

Brammer Standard Company, Inc.

Certificate of Analysis

BS 110B

**Certified Reference Material¹ for Grade 11000 Electronic Tough Pitch Copper
(UNS Number C11000)**

	Certified Value ²	Estimate of Uncertainty ³		Certified Value ²	Estimate of Uncertainty ³
Analysis listed as percent by weight					
Cu	99.94	0.05	Mn	<0.0001	
Ag	<0.0002		Ni	<0.0002	
Al	<0.0002		O	0.0363	0.0008
As	<0.0001		P	<0.0006	
Be	<0.0001		Pb	0.00052	0.00012
C	0.0007	0.0003	S	0.00030	0.00005
Ca	<0.0003		Sb	<0.0005	
Co	<0.0001		Si	<0.0004	
Cr	<0.0001		Sn	<0.0002	
Fe	0.0005	0.0002	Te	<0.0002	
Mg	<0.0001		Zn	<0.0003	

¹ 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)

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

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.

See the following pages for more information.

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Analysis	* Cu	* Ag	* Al	* As	* Be	* C	* Ca	* Co	* Cr	* Fe	* Mg
1	1 99.93	8 0.02	8 0.003	8 0.02	3 0.1	5 5	8 0.015	8 0.035	8 0.003	10 2.6	3 1
2	1 99.93	3 0.7	8 0.35	8 0.04	3 0.601	5 5	3 1	8 0.04	3 0.119	3 3	8 <0.001
3	1 99.96640	8 <0.1	3 0.7	3 0.3	8 <0.001	5 5.3	3 1.2	3 0.1	10 0.6292	3 4	8 <0.01
4		4 <1	4 0.89	10 0.3134	8 <0.05	5 5.4	3 1.3	4 0.29	3 1	3 4.7	4 <0.1
5		3 <1	3 1	4 <0.1	4 <0.1	5 8	8 <0.005	3 1.2	8 <0.005	10 5.058	3 <0.1
6		4 <1	3 <0.1	10 <0.30	3 <0.1	5 9	3 <0.1	10 1.995	3 <0.1	8 7.2	3 <0.1
7		4 <1	3 <1	10 <0.30	3 <0.1	5 9.0	3 <0.730	3 <0.3989	10 <0.20	8 7.3	3 <1
8		10 <1	3 <2	3 <1	3 <0.521	5 11	3 <1.5	3 <0.846	10 <0.20		3 <1
9		4 <1	4 <2	2 <1	3 <1		3 <2	3 <1	3 <0.540		3 <1
10		10 <1.0		9 <1	3 <1		3 <3	3 <1	3 <1		4 <1
11		10 <1.0		9 <1	3 <1			3 <1	3 <1		
12		3 <1.218		4 <1	3 <1			3 <1	4 <1		
13		3 <1.75			4 <1			4 <1	3 <1		
14									3 <1		
15									3 <1		
16									4 <1		
Average	99.942					7.2				4.8	
Std Dev	0.021					2.3				1.9	
Certified	99.94	<2	<2	<1	<1	7	<3	<1	<1	5	<1
t	4.3027					2.3646				2.4469	
C(95%)	0.052					2.0				1.7	

continued from above

Data listed as ppm by weight (mg/Kg)

Analysis	* Mn	* Ni	* O	* P	* Pb	* S	* Sb	* Si	* Sn	* Te	* Zn
1	8 0.003	3 0.1	6 330	8 0.2	10 0.8218	5 1	8 0.03	8 0.02	8 0.08	10 0.22	8 0.19
2	8 0.005	4 0.25	6 350	8 0.29	2 1.3	5 1.2	10 0.23	8 0.060	4 0.2	4 0.4	8 0.21
3	10 0.1013	3 0.319	6 352	3 0.6	3 3.7	8 2.7	4 0.3	4 2	10 0.29	4 0.5	10 0.4166
4	3 0.4	8 0.36	6 354	3 4.2	10 3.8	5 3.0	10 0.4801	3 2	4 0.3	10 0.5708	3 0.5
5	3 <0.0903	8 0.39	6 361	3 4.3	2 5	5 3	4 0.9	3 3.7	10 0.327	10 0.70	10 1.1
6	3 <0.1	10 0.7572	6 364	7 4.4	4 5.0	5 3	3 1.6	10 <0.10	3 1.4	2 1.5	3 2
7	4 <0.1	3 1	6 365	3 5	4 5.2	5 3.2	3 <0.1	10 <0.10	4 <0.1	8 <0.05	3 <0.1
8	10 <0.20	3 1.5	6 367	7 5.9	10 5.4	5 3.2	4 <0.1	3 <1	8 <0.1	3 <0.1	10 <0.20
9	10 <0.20	10 <0.20	6 368	3 <4.139	8 5.6		8 <0.1	3 <1.277	10 <0.20	4 <0.1	4 <0.5
10	3 <1	10 <0.20	6 371	3 <5	4 5.7		10 <0.30	3 <2	3 <0.484	8 <0.5	3 <0.848
11	3 <1	3 <1		7 <5	8 7.6		4 <1		4 <1	3 <0.521	3 <1
12	3 <1	3 <1					3 <1.921		3 <1	3 <1	3 <1
13	3 <1	3 <1					3 <2		3 <1.328	4 <1	3 <2
14	4 <1	4 <1					3 <3.41				
15		3 <1.450					3 <5				
Average			362.8		5.2	3.0					
Std Dev			6.7		1.1	0.2					
Certified	<1	<2	363	<6	5.2	3.0	<5	<4	<2	<2	<3
t			2.3646		2.306	2.5706					
C(95%)			5.6		0.88	0.19					

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

Code *Method of Analysis

- 1 Electrolytic plating
- 2 Graphite Furnace - Atomic Absorption Spectrometry
- 3 AES-ICP Inductively Coupled Plasma Spectrometry
- 4 AES-ICP with Mass Spectrometry
- 5 Combustion - Inferred Absorption Method

Code * Method of Analysis

- 6 Fusion - Thermal Conductivity Method
- 7 Spectrophotometric Method
- 8 GD-MS Glow Discharge with Mass Spectrometry
- 9 Flame Atomic Absorption Spectrometry
- 10 DC Arc - AES

AES = Atomic Emission Spectrometry

Data listed below is for information only and is not certified. Data listed as ppm by weight (mg/Kg)

Analysis	* Au	* B	* Bi	* Cd	* Cl	* Ga	* Hg	* In	* K	* Li	* Mo
1	8 <0.01	8 <0.001	8 <0.001	10 0.8024	8 0.02	8 <0.01	8 <0.01	8 <0.005	8 0.017	8 <0.001	8 <0.005
2	8 <0.5	8 <0.005	8 <0.01	8 <0.01	8 0.024	8 <0.01	8 <0.5	8 <0.1	8 <0.01	8 <0.01	8 0.015
3	4 <0.5	4 <0.5	10 <0.0725	3 <0.0348		4 <0.05	4 <0.5		4 <10	4 <0.1	4 1.2
4			4 <0.1	8 <0.1							
5			10 <0.10	10 <0.20							
6			10 <0.10	10 <0.20							
7				4 <0.5							
Uncertified	<0.5	<0.5	<0.10	<0.5	0.02	<0.05	<0.5	<0.10	<10	<0.1	<2

continued from above

Analysis	* Na	* Nb	* Se	* Ta	* Th	* Ti	* Tl	* V	* W	* Zr
1	8 0.022	8 <0.005	8 0.12	8 <0.1	8 <0.0001	8 0.002	8 <0.001	8 <0.001	8 <0.001	8 <0.001
2	8 <0.005	8 <0.1	10 0.3056	8 <5	8 <0.01	4 0.002	8 <0.01	8 <0.001	8 <0.05	4 <0.01
3	4 <10	4 <0.1	8 0.32	4 <10	4 <0.1	8 <0.1	4 <0.05		4 <1	8 <0.05
4			10 <0.020							
5			10 <0.020							
6			4 <2							
7			4 <2							
Uncertified	<10	<0.1	<2	<10	<0.1	<0.1	<0.05	<0.001	<1	<0.05

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

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
 Elemental Analysis, Inc., Lexington, Kentucky
 Laboratory Testing Inc., Hatfield, Pennsylvania
 LECO Corporation, St. Joseph, Michigan
 Lehigh Testing Laboratories, Inc., New Castle, Delaware
 Northern Analytical Laboratory, Inc., Merrimack, New Hampshire
 NSL Analytical, Cleveland, Ohio
 VHG Laboratories, Inc., Manchester, New Hampshire
 West Penn Testing Group, New Kensington, Pennsylvania

Contact person

Richard P. Beaumont
 Prof. Wang Haizhou
 Jean Fernandez
 Eric E. Dirats
 Nick Tzouanakis
 Rick Heist
 Dennis Lawrenz
 Peter M. Engelgau
 William A. Guidoboni
 Carm D'Agostino
 Julie M. McIntosh
 Bob Ross

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 and 3 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 393, 3101a, 3102a, 3103a, 3105, 3109a, 3112a, 3113, 3126, 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, C1253; BCR 074A, 075A; 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 Consolidated Extrusions Pty Ltd, Ingleburn, Australia.

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.

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 110B-042508-px/y, where x indicates the page number and y indicates the total number of pages. 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.

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	www.brammerstandard.com
14603 Benfer Road			
Houston, Texas 77069-2895 USA	Fax: (281) 440-4432	e-mail	contact@brammerstandard.com

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

Certificate Number 110B-042508p4/5

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

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 Website: 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

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