

Brammer Standard Company, Inc.

Certificate of Analysis

BS 750B

Nickel Alloy Grade 750 Reference Material

	Certified Value ^{1,2}	Estimate of Uncertainty ³		Certified Value ^{1,2}	Estimate of Uncertainty ³
Analysis listed as percent by weight					
C	0.052	0.003	Fe	7.23	0.05
Mn	0.09	0.01	Ti	2.58	0.04
P	0.006	0.001	Mg	(0.0003)	
S	(<0.001)		N	(0.002)	
Si ⁴	0.14	0.02	Nb	1.06	0.02
Cu	0.05	0.005	Ta	(0.01)	
Ni	71.92	0.05	V	0.04	0.01
Cr	15.70	0.06	W	(0.05)	
Mo	0.21	0.02	Zr	(0.01)	
Al	0.72	0.02			
B	0.003	0.001			
Co	0.35	0.01			

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

² Data in parentheses are not certified and are provided for information only.

³ 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.

⁴ Test data indicated some inhomogeneity in the silicon content.

See the following pages for more information.

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Certificate Number 750B-032699p2

Analysis	*	C	*	Mn	*	P	*	S	*	Si	*	Cu	*	Ni	*	Cr
1	7	0.050	2	0.08	2	0.0041	7	<0.0003	1	0.120	4	0.0400	3	71.84	3	15.65
2	7	0.051	3	0.08	1	0.0050	7	<0.001	2	0.1269	1	0.0437	1	71.89	10	15.656
3	7	0.0525	4	0.0854	1	0.0055	7	<0.001	4	0.129	1	0.0452	9	71.90	10	15.658
4	2	0.055	2	0.0861	3	0.006			3	0.14	3	0.05	1	71.95	1	15.66
5			12	0.088	19	0.0061			1	0.144	2	0.05	9	71.95	10	15.662
6			1	0.0919	1	0.007			2	0.15	1	0.050	9	71.950	10	15.68
7			1	0.092	19	0.007					2	0.0532	9	71.954	16	15.71
8			1	0.0920	19	0.007					2	0.054	9	71.955	1	15.74
9			2	0.107	2	0.007									10	15.76
10															1	15.77
Average		0.0521		0.089		0.0061				0.135		0.048		71.924		15.695
Std Dev		0.0022		0.008		0.0010				0.011		0.005		0.043		0.047
Certified		0.052		0.09		0.006		(<0.001)		0.14		0.05		71.92		15.70
t		3.1824		2.306		2.306				2.5706		2.3646		2.3646		2.2622
C(95%)		0.0035		0.006		0.0008				0.012		0.004		0.036		0.033

Analysis	*	Mo	*	Al	*	B	*	Co	*	Fe	*	Ti	*	Mg
1	2	0.195	1	0.698	1	0.002	1	0.336	3	7.19	1	2.53	1	0.0002
2	4	0.196	1	0.70	3	0.002	4	0.336	13	7.197	18	2.551	1	0.00030
3	3	0.1995	4	0.704	1	0.0020	2	0.34	1	7.20	18	2.554	1	0.0004
4	1	0.210	1	0.711	1	0.0032	1	0.343	13	7.209	18	2.556		
5	1	0.218	1	0.720	20	0.0034	1	0.35	13	7.228	18	2.575		
6	1	0.218	2	0.73	2	0.0035	3	0.35	1	7.28	2	2.59		
7	3	0.22	3	0.73			1	0.350	13	7.29	3	2.62		
8	2	0.23	1	0.737			3	0.3649			1	2.64		
9	11	0.234												
Average		0.2134		0.7163		0.0027		0.3462		7.228		2.577		0.00030
Std Dev		0.0143		0.0151		0.0008		0.0096		0.041		0.038		0.00010
Certified		0.21		0.72		0.003		0.35		7.23		2.58		(0.0003)
t		2.306		2.3646		2.5706		2.3646		2.4469		2.3646		4.3027
C(95%)		0.0110		0.0126		0.0008		0.0081		0.038		0.031		0.00025

Analysis	*	N	*	Nb	*	Ta	*	V	*	W	*	Zr
1	8	0.002	15	1.03	1	0.0021	4	0.028	1	0.02	1	0.01
2	8	0.0024	2	1.05	1	0.004	1	0.03	1	0.0546	3	0.01
3	8	0.003	1	1.05	3	0.01	1	0.036	1	0.0594	1	0.0127
4			1	1.063	1	0.01	1	0.0377	3	0.08	1	0.013
5			3	1.07	2	0.038	1	0.0378			2	0.015
6			1	1.08			3	0.04				
7			1	1.08			2	0.0458				
Average		0.0025		1.060		0.013		0.036		0.054		0.012
Std Dev		0.0005		0.018		0.015		0.006		0.025		0.002
Certified		(0.002)		1.06		(0.01)		0.04		(0.05)		(0.01)
t		4.3027		2.4469		2.7764		2.4469		3.1824		2.7764
C(95%)		0.0013		0.017		0.018		0.006		0.040		0.003

* Methods of analysis listed on page 3.

Data in parentheses are not certified but provided for information only.
Data listed as mass fraction expressed as percent.

$C(95\%) = (t \times sd) / \sqrt{n}$ 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.

Methods of analysis:**Certificate Number 750B-032699p3**

*Method	Description
1	AES - Inductively Coupled Plasma
2	AES - Optical Emission
3	X-ray Emission Spectrometry
4	Flame Atomic Absorption Spectrometry
7 C, S	Combustion-Infrared Absorption (ASTM E 1019)
8 N, O	Inert gas Fusion Method (ASTM E 1019)
9 Ni	Dimethylglyoxime gravimetric (ASTM E 353)
10 Cr	Ammonium Persulfate Redox titrametric
11 Mo	MAS - Thiocyanate
12 Mn	MAS - Metaperiodate (ASTM E 350)
13 Fe	Silver reduction titrametric (ASTM E 354)
15 Nb	Perchloric acid/sulfuric acid gravimetric
16 Cr	Peroxydisulfate oxidation titrametric (ASTM E 354)
18 Ti	MAS - Diantiprylmethane (ASTM E 354)
19 P	MAS - Molybdenum blue (ASTM E 354)
20 B	MAS - Mandelic acid ferrous phenathroline

AES = Atomic Emission Spectrometry

MAS = Molecular Absorption Spectrometry (photometric, spectrophotometric methods)

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.

Certificate Number: The unique identification number for this certificate of analysis is 750B-032699-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.

Analysis: Chemical analyses were made on chips prepared by a lathe from the certified portion of the bars. The laboratories participating in the testing normally followed the requirements of ISO Guide 25. The individual values listed on page 2 are the average of each analyst's results. Methods of analysis are listed above.

Outliers: Some outlying data was excluded from the data listed on page 2 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 for all elements except silicon. The test data indicated some inhomogeneity in the silicon content. The estimate of uncertainty for the certified value includes the inhomogeneity of silicon.

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

Laboratory

Brammer Standard Co., Inc., Houston, Texas

Laboratory contact

Richard Beaumont

Crucible Specialty Metals, Syracuse, New York
J. Dirats and Co., Inc., Westfield, Massachusetts
IncoTest, Huntington, West Virginia
Laboratory Testing Inc., Dublin, Pennsylvania
LECO Corporation, St. Joseph, Michigan
Shiva Analyticals (India) Ltd., Hoskote, Bangalore, India
VHG Laboratories, Inc., Manchester, New Hampshire

William Mastroe
Eric E. Dirats
R. E. Jackson
Lee Dilks
Dennis Lawrenz
Dr. T. V. Ramakrishna
Julie M. McIntosh

Traceability: This Reference Material was also examined by optical emission spectrometry and found to be compatible with the Certified Reference Material NIST SRM 1244.

The following Certified Reference Materials were used to validate the analytical data listed on page 2:
NIST SRM 73c, 101g, 125b, 344, 345, 349a, 362, 364, 690, 864, 865, 867, 868; BAS 310/1, 345, 351 ECRM 088-1, 096-1, 184-1, 284-1, 481-1.

Source: This material was produced by the Cyclops - Cytemp Specialty Steel Division, Titusville, Pennsylvania.

Available Form: This Reference Material is available in the form of a disc, 37 mm diameter and 12 mm thick.

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.

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 March 26, 1999.
G. R. Brammer

Certificate Number 750B-032699p4

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 353 - 93 Standard Test Methods for Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

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 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 750B-032699p5