

Brammer Standard Company, Inc.

Certificate of Analysis

B.S. 938-1

Reference Material for Leaded Bronze CDA Grade 938

	Certified Value ¹	Estimate of Uncertainty ²		Uncertified Value ³
Analysis listed as percent by weight				
Cu	77.1	0.15	As	(0.004)
Sn	7.16	0.05	Si	(<0.004)
Pb	14.8	0.1	Al	(<0.002)
Zn	0.26	0.01	Mn	(0.001)
P	0.059	0.004		
Ni	0.49	0.01		
Fe	0.015	0.002		
Sb	0.033	0.004		
S	0.009	0.002		
Ag	0.0048	0.0003		

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 the 95% confidence interval. The half-width confidence interval C(95%) is shown on page 2.

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

See reverse side for more information.

Certificate Number 938-1-021099p1

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Analysis	Cu	Sn	Pb	Zn	P	Ni	Fe	Sb	As	S	Ag
1	76.97	7.10	14.74	0.248	0.0523	0.48	0.013	0.0273	0.0021	0.0070	0.0045
2	77.02	7.14	14.82	0.250	0.055	0.48	0.0133	0.031	0.0026	0.0071	0.0046
3	77.08	7.15	14.82	0.2525	0.056	0.480	0.0134	0.0319	0.0029	0.0074	0.0046
4	77.1	7.15	14.83	0.254	0.056	0.4851	0.014	0.032	0.0049	0.0083	0.0048
5	77.18	7.16	14.87	0.254	0.0585	0.486	0.014	0.033	0.0050	0.0085	0.0050
6		7.1627	14.98	0.26	0.061	0.487	0.0144	0.0331		0.009	0.0050
7		7.17		0.26	0.0623	0.489	0.0157	0.0347		0.0095	0.0050
8		7.181		0.268	0.0641	0.489	0.0158	0.036		0.0097	
9		7.19		0.269	0.0644	0.492	0.016	0.0398		0.0099	
10		7.19		0.273		0.497	0.016				
11		7.21					0.0166				
12							0.017				
Average	77.070	7.164	14.843	0.2589	0.0588	0.4865	0.0149	0.0332	0.0035	0.0085	0.00479
Std Dev	0.080	0.030	0.079	0.0086	0.0043	0.0056	0.0014	0.0035	0.0014	0.0011	0.00022
Certified	77.1	7.16	14.8	0.26	0.059	0.49	0.015	0.033	(0.004)	0.009	0.0048
t	2.7764	2.2281	2.5706	2.2622	2.306	2.2622	2.201	2.306	2.7764	2.306	2.4469
C(95%)	0.099	0.020	0.083	0.0062	0.0033	0.0040	0.0009	0.0027	0.0017	0.0009	0.00020

Analysis	Si	Al	Mn
1	<0.0005	<0.0001	0.0002
2	<0.002	<0.001	0.0007
3	0.0006	0.0001	0.0007
4	0.0006	0.0001	0.001
5	0.0022	0.001	0.0011
6	0.0024	0.0014	0.0011
7	0.0024		0.0018
8	0.0026		
9	0.003		
Average			0.0009
Std Dev			0.0005
Certified	(<0.004)	(<0.002)	(0.001)

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

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

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 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 bars. The laboratories participating in the testing normally 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.

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

Anarem, Praha, Czech Republic
Brammer Standard Co., Inc., Houston, Texas
China National Analysis Center for Iron and Steel, 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 Hampshire

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 Materials: CTIF B30, B31, B32, UE54; CKD 318 through 321. Materials used to validate the analytical data listed on page 2 were: NIST 398, 400, 494, 498, 872; BAM 227-1; BCS 183/3, 364; IPT 10A, 15.

Source: This material was produced by Western Reserve Manufacturing Company, Inc., Lorain, Ohio. The material was produced by continuous casting.

Available Form: This Reference Material is available in the form of a disc, approximately 41 mm in diameter and 12 mm thick.

Use: This Reference Material is intended for use in optical emission and x-ray spectrometric methods of analysis.

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. Phone: (281) 440-9396
14603 Benfer Road
Houston, Texas 77069-2895 USA Fax: (281) 440-4432

Certified by: _____ on February 10, 1999
G. R. Brammer

Certificate Number 938-1-021099p3

By Certificate Number R-021, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9002 by the American Association for Laboratory Accreditation (A2LA).

**Brammer Standard Company's Chemical Laboratory is accredited to ISO Guide 25 by A2LA.
(Certificate Number 656.01)**

References:

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

E 826 - 85 (Reapproved 1990) Standard Practice for Testing Homogeneity of Materials for the Development of Reference Materials

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 34 (First edition, 1996), Quality system guidelines for the production of reference materials.

ISO Guide 35 (Second edition, 1989), 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