

**Brammer Standard Company, Inc.**  
**Certificate of Analysis**

**BS 800**

**Certified Reference Material for Incoloy 800 - UNS Number N08800<sup>1</sup>**

	Certified Value <sup>2</sup>	Estimate of Uncertainty <sup>3</sup>		Certified Value <sup>2</sup>	Estimate of Uncertainty <sup>3</sup>
	<b>Certified values<sup>4</sup></b>				
<b>Al</b>	<b>0.279</b>	0.004	<b>Pb</b>	<b>0.00004</b>	0.00001
<b>As</b>	<b>0.0036</b>	0.0002	<b>S</b>	<b>0.00036</b>	0.00005
<b>B</b>	<b>0.0032</b>	0.0001	<b>Sb</b>	<b>0.00046</b>	0.00006
<b>C</b>	<b>0.073</b>	0.001	<b>Si</b>	<b>0.560</b>	0.006
<b>Ca</b>	<b>0.00030</b>	0.00004	<b>Sn</b>	<b>0.0026</b>	0.0002
<b>Co</b>	<b>0.054</b>	0.001	<b>Ti</b>	<b>0.469</b>	0.006
<b>Cr</b>	<b>19.90</b>	0.04	<b>V</b>	<b>0.071</b>	0.001
<b>Cu</b>	<b>0.323</b>	0.003	<b>W</b>	<b>0.0056</b>	0.0005
<b>Fe</b>	<b>46.0</b>	0.1	<b>Zr</b>	<b>0.0018</b>	0.0002
<b>Mn</b>	<b>0.789</b>	0.006			
<b>Mo</b>	<b>0.195</b>	0.002			
<b>N</b>	<b>0.0112</b>	0.0005			
<b>Nb</b>	<b>0.0183</b>	0.0006			
<b>Ni</b>	<b>31.29</b>	0.08			
<b>P</b>	<b>0.0161</b>	0.0006			

**Informational values<sup>4,5</sup>**

Mg (0.002)                      O (0.0009)                      Ta (0.001)

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

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> Values are given in weight percent.

<sup>5</sup> 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.

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Analysis	* Al	* As	* B	* C	* Ca	* Co	* Cr	* Cu	* Fe	* Mn
1	12 0.240	12 0.0030	4 0.0017	1 0.0690	12 0.000005	4 0.049	4 19.72	10 0.300	13 45.72	10 0.760
2	4 0.244	1 0.0034	12 0.0020	1 0.0697	12 0.000020	4 0.050	13 19.79	4 0.312	4 45.77	10 0.770
3	5 0.249	5 0.0034	3 0.0024	1 0.0698	4 0.000050	4 0.050	8 19.80	4 0.313	10 45.92	4 0.775
4	10 0.260	9 0.0034	7 0.0026	1 0.0715	4 0.00020	8 0.051	4 19.85	4 0.314	4 46.08	4 0.776
5	4 0.265	3 0.0034	5 0.0030	1 0.0720	3 0.00030	10 0.052	3 19.86	8 0.318	10 46.09	4 0.777
6	10 0.270	15 0.0035	4 0.0032	1 0.0720	4 0.00030	12 0.052	10 19.87	4 0.318	10 46.12	10 0.778
7	4 0.273	5 0.0036	3 0.0033	1 0.0733	4 0.00039	4 0.054	10 19.89	5 0.320	10 46.14	10 0.780
8	4 0.275	5 0.0038	5 0.0033	1 0.0734	4 0.00050	3 0.054	4 19.91	10 0.320	10 46.30	3 0.786
9	4 0.276	9 0.0040	3 0.0035	1 0.0738	4 0.00051	4 0.054	4 19.92	10 0.320		10 0.787
10	4 0.280	12 0.0042	4 0.0036	3 0.0743	4 0.00076	8 0.055	10 19.93	7 0.320		4 0.788
11	4 0.287		5 0.0036	1 0.0747		4 0.055	13 19.94	4 0.321		4 0.789
12	8 0.290		3 0.0036	1 0.0760		10 0.055	10 19.95	3 0.322		4 0.790
13	6 0.290		7 0.0038	1 0.0761		5 0.056	4 19.97	4 0.324		10 0.790
14	10 0.290		4 0.0041	1 0.0770		4 0.057	4 19.98	5 0.327		4 0.790
15	3 0.290		4 0.0042	1 0.0775		10 0.057	4 20.03	10 0.330		4 0.792
16	8 0.291		4 0.0045			10 0.060	10 20.04	4 0.331		12 0.795
17	5 0.292					10 0.060	4 20.10	8 0.332		8 0.800
18	10 0.297							12 0.335		7 0.809
19								8 0.335		8 0.820
20								4 0.350		
Average	0.2791	0.00357	0.00323	0.07308	0.000298	0.0541	19.902	0.3227	46.003	0.7888
Std dev	0.0067	0.00025	0.00014	0.00087	0.000027	0.0017	0.062	0.0056	0.069	0.0098
H	0.0037	0.00024	0.00022	0.0016	0.000050	0.0013	0.054	0.0041	0.09	0.007
U <sub>1</sub>	0.0076	0.00035	0.00026	0.0018	0.000057	0.0021	0.082	0.0069	0.11	0.012
t-statistic	2.11	2.26	2.13	2.14	2.26	2.12	2.12	2.09	2.36	2.10
U <sub>2</sub>	0.0038	0.00025	0.00014	0.0010	0.000041	0.0011	0.042	0.0032	0.0960	0.0058
<b>Certified</b>	<b>0.279</b>	<b>0.0036</b>	<b>0.0032</b>	<b>0.073</b>	<b>0.00030</b>	<b>0.054</b>	<b>19.90</b>	<b>0.323</b>	<b>46.0</b>	<b>0.789</b>
Uncertainty	0.004	0.0002	0.0001	0.001	0.00004	0.001	0.04	0.003	0.1	0.006

Analysis	* Mo	* N	* Nb	* Ni	* P	* Pb	* S	* Sb	* Si	* Sn
1	10 0.180	2 0.0106	12 0.0135	6 30.99	10 0.0140	5 0.000020	12 0.000070	12 0.00034	10 0.520	12 0.0016
2	10 0.180	2 0.0109	5 0.0140	10 30.99	10 0.0150	12 0.000024	1 0.00010	5 0.00037	10 0.530	4 0.0022
3	4 0.187	2 0.0110	10 0.0150	10 31.14	4 0.0150	5 0.000030	1 0.00015	12 0.00041	10 0.550	7 0.0023
4	4 0.187	2 0.0111	4 0.0161	4 31.29	10 0.0150	12 0.000047	1 0.00015	5 0.00042	6 0.550	5 0.0024
5	4 0.188	2 0.0116	3 0.0168	10 31.29	4 0.0157	5 0.000050	1 0.00015	5 0.00049	10 0.550	10 0.0025
6	7 0.189	2 0.0118	5 0.0173	4 31.32	10 0.0160	5 0.000050	1 0.00020	5 0.00050	4 0.551	5 0.0025
7	12 0.190	2 0.0120	10 0.0181	10 31.35	3 0.0160	5 0.000050	1 0.00020	5 0.00050	4 0.554	4 0.0025
8	10 0.190	2 0.0120	4 0.0186	10 31.36	4 0.0162	3 0.000052	1 0.00020	15 0.00050	6 0.554	5 0.0025
9	10 0.190	2 0.0120	5 0.0189	13 31.40	5 0.0163	5 0.000060	1 0.00040	5 0.00056	4 0.559	5 0.0026
10	5 0.194		4 0.0209	4 31.41	7 0.0170		1 0.00048	5 0.00060	4 0.564	12 0.0027
11	12 0.195		10 0.0210	4 31.42	4 0.0170		1 0.00050		4 0.564	5 0.0028
12	3 0.198		4 0.0215	10 31.43	4 0.0172		1 0.00050		4 0.567	3 0.0037
13	4 0.198		12 0.0230	3 31.50	3 0.0172		1 0.00050		3 0.567	8 0.0039
14	10 0.200		5 0.0239	4 31.52	7 0.0175		1 0.00060		4 0.576	
15	7 0.200				4 0.0180		1 0.00100		10 0.580	
16	4 0.200						1 0.00103		6 0.607	
17	4 0.204									
18	4 0.207									
19	8 0.210									
20	5 0.212									
Average	0.1947	0.01119	0.01833	31.29	0.01615	0.000044	0.000357	0.000461	0.560	0.00261
Std dev	0.0041	0.00037	0.00074	0.12	0.00087	0.000011	0.000069	0.000043	0.010	0.00017
H	0.0030	0.00049	0.00067	0.07	0.0006	0.000015	0.000056	0.000066	0.006	0.00020
U <sub>1</sub>	0.0050	0.00061	0.00099	0.14	0.0011	0.000019	0.000089	0.000079	0.012	0.00026
t-statistic	2.09	2.31	2.16	2.16	2.14	2.31	2.13	2.26	2.13	2.18
U <sub>2</sub>	0.0023	0.00047	0.00057	0.080	0.00059	0.000014	0.000047	0.000056	0.0063	0.00015
<b>Certified</b>	<b>0.195</b>	<b>0.0112</b>	<b>0.0183</b>	<b>31.29</b>	<b>0.0161</b>	<b>0.00004</b>	<b>0.00036</b>	<b>0.00046</b>	<b>0.560</b>	<b>0.0026</b>
Uncertainty	0.002	0.0005	0.0006	0.08	0.0006	0.00001	0.00005	0.00006	0.006	0.0002

BS 800 \* Code for method Certified values listed as weight percent

Analysis	*	Ti	*	V	*	W	*	Zr
1	4	0.464	3	0.068	12	0.0046	4	0.0012
2	4	0.464	4	0.070	5	0.0049	5	0.0016
3	4	0.466	4	0.071	5	0.0052	5	0.0017
4	4	0.466	4	0.071	4	0.0052	4	0.0018
5	4	0.468	5	0.072	4	0.0054	12	0.0018
6	3	0.470	5	0.073	4	0.0058	4	0.0018
7	10	0.470	4	0.073	3	0.0059	5	0.0019
8	4	0.470	12	0.075	4	0.0063	5	0.0020
9	8	0.470	10	0.075	4	0.0070	4	0.0025
10	7	0.470	4	0.076				
11	4	0.470	4	0.077				
12	4	0.473	10	0.077				
13	4	0.473						
14	10	0.475						
Average		0.4692		0.0709		0.00563		0.00182
Std dev		0.0084		0.0016		0.00051		0.00019
H		0.0051		0.0016		0.00032		0.00016
U <sub>1</sub>		0.0099		0.0022		0.00060		0.00024
t-statistic		2.16		2.20		2.31		2.31
U <sub>2</sub>		0.0057		0.0014		0.00046		0.00019
<b>Certified</b>		<b>0.469</b>		<b>0.071</b>		<b>0.0056</b>		<b>0.0018</b>
Uncertainty		0.006		0.001		0.0005		0.0002

BS 800 \* Code for method Informational values listed as weight percent

Analysis	*	Mg	*	O	*	Ta
1	12	0.0010	2	0.0001	12	0.00005
2	4	0.0013	2	0.0003	4	0.0003
3	8	0.0026	2	0.0009	3	0.0008
4	3	0.0029	2	0.0014		
5			2	0.0018		
Average		0.00195		0.00089		0.00056
Std dev		0.00074		0.00050		0.00069
H		0.00016		0.00010		0.00007
U <sub>1</sub>		0.00076		0.00051		0.00069
t-statistic		3.18		2.78		4.30
U <sub>2</sub>		0.0012		0.00063		0.0017
(Certified)		(0.002)		(0.0009)		(0.001)
(Uncertainty)		(0.001)		(0.0006)		(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<sub>i</sub>) is used as the weight (w<sub>i</sub>) for its mean (M<sub>i</sub>). 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,  $w_L = 1/U_L^2$ ,  $A = \sum w_L M_L / \sum w_L$ , and  $S = 1/\sqrt{\sum w_L}$ . U<sub>1</sub> is the combined uncertainty from homogeneity and labs ( $\sqrt{H^2 + S^2}$ ). The final uncertainty estimate (U<sub>2</sub>) is the coverage factor (95 % t-statistic) times U<sub>1</sub> divided by the square root of the number of contributing laboratories ( $t \times U_1 / \sqrt{n}$ ). The final reported Uncertainty is U<sub>2</sub>, 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 0.0025	12 0.02	12 0.0025	12 0.025	12 0.025	12 0.025	12 0.0025
2	12 0.25				5 0.1		5 0.05			
3	9 0.8									

Analysis	* Dy	* Er	* Eu	* F	* Ga	* Gd	* Ge	* Hf	* Hg	* Ho
1	12 0.0025	12 0.0025	12 0.0025	12 0.005	12 23	12 0.0025	5 5.3	12 0.09	12 0.025	12 0.0025
2					5 27		12 22			

Analysis	* I	* In	* Ir	* K	* La	* Li	* Lu	* Na	* Nd	* Os
1	12 0.0005	12 0.05	12 0.08	12 0.025	12 0.025	12 0.0025	12 0.0025	12 0.025	12 0.0025	12 0.09
2								12 0.66		

Analysis	* Pd	* Pr	* Pt	* Rb	* Re	* Rh	* Ru	* Sc	* Se	* Sm
1	12 0.25	12 0.0025	12 0.09	12 0.0025	12 0.025	12 0.0025	12 0.05	12 0.0005	5 0.05	12 0.0025
2								12 0.05	12 0.05	

Analysis	* Sr	* Tb	* Te	* Th	* Tl	* Tm	* U	* Y	* Yb	* Zn
1	12 0.69	12 0.0025	12 0.025	12 0.0025	12 0.005	12 0.0025	12 0.065	12 0.05	12 0.0025	5 0.05
2			5 0.05		5 0.05					12 0.5
3			9 0.2							

### 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
Allegheny Ludlum Corporation	Lockport, NY	PRI/Nadcap	17025
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, Guide 34
Crucible Steel	Syracuse, NY	Steel Related Industries (SRI)	9001
Dirats Laboratories	Westfield, MA	PRI/Nadcap	17025
Elemental Analysis, Inc.	Lexington, KY	A2LA	17025
Inco Test	Huntington, WV	PRI/Nadcap	17025
Instytut Metalurgii Zelaza	Gliwice, Poland	Polish Center For Accreditation	AB 554
Jessop Steel Co	Washington, PA	TUV	9001
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
Shiva Technologies	Syracuse, NY	PRI/Nadcap	17025
Slater Steel	Fort Wayne, IN	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 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, 134, 153, 361, 866, 867, 897, 1246, 1263A, 3101A, 3102A, 3103A, 3107, 3109A, 3112A, 3113, 3114, 3121, 3126, 3132, 3136, 3137, 3139A, 3150, 3161A, 3162A, 3163, 3165, 3169; 501-024, 501-149, 501-501, 501-503, 501-506, 501-550, 501-673, 501-991, 501-992, 502-257; IMZ 1.8/3, 1.81, 1.85, 75/1, 112, 119, 130, 139; AR 511, 669; BAS 265/2, 402, 403, 459; ECRM 079-2, 085-1, 087-1; IARM 6B, 58A, 190A; CZ 2025A; 24X WASP 4C; BS 86A, 86D, 86E, 86F.

**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 1246, BS HH5157A, HH5179A, HH5196A, HH5300A, 86A, 86D, 86E, 86F.

**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 800 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 Slater Steels Corporation, Fort Wayne, IN.

**Form:** This CRM is machined in the form of a disc, approximately 44 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 REV800-080911. You may obtain information on revisions of certificates from the internet at [www.brammerstandard.com](http://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.  
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Phone: (281) 440-9396  
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web: [www.brammerstandard.com](http://www.brammerstandard.com)  
e-mail: [contact@brammerstandard.com](mailto:contact@brammerstandard.com)

Revision: This certified reference material was originally certified as a reference material on October 25, 1989, 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, N, Pb, Sb, Sn, W and Zr have been added to the certified list. Fe and Nb have been changed from informational to certified. Refined values for all elements are presented. Informational values for Mg, O, and Ta are 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](http://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](http://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 09, 2011.

Beau R. Brammer