

Brammer Standard Company, Inc.

Certificate of Analysis

BS 197B

Grade RA 333 Nickel Base Alloy Reference Material

Unified Number N06333

AMS Number 5593, 5717

Certified Value ¹	Estimate of Uncertainty ²	Certified Value ¹	Estimate of Uncertainty ²
------------------------------	--------------------------------------	------------------------------	--------------------------------------

Analysis listed as percent by weight

C	0.049	0.003	Co	3.22	0.06
Mn	1.58	0.02	Mg	0.013	0.001
P	0.011	0.002	Ti	0.091	0.005
S	0.0008	0.0002	V	0.053	0.003
Si	0.92	0.02	W	2.91	0.07
Cu	0.030	0.005			
Ni	45.6	0.2			
Cr	25.73	0.06			
Mo	3.27	0.04			
Fe	16.24	0.10			
Al	0.11	0.01			
B	0.0018	0.0003			

Informational values ³

Nb (0.02)

N (0.049)

Sn (0.002)

¹ The certified value listed is the present best estimate of the true value based on the results of an interlaboratory testing program.

² The uncertainties listed are based on value judgments of the material inhomogeneity and the 95% confidence interval. The half-width confidence interval C(95%) is shown on page 2.

³ Data in parentheses are not certified and are provided for information only.

See reverse the following pages for more information.

Certificate Number 197B-061699p1

Brammer Standard Company, Inc., 14603 Benfer Road, Houston, TX 77069-2895
Telephone (281) 440-9396 Fax (281) 440-4432

Analysis	*	C	* Mn	* P	* S	* Si	* Cu	* Ni	* Cr	* Mo	* Fe
1	7	0.048	47 1.56	1 0.008	7 0.0007	47 0.90	1 0.026	18 45.48	47 25.64	50 3.21	44 16.15
2	7	0.048	30 1.56	47 0.009	7 0.0007	47 0.90	1 0.0273	47 45.505	47 25.66	47 3.23	44 16.177
3	7	0.0486	30 1.578	47 0.009	7 0.0008	1A 0.90	47 0.0295	18 45.53	42 25.68	47 3.25	1 16.19
4	7	0.0486	30 1.578	2 0.010	7 0.0008	1 0.905	1A 0.0297	18 45.610	42 25.700	50 3.25	44 16.207
5	7	0.0486	30 1.58	1 0.0100	7 0.0008	2 0.906	47 0.03	18 45.624	1 25.74	47 3.25	44 16.210
6	7	0.050	4A 1.59	1A 0.0111		1 0.92	2 0.038	18A 45.639	47 25.745	1 3.29	1 16.21
7	7	0.053	1 1.59	26 0.012		24 0.931		1 45.65	42 25.78	38 3.299	47 16.25
8			47 1.59	26 0.012		24 0.934		47 45.82	42 25.805	4A 3.30	47 16.40
9			1 1.60	47 0.014		47 0.95		1 45.94	42 25.816	2 3.30	47 16.415
10										38 3.309	
11										1 3.32	
Average		0.0493	1.581	0.0106	0.00076	0.916	0.0301	45.64	25.730	3.273	16.245
Std Dev		0.0018	0.014	0.0019	0.00005	0.018	0.0042	0.15	0.063	0.037	0.096
Certified		0.049	1.58	0.011	0.0008	0.92	0.030	45.6	25.73	3.27	16.24
t		2.4469	2.306	2.306	2.7764	2.306	2.5706	2.306	2.306	2.2281	2.306
C(95%)		0.0016	0.011	0.0014	0.00007	0.014	0.0044	0.115	0.049	0.025	0.074

Continued from above

Analysis	*	Al	* B	* Co	* Mg	* Nb	* Ti	* V	* W	* N	* Sn
1	47	0.10	2 0.00155	47 3.10	1 0.012	47 0.0105	2 0.085	47 0.0505	47 2.84	11 0.0476	2 0.001
2	1	0.105	49 0.0016	47 3.16	2 0.0127	1A 0.0139	1 0.0883	47 0.051	47 2.86	11 0.050	4B 0.0018
3	2	0.106	49 0.0016	4A 3.16	2 0.013	1 0.017	1A 0.0898	1A 0.0515	47 2.88	11 0.050	2 0.002
4	1	0.106	2 0.00177	47 3.18	1 0.0131	1 0.0180	47 0.09	1 0.0545	2 2.933	11 0.050	2 0.0031
5	47	0.108	2 0.0020	2 3.20	4 0.0132	2 0.021	47 0.0925	2 0.056	1A 2.962		
6	2	0.121	1 0.0021	1 3.24	1A 0.0134	47 0.027	2 0.093	1 0.056	1 2.99		
7	1A	0.122	1A 0.0022	1 3.24	4 0.0141		1 0.100	47			
8	2	0.122		32 3.254							
9				32 3.274							
10				32 3.29							
11				32 3.30							
Average		0.1113	0.00183	3.218	0.0131	0.0179	0.0912	0.0533	2.911	0.0494	0.0020
Std Dev		0.0089	0.00027	0.063	0.0006	0.0057	0.0047	0.0025	0.060	0.0012	0.0009
Certified		0.11	0.0018	3.22	0.013	(0.02)	0.091	0.053	2.91	(0.049)	(0.002)
t		2.3646	2.4469	2.2281	2.4469	2.5706	2.4469	2.5706	2.5706	3.1824	3.1824
C(95%)		0.0075	0.00025	0.042	0.0006	0.0060	0.0043	0.0027	0.0628	0.0019	0.0014

Data listed as mass fraction expressed as percent.

Data in parentheses are not certified but provided for information only.

$C(95\%) = (t \times sd) / \sqrt{n}$ The half-width confidence interval, where t is the appropriate Student's t value, sd is the interlaboratory standard deviation, and n is the number of acceptable mean values. For further information regarding the confidence interval for the certified value, see ISO Guide 35:1989 section 4.

Certification Process: The requirements of ISO Guide 31, ISO Guide 34, ISO Guide 35, and ASTM Standard Guides E 1724 and E 1831 were followed for the preparation of this reference material and certificate of analysis. This is a reference material as defined by ISO Guide 30.

Analysis: Chemical analyses were made on chips prepared by a lathe from the certified portion of the bars in accordance with ASTM Standard Practice E 1806. The laboratories participating in the testing normally followed the requirements of ISO Guide 25. The individual values listed above are the average of each analyst's results. Methods of analysis used were a combination of ASTM Standard Methods E 350, E 354, and 1019 plus additional ICP and AA spectrometric methods.

Outliers: Some outlying data was excluded from the data listed above due to technical assessment of the cooperating laboratories and statistical evaluation.

Homogeneity: This Reference Material was tested for homogeneity using ASTM Standard Practice E 826 and found acceptable.

Methods of Analysis

Certificate Number 197B-061699p3

Method Nr	Description.
Method	
1	AES - ICP -Inductively Coupled Plasma Spectrometry
1A	Average from DCP and ICP determinations
2	AES - Optical Emission Spectrometry
4	FAS - Flame Atomic Absorption Spectrometry
4A	Average from DCP, ICP, and FAS determinations
4B	Average from DCP, ICP, Flameless Atomic Absorption Spectrometry determinations
7	Combustion-Infrared Absorption
11	Inert gas Fusion Method
18	Dimethylglyoxime gravimetric
18A	Average from EDTA, dimethylglyoxime gravimetric
24	MAS - Molybdenum blue photometric method
26	MAS - Molybdivanadophosphoric acid photometric
30	MAS - Periodate
32	MAS - Photometric with nitroso-R-sale
38	MAS - Thiocyanate after extraction with butyl acetate
42	Peroxydisulfate oxidation titrimetric
44	Silver reduction titrimetric
47	XRF spectrometric
49	MAS - Mandelic acid - ferrous phenanthroline photometric
50	Precipitation with α -Benzoin oxime gravimetric

AES = Atomic Emission Spectrometry

MAS = Molecular Absorption Spectrometry (photometric, spectrophotometric methods)

Traceability: This Reference Material was also examined by optical emission spectrometry and found to be compatible with the following Reference Material: NIST SRM 1247; BAS SS 387; BS H3B, H4B, H8, 197, 197A, 825, 825A.

The following Certified Reference Materials were used to validate the analytical data listed on page 2: NIST SRM 131e, 864, 865, 867.

Certificate Number: The unique identification number for this certificate of analysis is 197B-061699-px where x indicates the page number. Refer to future Brammer Standard Company catalogs for information on any revisions to this or other Brammer Standard reference materials. You may also obtain information on revisions of certificates from the internet at brammerstandard.com.

Co-operating Laboratories: Some of the co-operating laboratories were:

Laboratory

Laboratory contact

Allegheny Ludlum Corporation, Works Laboratory, Brackenridge, Pennsylvania
Allegheny Ludlum Corporation, Analytical Services, Brackenridge, Pennsylvania
Allvac, Lockport, New York
Auburn Analytical Lab, Inc., Auburn, Michigan
Brammer Standard Co., Inc., Houston, Texas
J. Dirats and Co., Inc., Westfield, Massachusetts
IncoTest, Huntington, West Virginia
Shiva Analyticals (India) Ltd., Hoskote, Bangalore, India
VHG Laboratories, Inc., Manchester, New Hampshire

Shawn Cooper
Sally Bissell-Seymour
Thomas Herdlein
Matt LaFramboise
Richard Beaumont
Eric C. Dirats
R. E. Jackson
Dr. T. V. Ramakrishna
Julie M. McIntosh

Validity statement: ISO Guide 31 requires that a validity period statement be included in the certificate of analysis. This Reference Material is valid for 20 years from the certificate date.

Source: This material was produced by Krupp VDM, Germany, and purchased from Rolled Alloys, Temperance, Michigan. The material was made in an electric arc furnace, cast into ingots and rolled into bar stock.

Available Form: This Reference Material is available in the form of a disc, approximately 38 mm (1.50") in diameter and 12 mm (0.50") thick.

Use: This Reference Material is intended for use in optical emission and x-ray spectrometric methods of analysis. The entire depth of the disc may be used.

Caution: As with any bar material, avoid optical emission spectrometric burns in the center of the disc (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 disc during surface preparation.

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.
14603 Benfer Road
Houston, Texas 77069-2895 USA

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

Certified by: _____ on June 16, 1999.
G. R. Brammer

Certificate Number 197B-061699p4

By Certificate Number R-021, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9002 by the American Association for Laboratory Accreditation (A2LA).

**Brammer Standard Company's Chemical Laboratory is accredited to ISO Guide 25 by A2LA.
(Certificate Number 656.01)**

References:

*ASTM documents available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959,
Telephone: 610-832-9500 Fax: 610-832-9555 e-mail: service@astm.org Website: www.astm.org*

E 350 - 90 Standard Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

E 354 - 93 Standard Test Methods for Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

E 826 - 85 (Reapproved 1990) Standard Practice for Testing Homogeneity of Materials for the Development of Reference Materials

E 1019 - 93 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys

E 1724 - 95 Standard Guide for Testing and Certification of Metal and Metal-Related Reference Materials

E 1806 - 96 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

E 1831 - 96 Standard Guide for Preparing Certificates for Reference Materials Relating to Chemical Composition of Metals, Ores, and Related Materials.

ISO Guides available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

ISO Guide 25 (Third edition, 1990), General requirements for the competence of calibration and testing laboratories.

ISO Guide 30 (Second edition, 1991), Terms and definitions used in connection with reference materials.

ISO Guide 31 (First edition, 1981), Contents of certificates of reference materials.

ISO Guide 33 (First edition, 1989), Uses of certified reference materials.

ISO Guide 34 (First edition, 1996), Quality system guidelines for the production of reference materials.

ISO Guide 35 (Second edition, 1989), Certification of reference materials - General and statistical principles.

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

Certificate Number 197B-061699p5