni	* O	* P	* Pb	* S	* Sb
1	4	0.061	4 9.08	2 0.0105	4 3.54	4 61.23	2 0.0004	12 0.0053	5 0.000015	1 0.00020	5 0.00013
2	10	0.062	10 9.09	2 0.0110	4 3.54	3 61.30	2 0.0009	4 0.0054	12 0.000016	1 0.00020	5 0.00016
3	4	0.062	4 9.16	2 0.0110	7 3.55	10 61.36	2 0.0011	4 0.0055	5 0.000020	1 0.00020	5 0.00016
4	4	0.063	4 9.16	2 0.0113	4 3.56	10 61.40	2 0.0020	3 0.0060	5 0.000024	1 0.00030	5 0.00017
5	12	0.064	4 9.18	2 0.0115	10 3.58	10 61.40		3 0.0066	12 0.000029	1 0.00035	5 0.00018
6	4	0.064	4 9.21		10 3.59			4 0.0066	9 0.000030	1 0.00040	12 0.00019
7	5	0.064	3 9.23		3 3.60			4 0.0067	5 0.000050	1 0.00047	5 0.00020
8	8	0.067	8 9.27		4 3.60			5 0.0068	4 0.000050	1 0.00050	1 0.00020
9	3	0.069	4 9.27		8 3.60			4 0.0068	5 0.000050	1 0.00050	12 0.00023
10	4	0.072	3 9.29		10 3.60			4 0.0079		3 0.00050	
11	4	0.072	4 9.31		4 3.61			4 0.0080		1 0.00060	
12	4	0.073	4 9.32		3 3.63					1 0.00062	
13	3	0.079	10 9.32		4 3.64					12 0.00062	
14	10	0.080	6 9.33		4 3.64					1 0.00100	
15	10	0.083			4 3.64					1 0.00115	
Average		0.0682	9.225	0.01116	3.597	61.330	0.00130	0.00650	0.0000334	0.000486	0.000182
Std dev		0.0022	0.040	0.00035	0.021	0.057	0.00025	0.00064	0.0000086	0.000068	0.000016
H		0.0017	0.064	0.00043	0.032	0.26	0.00009	0.00029	0.000006	0.000042	0.000020
U ₁		0.0028	0.076	0.00055	0.038	0.27	0.00026	0.00070	0.000010	0.000080	0.000026
t-statistic		2.14	2.16	2.78	2.14	2.78	3.18	2.23	2.31	2.14	2.31
U ₂		0.0015	0.044	0.00069	0.021	0.33	0.00042	0.00047	0.0000080	0.000044	0.000020
Certified		0.068	9.23	0.0112	3.60	61.3	0.0013	0.0065	0.00003	0.00049	0.00018
Uncertainty		0.002	0.04	0.0007	0.02	0.3	0.0004	0.0005	0.00001	0.00004	0.00002

BS 625A * Code for method Certified values listed as weight percent

Analysis	*	Si	*	Sn	*	Ta	*	Ti	*	V	*	W
1	10	0.041	12	0.00035	5	0.0031	4	0.270	12	0.0130	4	0.040
2	12	0.048	5	0.00070	4	0.0032	10	0.274	4	0.0137	12	0.046
3	4	0.050	5	0.00071	5	0.0033	3	0.278	4	0.0138	12	0.053
4	4	0.064	5	0.00074	1	0.0034	4	0.278	4	0.0140	3	0.061
5	12	0.072	12	0.00089	5	0.0035	4	0.279	4	0.0146	4	0.067
6	5	0.077	3	0.00117	5	0.0037	4	0.283	5	0.0147	3	0.068
7	10	0.081			3	0.0039	4	0.287	3	0.0150	4	0.068
8	4	0.083					4	0.288	1	0.0154	4	0.069
9	4	0.083					4	0.289	4	0.0156	4	0.070
10	3	0.084					4	0.289	12	0.0160	4	0.073
11	4	0.085					8	0.290	4	0.0160	4	0.074
12	4	0.090					3	0.291	8	0.0170	4	0.074
13	5	0.100					5	0.293	4	0.0176	5	0.076
14	7	0.100					5	0.295	3	0.0180	4	0.077
15	3	0.103					7	0.299			5	0.087
16	4	0.116					12	0.300				
Average		0.0798		0.000768		0.00342		0.2869		0.01514		0.0662
Std dev		0.0030		0.000088		0.00027		0.0063		0.00074		0.0030
H		0.0019		0.00006		0.00018		0.0048		0.00054		0.0016
U ₁		0.0035		0.00011		0.00033		0.0079		0.00092		0.0034
t-statistic		2.13		2.57		2.45		2.13		2.16		2.14
U ₂		0.0019		0.00011		0.00030		0.0042		0.00053		0.0019
Certified		0.080		0.0008		0.0034		0.287		0.0151		0.066
Uncertainty		0.002		0.0001		0.0003		0.004		0.0005		0.002

BS 625A * Code for method Informational values listed as weight percent

Analysis	*	Zr
1	12	0.0006
2	4	0.0015
3	3	0.0020
Average		0.00126
Std dev		0.00069
H		0.00009
U ₁		0.00070
t-statistic		4.30
U ₂		0.0017
(Certified)		(0.001)
(Uncertainty)		(0.002)

For each element, in accordance with the requirements of ISO Guides 34 and 35, an effort must be made to account for the effects on the certified value of the uncertainty estimate from the homogeneity testing 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 uncertainty (U_i) is used as the weight (w_i) for its mean (M_i). The standard deviation (S) is calculated as the square root of the reciprocal of the sum of the weights. All but the final reported values are taken to two significant figures as determined by the standard deviation. Thus, $w_L = 1/U_i^2$, $A = \sum w_L M_L / \sum w_L$, and $S = 1/\sqrt{\sum w_L}$. U₁ is the combined uncertainty from homogeneity and labs ($\sqrt{H^2 + S^2}$). The final uncertainty estimate (U₂) is the coverage factor (95 % t-statistic) times U₁ divided by the square root of the number of contributing laboratories ($t \times U_1 / \sqrt{n}$). The final reported Uncertainty is U₂, rounded to one significant figure and the final reported Certified value is A, rounded to the same decimal place as the Uncertainty. For further information regarding the confidence interval for the certified value see ISO Guide 35:2006 section 6.

Analysis	* Ag	* Au	* Ba	* Be	* Bi	* Br	* Cd	* Ce	* Cl	* Cs
1	5 0.1	12 0.05	12 0.005	12 0.025	12 0.0025	12 0.0025	9 0.01	12 0.2	12 0.0005	12 0.025
2	12 0.19				5 0.01		12 0.03			
3	12 0.25				5 0.03		17 0.05			
4	5 0.3				5 0.05		12 0.3			
5	9 0.4				5 0.05		5 0.5			
6	5 0.5				5 0.05		5 0.5			
7	5 0.5						4 1			
8	5 0.8						4 2			

Analysis	* Dy	* Er	* Eu	* F	* Ga	* Gd	* Ge	* Hf	* Hg	* Ho
1	12 0.0025	12 0.0025	12 0.0025	12 0.025	4 2.5	12 0.0025	5 0.05	12 0.09	12 0.025	12 0.0025
2					5 20.3		12 0.33			
3					5 23.6					
4					5 24					
5					5 24.4					
6					5 26					
7					12 28					
8					5 51.3					

Analysis	* I	* In	* Ir	* K	* La	* Li	* Lu	* Na	* Nd	* Os
1	12 0.0025	12 0.05	12 0.1	12 0.05	12 0.06	12 0.0025	12 0.0025	12 0.025	12 0.07	12 0.07
2								12 0.1		

Analysis	* Pd	* Pr	* Pt	* Rb	* Re	* Rh	* Ru	* Sc	* Se	* Sm
1	12 0.05	12 0.03	12 0.05	12 0.005	12 0.59	12 0.025	12 0.025	12 0.0008	5 0.05	12 0.0025
2									17 0.05	
3									9 0.1	
4									12 0.3	
5									12 0.5	
6									9 2	
7									5 3	
8									5 15	

Analysis	* Sr	* Tb	* Te	* Th	* Tl	* Tm	* U	* Y	* Yb	* Zn
1	12 0.5	12 0.0025	17 0.05	12 0.0025	5 0.025	12 0.0025	12 0.06	12 0.025	12 0.0025	5 0.05
2			12 0.05		5 0.025					12 0.45
3			12 0.2		12 0.025					12 0.53
4			9 0.25		5 0.05					5 2
5			5 0.5		5 0.05					8 5
6			5 2		5 0.5					5 24
7			4 5		5 0.5					

Analytical Method Codes:

1	Combustion (ASTM E1019)	5	ICP Mass Spectrometry	9	GF Atomic Absorption	13	Titrimetric
2	Fusion (ASTM E 1019)	6	Gravimetric	10	X-Ray Fluorescence	14	DCP Atomic Emission
3	Spark Atomic Emission	7	Photometric	11	GD Atomic Emission	15	HG Atomic Fluorescence
4	ICP Atomic Emission	8	Flame Atomic Absorption	12	GD Mass Spectrometry		

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

Laboratory	Location	Registrar	Accreditation
Allegheny Ludlum Corporation	Brackenridge, PA	A2LA	17025
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, Guide 34
Dirats Laboratories	Westfield, MA	PRI/Nadcap	17025
Shiva Technologies	Syracuse, NY	PRI/Nadcap	17025
Elemental Analysis, Inc.	Lexington, KY	A2LA	17025
Instytut Metalurgii Zelaza	Gliwice, Poland	Polish Center For Accreditation (PCA)	AB 554
Inco Test	Huntington, WV	PRI/Nadcap	17025
LECO Corporation	St. Joseph, MI	The British Standards Institution (BSI)	9001
Laboratory Testing, Inc.	Hatfield, PA	PRI/Nadcap	17025
National Analysis Center For Iron And Steel	Beijing, China	China National Accreditation Service	17025
Northern Analytical Laboratory, Inc.	Londonderry, NH	PRI/Nadcap	17025
NSL Analytical	Cleveland, OH	PRI/Nadcap	17025
VHG Labs	Manchester, NH	A2LA	Guide 34

Analysis: Chemical analyses were made on chips prepared by a lathe from a representative sample of the certified portion of the lot in accordance with ASTM Standard Practice E 1806. The laboratories participating in the testing followed the requirements of ISO Standard 17025. Methods of analysis used were a those listed on page 4.

Traceability: The following Certified Reference Materials were used to validate the analytical data listed on pages 2 through 4: SRM 16F, 362, 865, 868, 1243, 1245, 1245A, 1249, 1265A, 3101A, 3102A, 3103A, 3106, 3107, 3108, 3109A, 3112A, 3113, 3114, 3119A, 3126A, 3128, 3131, 3131A, 3134, 3137, 3139A, 3149, 3150, 3151, 3155, 3156, 3158, 3162A, 3163, 3165, 3168, 3168A, 3169; 501-024, 501-149, 501-501, 501-503, 501-506, 501-550, 501-673, 501-991, 501-992, 502-257; IARM 54E, 190A; AR 511; BAS 346A, 351; JSS 190-1, 101-1, 192-1, 193-1, 194-1, 195-1; BS 600-2, 625, 625B, 690, 725, H-7.

Homogeneity: This Certified Reference Material (CRM) was tested for homogeneity using ASTM Standard Method E 826 and found acceptable. It was also examined by spark atomic emission spectrometry and found to be compatible with the following Reference Materials: SRM 1245, BS 600-2, BS 625, BS 625B, BS 690, BS 725, BS H-7, BS B7007, BS E3919.

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 625A is valid indefinitely. The certification is nullified if this CRM is damaged, contaminated, or otherwise modified.

Source: The bar stock for this CRM was produced by INCO Alloys, Huntington, West Virginia.

Form: This CRM is machined in the form of a disc, approximately 38 mm in diameter and 12 mm thick by Brammer Standard Company, Inc.

Use: This CRM is intended for use in spark atomic emission 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 you use for production specimens. Avoid overheating the sample during surface preparation.

Certificate Number: The unique identification number for this certificate of analysis is REV625A-080311. You may obtain information on revisions of certificates from the internet at www.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. Phone: (281) 440-9396 web: www.brammerstandard.com
14603 Benfer Road
Houston, Texas 77069-2895 USA Fax: (281) 440-4432 e-mail: contact@brammerstandard.com

Revision: This certified reference material was originally certified as a reference material on May 12, 1992, before extensive homogeneity studies were employed. A comprehensive homogeneity study, including additional information about its contribution to the uncertainty estimates, was performed. The revision supplies uncertainty estimates for all certified elements. Additional interlaboratory testing was performed. The elements As, Ca, O, Pb, Sb, Sn, and Ta have been added to the certified list. Si and N have been changed from informational to certified. Refined values for all elements except Cr, and Nb are presented. An informational value for Zr is provided. All trace data are presented in mg/kg (ppm). A number of trace elements have been added.

Brammer Standard Company, Inc., is accredited by the American Association For Laboratory Accreditation (A2LA) to ISO Guide 34 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 9001:2008 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

E 826 Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry
E 1019 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques

E 1806 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 9001:2008 Quality Management Systems - Requirements

ISO Guide 30:1992 Terms and definitions used in connection with reference materials + 2008 amendment

ISO Guide 31:2000 Reference materials - Contents of certificates and labels

ISO Guide 33:2000 Uses of certified reference materials

ISO Guide 34:2009 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, 1916 Race Street, Philadelphia, PA, 19103.

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 August 03, 2011.

Beau R. Brammer