

Brammer Standard Company, Inc.
Certificate of Analysis

BS 200-4

Certified Reference Material for Nickel 200 - UNS Number N02200¹

	Certified Value ²	Estimate of Uncertainty ³		Certified Value ²	Estimate of Uncertainty ³
Certified values⁴					
Al	0.0057	0.0002	O	0.0015	0.0004
As	0.0014	0.0001	P	0.0023	0.0002
B	0.0037	0.0001	Pb	0.00087	0.00006
C	0.107	0.001	S	0.0076	0.0003
Ca	0.00028	0.00004	Sb	0.00004	0.00001
Co	0.0911	0.0007	Si	0.101	0.002
Cr	0.132	0.002	Sn	0.00020	0.00005
Cu	0.0482	0.0008	Ta	0.0003	0.0001
Fe	0.297	0.005	Ti	0.0191	0.0004
Mg	0.0312	0.0004	V	0.0024	0.0002
Mn	0.310	0.003	W	0.00095	0.00009
Mo	0.0013	0.0001			
N	0.00031	0.00009			
Nb	0.0010	0.0001			
Ni	98.9	0.1			

Informational values^{4,5}

Zr (0.0004)

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.

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Analysis	*	Al	*	As	*	B	*	C	*	Ca	*	Co	*	Cr	*	Cu	*	Fe	*	Mg
1	4	0.0005	9	0.0005	4	0.0034	1	0.100	12	0.000005	5	0.0785	12	0.115	5	0.0459	4	0.264	8	0.0270
2	12	0.0037	12	0.0008	4	0.0034	1	0.102	12	0.000025	12	0.0790	10	0.124	3	0.0460	5	0.280	4	0.0289
3	5	0.0044	9	0.0011	4	0.0034	1	0.102	4	0.000050	5	0.0870	4	0.124	5	0.0462	10	0.280	4	0.0293
4	5	0.0046	15	0.0012	3	0.0036	1	0.104	4	0.00010	4	0.0871	4	0.130	4	0.0468	4	0.281	4	0.0300
5	4	0.0047	5	0.0012	4	0.0036	1	0.104	4	0.00019	4	0.0880	3	0.131	4	0.0469	4	0.286	12	0.0300
6	4	0.0047	5	0.0013	5	0.0036	1	0.105	4	0.00020	8	0.0880	4	0.131	4	0.0470	4	0.288	4	0.0306
7	5	0.0048	12	0.0013	4	0.0036	1	0.105	3	0.00027	4	0.0881	8	0.134	4	0.0480	5	0.289	4	0.0309
8	4	0.0052	5	0.0013	5	0.0037	1	0.106	4	0.00042	4	0.0884	4	0.136	3	0.0485	4	0.290	5	0.0312
9	5	0.0054	5	0.0014	3	0.0038	1	0.106	5	0.00050	8	0.0889	5	0.140	4	0.0487	3	0.296	4	0.0312
10	4	0.0061	5	0.0018	7	0.0038	1	0.107	4	0.00050	4	0.0890	4	0.140	4	0.0488	5	0.298	4	0.0317
11	4	0.0065	3	0.0019	7	0.0039	1	0.107	4	0.00070	10	0.0890	5	0.140	4	0.0490	4	0.302	12	0.0320
12	3	0.0070	5	0.0020	5	0.0040	1	0.108	5	0.0900	4	0.0900	4	0.141	8	0.0492	8	0.304	5	0.0330
13	3	0.0079	5	0.0040	3	0.108			4	0.0900	5	0.148	5	0.0495	5	0.314	3	0.0330		
14	4	0.0085	2	0.0041	5	0.109			3	0.0910	3	0.0910	4	0.0495	10	0.315	4	0.0330		
15	5	0.0100	5	0.0042	1	0.110			5	0.0911	5	0.0911	5	0.0500	4	0.320	3	0.0332		
16	8	0.0104			1	0.111			3	0.0921	4	0.0944	12	0.350	4	0.0340				
17									8	0.0966										
18																				
Average		0.00572		0.00136		0.00367		0.1065		0.000277		0.09106		0.1316		0.0482		0.2965		0.03124
Std dev		0.00024		0.00015		0.00014		0.0019		0.000028		0.00084		0.0025		0.0012		0.0007		0.00038
H		0.00028		0.00013		0.00022		0.0013		0.000055		0.0012		0.0015		0.0009		0.0023		0.00068
U ₁		0.00037		0.00020		0.00026		0.0023		0.000062		0.0015		0.0029		0.0015		0.0090		0.00078
t-statistic		2.13		2.20		2.14		2.13		2.23		2.11		2.18		2.14		2.13		2.13
U ₂		0.00020		0.00013		0.00014		0.0012		0.000041		0.00073		0.0017		0.00081		0.00480		0.00042
Certified		0.0057		0.0014		0.0037		0.107		0.00028		0.0911		0.132		0.0482		0.297		0.0312
Uncertainty		0.0002		0.0001		0.0001		0.001		0.00004		0.0007		0.002		0.0008		0.005		0.0004

Analysis	*	Mn	*	Mo	*	N	*	Nb	*	Ni	*	O	*	P	*	Pb	*	S	*	Sb
1	5	0.280	4	0.0005	2	0.00010	5	0.0007	3	98.83	2	0.0009	12	0.0010	12	0.00072	1	0.0060	5	0.000025
2	12	0.285	4	0.0007	2	0.00015	12	0.0007	4	98.85	2	0.0013	3	0.0013	5	0.00074	1	0.0065	5	0.000030
3	5	0.300	4	0.0007	2	0.00020	5	0.0008	10	98.93	2	0.0015	4	0.0019	5	0.00075	1	0.0074	12	0.000034
4	10	0.300	5	0.0008	2	0.00020	4	0.0008	5	98.99	2	0.0016	4	0.0020	5	0.00076	1	0.0074	5	0.000034
5	4	0.300	4	0.0008	2	0.00040	5	0.0008	2	0.0020	7	0.0020	5	0.00076	1	0.0074	5	0.000034		
6	5	0.304	5	0.0008	2	0.00040	12	0.0008	5	0.0020	5	0.0020	5	0.00080	1	0.0076	12	0.000035		
7	4	0.307	5	0.0009	2	0.00050	5	0.0011	10	0.0025	5	0.00080	1	0.0078	5	0.000035				
8	3	0.308	8	0.0009	2	0.00050	5	0.0011	4	0.0026	5	0.00080	1	0.0078	5	0.000040				
9	4	0.308	12	0.0010	3	0.0014			4	0.0027	12	0.00081	1	0.0080	3	0.000050				
10	8	0.309	3	0.0014	4	0.0015			5	0.0030	5	0.00081	5	0.0080	5	0.000050				
11	4	0.319	4	0.0015	4	0.0015			3	0.0030	8	0.00090	1	0.0080	15	0.000050				
12	4	0.322	4	0.0016	4	0.0016			4	0.0031	4	0.00100	1	0.0088	5	0.000050				
13	5	0.326	10	0.0020					5	0.00100	1	0.0091	4	0.000050						
14	8	0.329	3	0.0020					9	0.00100										
15	4	0.332	4	0.0021					9	0.00110										
16	4	0.346	12	0.0022					4	0.00113										
17			4	0.0024					3	0.00120										
Average		0.3095		0.00130		0.000308		0.00100		98.873		0.00146		0.00226		0.000874		0.00758		0.0000393
Std dev		0.0043		0.00022		0.000091		0.00013		0.046		0.00029		0.00019		0.000059		0.00035		0.0000073
H		0.0023		0.00013		0.00006		0.00011		0.050		0.00013		0.00017		0.00010		0.00032		0.000019
U ₁		0.0049		0.00025		0.00011		0.00017		0.068		0.00032		0.00025		0.00012		0.00048		0.000021
t-statistic		2.13		2.12		2.36		2.23		3.18		2.78		2.20		2.12		2.18		2.18
U ₂		0.0026		0.00013		0.000090		0.00011		0.11		0.00039		0.00016		0.000060		0.00029		0.000013
Certified		0.310		0.0013		0.00031		0.0010		98.9		0.0015		0.0023		0.00087		0.0076		0.00004
Uncertainty		0.003		0.0001		0.00009		0.0001		0.1		0.0004		0.0002		0.00006		0.0003		0.00001

BS 200-4 * Code for method Certified values listed as weight percent

Analysis	*	Si	* Sn	* Ta	* Ti	* V	* W
1	4	0.098	5 0.00014	5 0.00001	4 0.0159	4 0.0018	3 0.00050
2	4	0.098	5 0.00019	5 0.00001	4 0.0160	4 0.0020	4 0.00051
3	4	0.098	12 0.00019	12 0.00002	12 0.0160	12 0.0021	4 0.00070
4	4	0.100	5 0.00020	5 0.00005	4 0.0180	4 0.0022	12 0.00075
5	6	0.100	5 0.00022	5 0.00005	5 0.0180	5 0.0022	12 0.00075
6	5	0.100	12 0.00022	5 0.0002	4 0.0180	5 0.0023	3 0.00080
7	5	0.100	4 0.00025	4 0.0004	5 0.0185	5 0.0023	5 0.00097
8	3	0.100		4 0.0010	5 0.0188	4 0.0023	5 0.00106
9	4	0.101		4 0.0012	4 0.0189	4 0.0026	5 0.00120
10	5	0.105			8 0.0190	3 0.0028	5 0.00120
11	4	0.111			3 0.0190	4 0.0028	4 0.00150
12	4	0.114			3 0.0195		5 0.00175
13					5 0.0200		
14					4 0.0203		
15					4 0.0218		
16					7 0.0220		
17					4 0.0235		
Average		0.1015	0.000201	0.000333	0.01909	0.00236	0.000947
Std dev		0.0037	0.000021	0.000048	0.00050	0.00017	0.000084
H		0.0013	0.000046	0.00006	0.00053	0.00017	0.00011
U ₁		0.0039	0.000051	0.000077	0.00073	0.00024	0.00014
t-statistic		2.20	2.45	2.31	2.12	2.23	2.20
U ₂		0.0025	0.000047	0.000059	0.00037	0.00016	0.000086
Certified		0.101	0.00020	0.0003	0.0191	0.0024	0.00095
Uncertainty		0.002	0.00005	0.0001	0.0004	0.0002	0.00009

BS 200-4 * Code for method Informational values listed as weight percent

Analysis	*	Zr
1	5	0.00004
2	12	0.00006
3	4	0.00007
4	3	0.0011
Average		0.00044
Std dev		0.00042
H		0.00007
U ₁		0.00042
t-statistic		3.18
U ₂		0.00067
(Certified)		(0.0004)
(Uncertainty)		(0.0007)

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, $w_i = 1/U_i^2$, $A = \sum w_i M_i / \sum w_i$, and $S = 1/\sqrt{\sum w_i}$. 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 0.13	12 0.05	12 0.005	12 0.025	5 0.05	12 0.0025	5 0.05	12 0.0025	12 0.0005	12 0.0025
2	12 0.18	5 0.5			5 0.07		5 0.05			
3	9 0.25				12 0.08		5 0.1			
4	12 0.25				5 0.09		12 0.25			
5	5 0.35				5 0.1		12 0.25			
6	5 0.4				12 0.12		5 0.5			
7	5 0.5				5 0.15		15 0.5			
8	5 0.5				5 0.5		5 0.5			
9	5 0.7				9 1					

Analysis	* Dy	* Er	* Eu	* F	* Ga	* Gd	* Ge	* Hf	* Hg	* Ho
1	12 0.0025	12 0.0025	12 0.0025	12 0.025	12 1.7	12 0.0025	12 0.05	12 0.025	12 0.025	12 0.0025
2					5 2		5 0.4		5 0.5	
3					5 2					
4					12 2.1					
5					5 2.2					
6					5 2.3					
7					5 2.3					
8					5 2.9					

Analysis	* I	* In	* Ir	* K	* La	* Li	* Lu	* Na	* Nd	* Os
1	12 0.0025	12 0.05	12 0.025	12 0.05	12 0.0025	12 0.0025	12 0.0025	12 0.025	12 0.0025	12 0.025
2		5 0.5						12 0.034		

Analysis	* Pd	* Pr	* Pt	* Rb	* Re	* Rh	* Ru	* Sc	* Se	* Sm
1	12 0.05	12 0.0025	12 0.05	12 0.005	12 0.025	12 0.025	12 0.025	12 0.0005	5 0.5	12 0.0025
2									12 0.65	
3									15 0.9	
4									4 1	
5									5 1.3	
6									12 1.4	
7									9 1.5	
8									5 1.8	
9									9 1.9	
10									9 2	

Analysis	* Sr	* Tb	* Te	* Th	* Tl	* Tm	* U	* Y	* Yb	* Zn
1	12 0.5	12 0.0025	15 0.05	12 0.0025	5 0.005	12 0.0025	12 0.0025	12 0.025	12 0.0025	8 0.5
2			12 0.05		5 0.02					4 1.1
3			5 0.1		12 0.025					5 2
4			9 0.1		12 0.025					12 2.0
5			5 0.1		5 0.05					8 2.5
6			12 0.17		5 0.1					5 3
7			5 0.2		5 0.5					12 3.2
8			9 0.25		5 0.5					4 3.8
9			5 0.5		9 1					5 4.6
10			5 1							

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
ATI Allvac	Monroe, NC	PRI/Nadcap	17025
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, Guide 34
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
Laboratory Testing, Inc.	Hatfield, PA	PRI/Nadcap	17025
LECO Corporation	St. Joseph, MI	The British Standards Institution	9001
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
VHG Labs	Manchester, NH	A2LA	Guide 34

Certification Process: The requirements of ISO Guides 31, 34, and 35, 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 an end Mill 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 867, 882, 897, 898, 899, 1243, 1249, 3119A, 3137, 3158; 501-024, 501-149, 501-501, 501-503, 501-504, 501-506, 501-550, 501-673, 501-991, 501-992, 502-257; IMZ 181: NCS HC11520: 24X WASP4 C, ECRM 328-1; IARM 50A, 190A; AR 511; BAS 335, 337, 345, 346, 346A, 351; BS 200, 200A, 200-1, 200-2, 200-3

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: BS 200, 200A, 200-1, 200-2, 200-3; 21X 17521J; VAW 4-28

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 200-4 is valid indefinitely. The certification is nullified if this CRM is damaged, contaminated, or otherwise modified.

Source: The original 25 mm bar stock for this CRM was produced by Inco Alloys International.

Form: This CRM is isothermally forged and machined in the form of a disc, approximately 38 mm in diameter and 15 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 REV200-4 - 071511. 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.
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Houston, Texas 77069-2895 USA

Phone: (281) 440-9396
Fax: (281) 440-4432

web: www.brammerstandard.com
e-mail: contact@brammerstandard.com

Revision: This certified reference material was originally certified as a reference material by Brammer Standard Company on November 14, 1991, 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, O, Sb, Sn, and Ta have been added to the certified list. Al, Mo, and Ni have been changed from informational to certified. Refined values for all elements except B are presented. An informational value for Zr is provided. All trace data are presented in 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 July 15, 2011.

Beau R. Brammer