Brammer Standard Company, Inc.

Certificate of Analysis

BS 405

Reference Material for Monel® Alloy R405

	Certified Value[1]	Estimate of Uncertainty[2]		Certified Value[1]	Estimate of Uncertainty[2]
		Analysis listed as percent by weight			
C	**0.13**	0.005	**Cr**	**0.006**	0.002
Mn	**1.03**	0.02	**Mg**	**0.026**	0.003
P	**0.010**	0.002	**Ti**	**0.003**	0.001
S	**0.041**	0.005			
Si	**0.04**	0.005			
Cu	**31.80**	0.10			
Ni	**65.49**	0.10	Informational Values[3]		
Al	**0.10**	0.01	B	(0.001)	
Fe	**1.34**	0.02	Mo	(0.002)	
Co	**0.025**	0.005	Nb	(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 possible bias in the determined analytical values. No attempt is made to derive exact statistical measurements of imprecision because several methods were used in the determination of most constituents.

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

The requirements of ISO Guide 31 and ISO Guide 35 were generally followed for the preparation of this reference material and certificate of analysis. This is a reference material as defined by ISO Guide 30.

See reverse side for more information. Certificate Number 405-070298p1

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

BS 405 Certificate number 405-070298p2

Analysis	C	Mn	P	S	Si	Cu	Ni	Al	Fe
1	0.128	0.99	0.008	0.0356	0.030	31.64	65.32	0.08	1.30
2	0.129	1.013	0.0086	0.0379	0.030	31.65	65.36	0.0919	1.323
3	0.13	1.020	0.009	0.040	0.0343	31.68	65.399	0.0939	1.327
4	0.13	1.022	0.0103	0.040	0.04	31.73	65.46	0.094	1.33
5	0.13	1.03	0.0106	0.045	0.04	31.74	65.49	0.0958	1.33
6	0.130	1.03	0.011	0.049	0.04	31.76	65.49	0.096	1.33
7	0.131	1.032	0.012		0.042	31.76	65.498	0.098	1.34
8	0.132	1.040	0.0123		0.044	31.8	65.517	0.103	1.341
9		1.04	0.013		0.050	31.87	65.55	0.104	1.35
10		1.04			0.05	31.889	65.55	0.11	1.360
11		1.047				31.906	65.58	0.111	1.37
12		1.06				31.912	65.59		1.38
13						32.06	65.62		
Average	0.130	1.030	0.0105	0.0413	0.040	31.800	65.494	0.098	1.340
Std Dev	0.001	0.018	0.0017	0.0049	0.007	0.122	0.090	0.009	0.022
Certified	0.13	1.03	0.010	0.041	0.04	31.80	65.49	0.10	1.34
t	2.3646	2.201	2.306	2.5706	2.2622	2.1788	2.1788	2.2281	2.201
C(95%)	0.001	0.011	0.0013	0.0052	0.005	0.074	0.055	0.006	0.014

continued from above

Analysis	Co	Cr	Mg	Ti	B	Mo	Nb
1	0.016	0.0048	0.0224	0.0016	0.0003	0.0003	0.0007
2	0.0208	0.0050	0.0259	0.003	0.0007	0.001	0.0012
3	0.0238	0.0055	0.0263	0.003	0.0010	0.0013	0.0017
4	0.024	0.006	0.0272	0.0033	0.001	0.0021	0.003
5	0.028	0.006	0.028	0.004	0.001	0.003	
6	0.029	0.008	0.0284	0.004	0.0013	0.003	
7	0.031	0.009					
Average	0.0247	0.0063	0.0264	0.0032	0.0009	0.0018	0.0017
Std Dev	0.0052	0.0016	0.0022	0.0009	0.0003	0.0011	0.0010
Certified	0.025	0.006	0.026	0.003	(0.001)	(0.002)	(0.002)
t	2.4469	2.4469	2.5706	2.5706	2.5706	2.5706	3.1824
C(95%)	0.0048	0.0015	0.0023	0.0009	0.0004	0.0012	0.0016

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

C(95%) = (t x sd)/√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 Guide E 1724 were followed for the preparation of this reference material and certificate of analysis. This is a reference material as defined by ISO Guide 30.

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

ANAREM, Prague, Czech Republic
Brammer Standard Co., Inc., Houston, Texas
J. Dirats and Co., Inc., Westfield, Massachusetts
IncoTest, Huntington, West Virginia
LECO Corporation, St. Joseph, Michigan
Shiva Analyticals (India) Ltd., Hoskote, Bangalore, India
VHG Laboratories, Inc., Manchester, New Hampshire

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 59. 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 used were a combination of ASTM Standard Methods E 53, E76, E 353, E 354, E 1473, and E 1019 plus additional ICP and AA spectrometric methods.

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

Traceability: This Reference Material was also examined by optical emission spectrometry and found to be compatible with the following Certified Reference Material: NIST SRM C1248. The following Certified Reference Materials were used to validate the analytical data listed on page 2: NIST SRM 344, 349a, 864, 865, 866, 867, 868; ECRM 284-1, 481-1; BCS 310/1, 345, 351; BAM 328-1.

Source: This material was produced by Inco Alloys International, Huntington, West Virginia. The material was made in an electric arc furnace and cast into ingots. The resulting bars were cold drawn rolled down to 1.50 inch (38 mm) diameter.

Available Form: This Reference Material is available only 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.

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 July 2, 1998.
G. R. Brammer

Certificate Number 405-070298p3

Referenced Documents

ASTM documents available from ASTM, 1916 Race Street, Philadelphia, PA, 19103.

E 59 - 93 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

E 76 - 88 (Reapproved 1993) Standard Test Methods for Chemical Analysis of Nickel-Copper Alloys

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

E 354 - 96 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 1473 - 92 Standard Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature 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 35 (Second edition, 1989), Certification of reference materials - General and statistical principles.

Other useful documents available at no cost from NIST, U.S. Department of Commerce, Gaithersburg, MD 20899.

NBS 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 405-070298p4