

Brammer Standard Company, Inc.

# Certificate of Analysis

**BS 14500**

**Certified Reference Material<sup>1</sup> for Grade 14500 Copper Alloy  
(UNS Number C14500)**

<b>Certified Value<sup>2</sup></b>	<b>Estimate of Uncertainty<sup>3</sup></b>	<b>Information Values<sup>4</sup></b>		
<b>Analysis listed as percent by weight</b>				
<b>C</b>	<b>0.0005</b>	0.0002	Ag	<0.0002
<b>Cu</b>	<b>99.4</b>	0.1	Al	<0.0006
<b>Fe</b>	<b>0.0041</b>	0.0010	As	<0.0005
<b>Mn</b>	<b>0.00004</b>	0.00002	Be	<0.0001
<b>O</b>	<b>0.0007</b>	0.00015	Ca	<0.0003
<b>P</b>	<b>0.0075</b>	0.0008	Co	<0.0001
<b>Pb</b>	<b>0.0008</b>	0.0004	Cr	<0.0001
<b>S</b>	<b>0.0033</b>	0.0003	Mg	<0.0003
<b>Sn</b>	<b>0.0002</b>	0.00005	Ni	<0.0003
<b>Te</b>	<b>0.53</b>	0.015	Sb	<0.001
<b>Zn</b>	<b>0.004</b>	0.002	Si	<0.002

<sup>1</sup> Brammer Standard Company, Inc., is accredited to ISO Guide 34 as a Reference Material Producer to produce Certified Reference Materials by A2LA (Certificate Number 656.02)

<sup>2</sup> The certified value listed is the present best estimate of the true value based on the results of an interlaboratory testing program.

<sup>3</sup> 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.

<sup>4</sup> The values listed in parentheses are not certified and are for information only.

See the following pages for more information.

**Certificate Number 14500-032808p1**

**Brammer Standard Company, Inc., 14603 Benfer Road, Houston, TX 77069-2895  
Telephone (281) 440-9396 Fax (281) 440-4432 [brammerstandard.com](http://brammerstandard.com)**

Analysis	* C	* Cu %	* Fe	* Mn	* O	* P	* Pb	* S	* Sn	* Te %	* Zn
1	1 4	5 99.41	3 27.41	7 0.16	2 5	3 63	3 3.47	1 30.3	13 1.5	1 0.5050	13 20.24
2	1 4	5 99.41	3 36.5	3 0.338	2 5	9 65	8 3.6	1 31.8	13 1.5	3 0.5120	13 21
3	1 4	5 99.41578	7 37	7 0.4	2 7	4 67	7 7.7	1 32	7 1.8	3 0.5265	7 26
4	1 5.8		3 39	3 0.5	2 7	3 70.9	7 7.9	1 32.8	3 1.93	3 0.5300	13 32
5	1 6.2		3 42	13 0.5534	2 7.7	3 72.92	13 8.3	1 33	7 2.0	3 0.5343	7 35
6	1 7.5		3 44	9 0.60	2 7.8	10 76	13 8.3	1 34	7 2	7 0.542	4 36
7			9 48			7 80	7 8.6	1 34	7 2.1	7 0.544	3 43.6
8			4 55			10 80	13 8.842	4 36	9 2.2		3 46
9						3 81	7 9.6		13 2.469		9 50
10						7 82	9 13		3 2.5		6 58.0
11						3 82	3 14		4 3		6 60.2
12											3 63.8
Average	5.3	99.412	41.1	0.43	6.6	74.53	8.48	33.0	2.1	0.5277	41.0
Std Dev	1.5	0.003	8.3	0.16	1.3	7.15	3.20	1.7	0.4	0.0146	15.0
Certified	5	99.4 %	41	0.4	7	75	8	33	2	0.53 %	40
t	2.5706	4.3027	2.3646	2.5706	2.5706	2.2281	2.2281	2.3646	2.2281	2.4469	2.201
C(95%)	1.55	0.0083	6.92	0.17	1.33	4 4.8	2.15	1.4	0.3	0.0135	9.6

\* indicate method of analysis Below data is for information only and is not certified.

Analysis	* Ag	* Al	* As	* Be	* Ca	* Co	* Cr	Mg	* Ni	* Sb	* Si
1	3 <0.1	9 0.011	9 0.06	9 <0.05	9 0.015	3 0.052	9 0.009	9 0.014	7 <0.1	7 <0.1	9 0.012
2	13 0.6226	7 0.89	7 <0.1	7 <0.1	3 <1	7 <0.1	13 0.6229	7 <0.1	13 <0.20	7 0.1	13 <0.1
3	7 0.8	3 3.29	13 <0.30	7 <0.1	3 <1	3 <0.1	13 <0.20	7 <0.1	13 <0.20	9 0.15	13 <0.1
4	7 0.9	3 4.8	13 <0.30	3 <1	4 1	7 0.1	13 <0.20	3 <1	3 <1	13 <0.3	3 <1
5	4 <1	3 4.9	13 0.3363	3 <1	3 1	9 0.26	4 <1	3 <1	3 <1	13 <0.3	3 <1
6	3 <1	3 5.2	3 0.7	4 <1	3 2	3 <1	3 <1	3 <1	3 0.429	13 0.5591	7 <3
7	7 <1	7 <0.1	8 <1	3 <1	3 2.4	3 <1	7 <1	3 2.4	9 0.54	3 0.7	3 10.7
8	13 <1.0	3 <1	8 <1		7 <10	3 <1	3 <1		13 0.6619	4 <1	10 11
9	13 <1.0	4 <1	8 <1				3 <1		7 0.79	3 6	10 13
10	9 1.2		4 <1				7 <1		3 2	3 8.87	4 14
11			3 <5						3 2.6		3 17.4
Estimate	<2	<6	<5	<1	<3	<1	<1	<3	<3	<10	<20

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.

\* Methods of Analysis

Code	Method
1	Combustion - Inferred Absorption Method
2	Fusion - Thermal Conductivity Method
3	AES-ICP Inductively Couples Plasma Spectrometry
4	AES- Spark Optical Emission Spectrometry
5	Gravimetric method
6	Flame Atomic Absorption Spectrometry
7	AES-ICP-MS Inductively Couples Plasma with Mass Spectrometry
8	Graphite Furnace - Atomic Absorption Spectrometry
9	Colorimetric method
10	Spectrophotometric method
11	X-Ray Fluorescence spectrometry
12	Titration method

AES = Atomic Emission Spectrometry

Co-operating Laboratories: The co-operating laboratories were:

Laboratory

Brammer Standard Co., Inc., Houston, Texas  
 China National Analysis Center for Iron and Steel, Beijing, China  
 Freeport-McMoran Copper & Gold, El Paso, Texas  
 J. Dirats and Co., Inc., Westfield, Massachusetts  
 Laboratory Testing Inc., Hatfield, Pennsylvania  
 LECO Corporation, St. Joseph, Michigan  
 Northern Analytical Laboratory, Inc., Merrimack, New Hampshire  
 VHG Laboratories, Inc., Manchester, New Hampshire

Contact person

Richard P. Beaumont  
 Prof. Wang Haizhou  
 Jean Fernandez  
 Eric E. Dirats  
 Rick Heist  
 Dennis Lawrenz  
 William A. Guidoboni & Peter S. Dickson  
 Julie M. McIntosh

**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 Certified 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 discs in accordance with ASTM Standard Practice E 255-07. The laboratories participating in the testing normally followed the requirements of ISO Standard 17025. Individual values listed on page 2 are the average of each analyst's results. Methods of analysis are listed on page 2.

**Outliers:** Some outlying data was excluded from the data listed on page 2 due to technical assessment of the cooperating laboratories and statistical evaluation.

**Traceability:** The following Certified Reference Materials were used to validate the analytical data listed on page 2: NIST SRMs 3101a, 3102a, 3103a, 3105, 3109a, 3112a, 3113, 3128, 3131a, 3132, 3136, 3139a, 3150, 3151, 3156, 3161a, 3168a;

**Homogeneity:** This Certified Reference Material was tested for homogeneity using ASTM Standard Method E 826 and found acceptable. It was also examined by optical emission spectrometry using and found to be compatible with the following Reference Materials: NIST SRM C1251, C1252, C1253; BCR 075; MBH 39X17870; BS 110, 110A.

**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. Whereas this material is in a solid form and stable, no expiration date is specified.

**Source:** This material was produced by National Bronze & Metal, Inc., Houston, Texas

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

**Use:** This Certified Reference Material is intended for use in optical emission and x-ray spectrometric methods of analysis. Refer to ISO Guide 33 for information about the use of Reference Materials.

**Certified area:** 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.

**Certificate Number:** The unique identification number for this certificate of analysis is 14500-032808-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 [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.	Phone: (281) 440-9396	web	<a href="http://www.brammerstandard.com">www.brammerstandard.com</a>
14603 Benfer Road			
Houston, Texas 77069-2895 USA	Fax: (281) 440-4432	e-mail	<a href="mailto:contact@brammerstandard.com">contact@brammerstandard.com</a>

Certified by: \_\_\_\_\_ on March 28, 2008.  
Beau R. Brammer

**Certificate Number 14500-032808p3**

**Brammer Standard Company, Inc., is accredited to ISO Guide 34 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials by A2LA (Certificate Number 656.02)  
The scope of accreditation is listed on the website: [www.brammerstandard.com](http://www.brammerstandard.com)**

**By Certificate Number 10539, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9001:2000 by National Quality Assurance, U.S.A.**

**Brammer Standard Company's Chemical Laboratory is accredited to ISO Standard 17025 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](mailto:service@astm.org) Website: [www.astm.org](http://www.astm.org)*

E 255-07 Standard Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition

E 826 - 85 (Withdrawn 2005) Standard Practice for Testing Homogeneity of Materials for the Development of Reference Materials

E 1724 - 95 (Reapproved 2001) Standard Guide for Testing and Certification of Metal and Metal-Related Reference Materials

E 1831 - 96 (Withdrawn 2005) Standard Guide for Preparing Certificates for Reference Materials Relating to Chemical Composition of Metals, Ores, and Related Materials.

*ISO Guides and Standards available from Global Engineering - [www.global.ihs.com](http://www.global.ihs.com)*

ISO Standard 17025 (Second edition, 2005), General requirements for the competence of calibration and testing laboratories.

ISO Guide 30 (Second edition, 1992), Terms and definitions used in connection with reference materials.

ISO Guide 31 (Second edition, 2000), Reference materials -Contents of certificates and labels.

ISO Guide 33 (Second edition, 2000), Uses of certified reference materials.

ISO Guide 34 (Second edition, 2000), General requirements for the competence of reference material producers.

ISO Guide 35 (Third edition, 2006), 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 14500-032808p4**