

BRAMMER STANDARD COMPANY, INC.

Certificate of Analysis

BS 938-1

Reference Material for Leaded Bronze CDA 938 - UNS Number C93800¹

	Certified Value ²	Estimate of Uncertainty ³	Certified Values⁴	Certified Value ²	Estimate of Uncertainty ³
Ag	0.0048	0.0003			
Cu	77.1	0.15			
Ni	0.49	0.01			
Pb	14.8	0.1			
S	0.009	0.002			
Sb	0.033	0.004			
Sn	7.16	0.05			
Zn	0.26	0.01			

Informational Values^{4,5}

Al (<0.002)	As (0.004)	Fe (0.015)	Mn (0.001)	P (0.059)
Si (<0.004)				

¹ This certificate is a revision. For more information on the nature and extent of the revision, see the revision statement on page 3.

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.

⁴ Values are given in weight percent.

⁵ Values in parentheses are not certified and are provided for information only.

The requirements of ISO Guides 31, 34, and 35 were followed for the preparation of this Certified Reference Material and certificate of analysis. This is a Certified Reference Material as defined by ISO Guide 30.

BS 938-1 Certified values listed as weight percent

Analysis *	Ag *	Cu *	Ni *	Pb *	S *	Sb *	Sn *	Zn *
1	0.0045	76.97	0.48	14.74	0.0070	0.0273	7.10	0.248
2	0.0046	77.02	0.48	14.82	0.0071	0.031	7.14	0.250
3	0.0046	77.08	0.480	14.82	0.0074	0.0319	7.15	0.2525
4	0.0048	77.1	0.4851	14.83	0.0083	0.032	7.15	0.254
5	0.0050	77.18	0.486	14.87	0.0085	0.033	7.16	0.254
6	0.0050		0.487	14.98	0.009	0.0331	7.1627	0.26
7	0.0050		0.489		0.0095	0.0347	7.17	0.26
8			0.489		0.0097	0.036	7.181	0.268
9			0.492		0.0099	0.0398	7.19	0.269
10			0.497				7.19	0.273
11							7.21	
Average	0.00479	77.070	0.4865	14.843	0.0085	0.0332	7.164	0.2589
Std dev	0.00022	0.080	0.0056	0.079	0.0011	0.0035	0.030	0.0086
t-statistic	2.4469	2.7764	2.2622	2.5706	2.306	2.306	2.2281	2.2622
Certified	0.0048	77.1	0.49	14.8	0.009	0.033	7.16	0.26
C (95%)	0.00020	0.099	0.0040	0.083	0.0009	0.0027	0.099	0.0062

BS 938-1 Informational values listed as weight percent

Analysis *	Al *	As *	Fe *	Mn *	P *	Si *
1	<0.0001	0.0021	0.013	0.0002	0.0523	<0.0005
2	<0.001	0.0026	0.0133	0.0007	0.055	<0.002
3	0.0001	0.0029	0.0134	0.0007	0.056	0.0006
4	0.0001	0.0049	0.014	0.001	0.056	0.0006
5	0.001	0.0050	0.014	0.0011	0.0585	0.0022
6	0.0014		0.0144	0.0011	0.061	0.0024
7			0.0157	0.0018	0.0623	0.0024
8			0.0158		0.0641	0.0026
9			0.016		0.0644	0.003
10			0.016			
11			0.0166			
12			0.017			
(Informational)	(<0.002)	(0.004)	(0.059)	(0.001)	(0.059)	(<0.004)

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

Laboratory

Anarem
 Brammer Standard Company, Inc.
 China National Analysis Center for Iron and Steel
 J. Dirats and Co., Inc.
 Laboratory Testing, Inc.
 LECO Corporation
 Shiva Analyticals (India) Ltd.
 VHG Laboratories, Inc.

Location

Praha, Czech Republic
 Houston, Texas
 Beijing, China
 Westfield, Massachusetts
 Dublin, Pennsylvania
 St. Joseph, Michigan
 Bangalore, India
 Manchester, New Hampshire

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. The individual values listed above are the average of each analyst's results. Methods of analysis used were a combination of ICP, OES, GFAA, and AA spectrometric methods plus classical wet methods.

Traceability: The following Certified Reference Materials were used to validate the analytical data listed above — BAS 183/3, 364; CKD 318, 319, 320, 321; CTIF B30, B31, B32, UE54; IPT 10A, 15; SRM 398, 400, 494, 498, 872.

Homogeneity: This Certified Reference Material (CRM) was tested for homogeneity using ASTM Standard Method E 826 and found acceptable.

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 938-1 is valid indefinitely. The certification is nullified if this CRM is damaged, contaminated, or otherwise modified.

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

Form: This CRM is machined in the form of a disc, approximately 41x mm in diameter and 12 mm thick by Brammer Standard Company, Inc.

Use: This CRM 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 Certified Reference Materials.

Certified Area: The entire depth of the CRM may be used.

Caution: As with any bar material, avoid spark atomic emission spectrometric burns in the center of the CRM (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 sample during surface preparation.

Certificate Number: The unique identification number for this certificate of analysis is REV938-1-112213. 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:

Brammer Standard Co., Inc.
14603 Benfer Road

Houston, Texas 77069-2895 USA

Phone: (281) 440-9396

Fax: (281) 440-4432

Web: www.brammerstandard.com

Email: contact@brammerstandard.com

Revision: This certified reference material was originally certified as a reference material on February 10, 1999. Fe and P have been changed from certified to informational to include previously excluded sublots.

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)

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 1019 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques
- E 1806 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

- ISO Standard 17025:2005 General requirements for the competence of testing and calibration laboratories
- ISO Standard 9001:2008 Quality Management Systems - Requirements
- ISO Guide 30:1992 Terms and definitions used in connection with reference materials + 2008 amendment
- ISO Guide 31:2000 Reference materials - Contents of certificates and labels
- ISO Guide 33:2000 Uses of certified reference materials
- ISO Guide 34:2009 General requirements for the competence of reference material producers
- ISO Guide 35:2006 Reference Materials - General and statistical principles for certification

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 November 22, 2013.

Beau R. Brammer