Brammer Standard Company, Inc.

Certificate of Analysis

BS 905A-4

Reference Material for Bronze CDA Grade 905 - UNS Number C90500

Certified Values[3]

	Certified Value[1]	Estimate of Uncertainty[2]		Certified Value[1]	Estimate of Uncertainty[2]
As	**0.002**	0.001			
Fe	**0.012**	0.001			
Ni	**0.018**	0.002			
P	**0.049**	0.001			
Pb	**0.033**	0.001			
Sb	**0.004**	0.001			
Sn	**10.3**	0.1			
Zn	**2.2**	0.1			

Informational Values[3,4]

Ag (0.002)	**Al (<0.005)**	**C (0.002)**	**Cu [87.3]**	**Mn (<0.005)**
S (0.004)	**Si (<0.005)**			

[1] For each element, the certified value listed is the present best estimate of the true value based on the mean of the weighted results of an interlaboratory testing program. See page 2 for more information on its calculation.

[2] For each element, the uncertainty listed is 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 page 2 for more information on its calculation.

[3] Values are given in weight percent.

[4] Values in parentheses are not certified and are provided for information only.

The requirements of ISO Guides 31, 34, and 35, and ASTM Standard Guides E1724 and E1831, were followed for the preparation of this reference material and certificate of analysis. This is a reference material as defined by ISO Guide 30.

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BS 905A-4 Certified values listed as weight percent

Analysis *	As	* Fe	* Ni	* P	* Pb	* Sb	* Sn	* Zn
1	0.0002	0.011	0.0166	0.0475	0.0323	0.0032	10.22	2.19
2	0.0003	0.0111	0.0166	0.0477	0.0324	0.0033	10.25	2.20
3	0.0010	0.0114	0.0173	0.0477	0.0324	0.0035	10.310	2.20
4	0.0012	0.0114	0.0173	0.0478	0.0325	0.0039	10.32	2.200
5	0.0023	0.0116	0.018	0.0478	0.0326	0.0042	10.34	2.21
6	0.0026	0.0116	0.019	0.0481	0.0327	0.0042	10.35	2.21
7	0.0026	0.0119		0.0489	0.0327	0.0044	10.35	2.21
8	0.0026	0.012		0.0490	0.0328	0.0045	10.35	2.21
9	0.0027	0.0127		0.0492	0.0330	0.0045	10.35	2.22
10	0.0027	0.0130		0.0500		0.0048	10.36	2.22
11	0.0027	0.0130		0.0504		0.0048	10.37	2.22
12	0.0027	0.0131		0.0515		0.0048	10.39	2.222
13	0.0028	0.0133		0.0527		0.0051	10.41	2.23
14	0.0029	0.014						2.23
15								2.24
Average	0.0021	0.01222	0.01747	0.0491	0.03260	0.00425	10.336	2.214
Std dev	0.0010	0.00094	0.00092	0.0016	0.00022	0.00061	0.052	0.014
t-statistic	2.16	2.20	2.57	2.20	2.31	2.18	2.26	2.18
Certified	**0.002**	**0.012**	**0.018**	**0.049**	**0.033**	**0.004**	**10.3**	**2.2**
Uncertainty	**0.001**	**0.001**	**0.002**	**0.001**	**0.001**	**0.001**	**0.1**	**0.1**
C(95%)	0.0006	0.0006	0.0010	0.0010	0.0002	0.0004	0.0373	0.0082

BS 905A-3 Informational values listed as weight percent

Analysis *	Ag	* Al	* C	* Cu	* Mn	* S	* Si
1	0.0014	<0.0001	0.0002	87.14	<0.0001	0.0035	<0.0005
2	0.0017	<0.0001	0.0011	87.20	<0.0001	0.0035	<0.001
3	0.0017	<0.001	0.0011	87.2345	<0.0003	0.0035	0.0007
4	0.002	0.0007	0.0016	87.24		0.0036	0.001
5	0.0020	0.001	0.0017	87.2866		0.0037	0.0012
6	0.003		0.0017	87.30		0.0038	0.0018
7			0.0018	87.3		0.0038	
8			0.0025	87.37		0.0039	
9				87.3977		0.0041	
10				87.5153			
11				87.52			
12							
13							
Average	0.00197		0.00146	87.32		0.00371	
Std dev	0.00055		0.00067	0.12		0.00021	
t-statistic	2.57		2.36	2.23		2.31	
(Informational)	(0.002)	(<0.005)	(0.002)	[87.3]	(<0.005)	(0.004)	(<0.005)
C(95%)	0.0006		0.0006	0.0820		0.0002	

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.

Laboratory	Location
Anarem	Praha, Czech Republic
Brammer Standard Company, Inc.	Houston, Texas
China National Analysis Center for Iron and	Beijing, China
J. Dirats and Co., Inc.	Westfield, Massachusetts
Laboratory Testing Inc.	Dublin, Pennsylvania
Leco Corporation	St. Joseph, Michigan
Shiva Analyticals (India) Ltd.	Bangalore, India
VHG Laboratories, Inc.	Manchester, New

Analysis: Chemical analyses were made on solid pieces and chips prepared by a lathe from representative samples for the certified portion of the lot. The laboratories participating in the testing followed the requirements of ISO Guide 25.

Traceability: The following reference materials were used to validate the analytical data listed on page 2 — BAM 224-1; BAS 183/3, 364; SRM 37e, 52c, 398, 494, 498, 879.

Homogeneity: This reference material (RM) was tested for homogeneity using ASTM Standard Method E 826 and found acceptable. It was also examined by spark atomic emission spectrometry and found to be compatible with the following Reference Materials — CTIF L3, UZ30, 9862, 9863; SRM 1107, 1108.

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. The certification of BS 905A-4 is valid indefinitely. The certification is nullified if this RM is damaged, contaminated, or otherwise modified.

Source: The bar stock for this RM was produced by Western Reserve Manufacturing Company, Inc., Lorain, Ohio.

Form: This RM is machined in the form of a disc, approximately 39 mm in diameter and 12 mm thick by Brammer Standard Company, Inc.

Use: This RM is intended for use in spark atomic 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 RM 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 sample during surface preparation.

Certificate Number: The unique identification number for this certificate of analysis is 905A-4-121313 You may 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:

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Phone: (281) 440-9396 **Web: www.brammerstandard.com**

Fax: (281) 440-4432 **Email: contact@brammerstandard.com**

At the time of testing Brammer Standard Company, Inc. was accredited by the American Association for Laboratory Accredtiation to ISO Guide 25 (Certificate Number 656.01) and to ISO 9002 (Certificate Number R-021).

Currently, Brammer Standard Company, Inc., is accredited by the American Association for Laboratory Accreditation (A2LA) to ISO Guide 34 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials (Certificate Number 656.02) and Brammer Standard Company's Chemical Laboratory is accredited by A2LA to ISO Standard 17025. (Certificate Number 656.01)

By Certificate Number 10539, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9001:2008 by National Quality Assurance (NQA), U.S.A.

The scopes of accreditation are listed on the website: www.brammerstandard.com

References:

Versions used were those available at the time of testing and characterization

E 826 Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry

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

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

ISO Guide 25:1990 General requirements for the competence of calibration and testing laboratories

ISO Guide 30:1991 Terms and definitions used in connection with reference materials

ISO Guide 31:1981 Contents of certificates of reference materials

ISO Guide 33:1989 Uses of certified reference materials

ISO Guide 34:1996 Quality system guidelines for the production of reference materials.

ISO Guide 35:1989 Certification of reference materials - General and statistical principles.

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

*ISO Guides and Standards available from Global Engineering - **www.global.ihs.com***

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

Certified by: _____ on December 13, 2013.

Beau R. Brammer