

Brammer Standard Company, Inc.

Certificate of Analysis

BS 954D

Certified Reference Material for High Strength Aluminum Bronze Alloy - UNS Number C95400

	Certified Value ¹	Estimate of Uncertainty ²	Certified Values ³	Certified Value ¹	Estimate of Uncertainty ²
Al	10.3	0.2	Ni	0.034	0.007
As	0.003	0.002	P	0.004	0.002
C	0.0042	0.0005	Pb	0.009	0.003
Cr	0.0015	0.0006	S	0.0007	0.0005
Cu	85.6	0.3	Si	0.030	0.005
Fe	3.8	0.2	Sn	0.006	0.003
Mn	0.02	0.01	Zn	0.083	0.007

	Reference Value ¹	Estimate of Uncertainty ²	Reference Values ^{3,4}	Reference Value ¹	Estimate of Uncertainty ²
Ag	0.002	0.001	O	<0.005	
H	<0.005		Sb	0.004	0.003
Mg	<0.05		Zr	<0.05	

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 4 for more information on its calculation.

² For each element, the uncertainty listed is based on a statistical evaluation of the contributions of homogeneity and the interlaboratory testing program. See page 4 for more information on its calculation.

³ Values are given in weight percent. Values in brackets are reported by difference.

⁴ Reference values are not certified and are provided for information only.

The requirements of ISO Guides 30, and Standards 33401 and 33405 were followed for the preparation of this Certified Reference Material and certificate of analysis.

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* Code for method

Certified values listed as weight percent

Analysis	*	Al	*	As	*	C	*	Cr	*	Cu	*	Fe	*	Mn	*	Ni	*	P	*	Pb
1	3	10.17	4	0.00031	11	0.0029	4	0.0012	4	84.74	11	3.705	4	0.0066	3	0.003	4	0.0015	3	0.004
2	4	10.18	3	0.0015	1	0.00407	11	0.001375	16	85.34	3	3.715	11	0.012925	3	0.003	3	0.00205	3	0.006
3	17	10.2	4	0.002	3	0.00408	3	0.0014	16	85.5675	3	3.725	17	0.013	11	0.027425	4	0.0021	3	0.0069
4	4	10.22	3	0.003525	3	0.0041	3	0.0015	16	85.595	11	3.7475	3	0.015	3	0.0306	3	0.003075	4	0.0069
5	3	10.25	3	0.004	11	0.00413	11	0.0016	16	85.61	4	3.75	3	0.01545	11	0.03175	11	0.0043	3	0.007325
6	3	10.265	3	0.004	1	0.00417			16	85.6125	3	3.7975	4	0.0157	3	0.03325	3	0.0043	11	0.0075
7	4	10.285	3	0.0052	11	0.00438			16	85.695	11	3.805	4	0.016	4	0.0371	11	0.00575	3	0.00765
8	3	10.32			4	0.0044			4	85.78	17	3.8105	4	0.019	11	0.0396	11	0.005825	4	0.008
9	3	10.35			1	0.0044			6	85.80	17	3.82	4	0.019	4	0.040			3	0.008
10	11	10.36			1	0.00483			16	85.81	17	3.83	3	0.02165	4	0.040			11	0.008775
11	11	10.385							16	85.82	4	3.84	11	0.0226	4	0.04			4	0.010
12	3	10.4325							4	85.825	3	3.86	11	0.029575	17	0.040			17	0.010
13	11	10.445							4	85.9	4	3.87	3	0.036	3	0.04535			4	0.0105
14	4	10.575									4	3.92	3	0.0365	4	0.060			17	0.012
15											4	3.93							11	0.0129
16											3	3.98							17	0.013
17											3	4.11								
Average		10.334		0.0029		0.00419		0.001480		85.624		3.84		0.0168		0.034		0.0036		0.0087
Std Dev		0.015		0.0017		0.00014		0.000051		0.032		0.10		0.0010		0.015		0.0017		0.0025
H		0.043		0.00065		0.00075		0.00049		0.17		0.024		0.0014		0.001875		0.00070		0.0010
U ₁		0.046		0.00066		0.00076		0.00050		0.18		0.024		0.0017		0.0019		0.00071		0.0010
t-statistic		2.16		2.45		2.26		2.78		2.18		2.12		2.16		2.16		2.36		2.13
U ₂		0.10		0.0016		0.0017		0.0014		0.39		0.050		0.0037		0.0041		0.0017		0.0022
U ₃		0.026		0.00061		0.00054		0.00062		0.11		0.012		0.0010		0.0011		0.00060		0.00054
Certified		10.3		0.003		0.0042		0.0015		85.6		3.8		0.02		0.034		0.004		0.009
Uncertainty		0.2		0.002		0.0005		0.0006		0.3		0.2		0.01		0.007		0.002		0.003
Tolerance		0.6		0.002		0.0015		0.0014		0.9		0.6		0.01		0.021		0.003		0.008

Analysis	*	S	*	Si	*	Sn	*	Zn												
1	1	0.00023	4	0.0248	4	0.0010	4	0.068												
2	1	0.000263	3	0.025	4	0.0028	4	0.076												
3	1	0.000357	4	0.026	9	0.0041	4	0.0773												
4	1	0.000533	3	0.0265	17	0.0047	17	0.078												
5	3	0.001	3	0.029	4	0.005	3	0.08075												
6	4	0.001	17	0.031	3	0.0051	3	0.0824												
7	3	0.001	4	0.032	4	0.0067	3	0.0826												
8	11	0.0015	3	0.032725	3	0.007	11	0.0828												
9			3	0.03275	3	0.00788	3	0.0855												
10			11	0.03315	3	0.008	3	0.087												
11			3	0.03325	3	0.0087	4	0.0875												
12			11	0.034025	3	0.009	11	0.0895												
13			11	0.03455			3	0.09												
14							11	0.09095												
Average		0.00074		0.0304		0.0058		0.0827												
Std Dev		0.00046		0.0036		0.0025		0.0064												
H		0.00038		0.0018		0.00086		0.0029												
U ₁		0.00040		0.0018		0.00086		0.0029												
t-statistic		2.36		2.18		2.20		2.16												
U ₂		0.00094		0.0039		0.0019		0.0063												
U ₃		0.00033		0.0011		0.00055		0.0017												
Certified		0.0007		0.030		0.006		0.083												
Uncertainty		0.0005		0.005		0.003		0.007												
Tolerance		0.0006		0.015		0.005		0.021												

BS 954D

* Code for method

Reference values listed as weight percent

Analysis	*	Ag	*	H	*	Mg	*	O	*	Sb	*	Zr								
1	17	0.001	2	0.000127	4	0.0074	2	0.00062	4	0.00037	11	0.0119								
2	4	0.0014							11	0.0011										
3	17	0.002167							3	0.0065										
4	17	0.002167							3	0.007										
Average		0.0017		0.000127		0.01		0.00062		0.0037		0.0119								
Std Dev		0.0090		0.000014		0.16		0.00026		0.0035		0.0012								
H		0.0005		0.00021		0.001		0.00036		0.00071		0.0012								
U ₁		0.0091		0.00021		0.16		0.00044		0.00073		0.0017								
t-statistic		3.18		12.71		12.71		12.71		3.18		12.71								
U ₂		0.029		0.0027		1.99		0.0056		0.0023		0.021								
U ₃		0.014		0.0027		1.99		0.0056		0.0012		0.021								
Reference		0.002		<0.005		<0.05		<0.005		0.004		<0.05								
Uncertainty		0.001								0.003										
Tolerance		0.001								0.003										

For each element, in accordance with the requirements of ISO 17034 and 33405, an effort must be made to account for the effects on the certified value of the uncertainty estimate from homogeneity testing (H) and the uncertainties of the contributing laboratories. The average (A) is calculated using a weighted mean where the reciprocal of the square of each laboratory's combined uncertainty (C_L), calculated from its standard deviation (S_L) and its uncertainty estimate (U_L), is used as the weight (W_L) for its mean (M_L). The standard deviation (S) is calculated as the square root of the reciprocal of the sum of the weights. U₁ is the combined uncertainty from homogeneity and labs. U₂ is U₁ multiplied by the coverage factor (95 % t-statistic). U₃ is U₂ divided by the square root of the number of determinations (n). Thus:

$$C_L = \sqrt{S_L^2 + U_L^2} \quad W_L = \frac{1}{C_L^2} \quad A = \frac{\sum_{i=1}^n W_L M_L}{\sum_{i=1}^n W_L} \quad S = \frac{1}{\sqrt{\sum_{i=1}^n W_L}} \quad U_1 = \sqrt{H^2 + S^2} \quad U_2 = t \times U_1 \quad U_3 = \frac{U_2}{\sqrt{n}}$$

All but the final reported values are taken to two significant figures as determined by each quantity's uncertainty estimate. The final reported Uncertainty is U₃ rounded to one significant figure and represents the half width of the 95 % confidence interval for the **Certified** value. The final reported **Certified** value is A rounded to the same decimal place as the Uncertainty. The Uncertainty is a measure of the quality of the **Certified** value.

The Tolerance is a measure of the expected performance of an analysis. This involves further expanding the sample uncertainty to include instrument and operator uncertainty, for those without access to such calculations.

For further information regarding the confidence interval for the certified value see ISO Standard 33405:2024 section 10.

Analytical Method Codes:

1 Combustion (ASTM E1019)	7 Photometric	13 Titrimetric
2 Fusion (ASTM E1019)	8 Flame Atomic Absorption	14 DCP Atomic Emission
3 Spark Atomic Emission	9 GF Atomic Absorption	15 HG Atomic Fluorescence
4 ICP Atomic Emission	10 X-Ray Fluorescence	16 Difference
5 ICP Mass Spectrometry	11 GD Atomic Emission	17 AAS
6 Gravimetric	12 GD Mass Spectrometry	18 [Other]

ICP = Inductively Coupled Plasma GF = Graphite Furnace GD = Glow Discharge
DCP = Direct Current Plasma HG = Hydride Generation AAS = Atomic Absorption Spectrometry

Lab Name	Location	Registrar	Accreditation
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, 17034
Andrew S. McCreath & Son, Inc.	Harrisburg, PA	A2LA	17025
Coleman Testing Laboratories Corp.			
Analytical Associates	Detroit, MI	A2LA	17025
VHG Labs	Manchester, NH	A2LA	17025
LECO Corporation	St. Joseph, MI	A2LA	17025

A2LA = American Association for Laboratory Accreditation

Analysis: Chemical analyses were made on solid pieces and chips prepared by a lathe from representative samples for the certified portion of the lot in accordance with ASTM Standard Practice E1806. The laboratories participating in the testing followed the requirements of ISO Standard 17025.

Traceability: The following Certified Reference Materials were used to validate the analytical data: BAM 211, 221, 222; BAS 180/2, 304/1; BS 110B, 510B, 510C, 544B, 623, 623A, 624, 642A, 642B, 642C, 642D, 715C, 937C, 954, 954A, 954B, 954C, 955; IARM 81B, 279A; SRM 393, 398, 400.

Homogeneity: This Certified Reference Material (CRM) was tested for homogeneity using ASTM Standard Method E826 and found acceptable. It was also examined by spark atomic emission spectrometry and found to be compatible with the following Reference Materials: BS 623, 623A, 624, 642A, 954, 954B, 954C; IARM 81B.

Validity statement: ISO Standard 33401 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 954D is valid indefinitely. The certification is nullified if this CRM is damaged, contaminated, or otherwise modified.

Storage: This CRM must be stored in a cool, dry, non-corrosive environment.

Source: The bar stock for this CRM was produced by Morris Metals Service; Houston, TX.

Form: This CRM is machined in the form of a disc, approximately 46mm in diameter and 19mm thick by Brammer Standard Company, Inc.

Use: This CRM is intended for use in spark atomic emission, glow discharge, and x-ray spectrometric methods of analysis. Refer to ISO Standard 33403 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 used for production specimens. Avoid overheating the sample during surface preparation.

Caution: CRM contains significant insoluble soft metal inclusions. Surface smearing may occur. Spark atomic emission spectrometers may require extended preburns to compensate.

Certificate Number: The unique identification number for this certificate of analysis is 954D-082526. You may obtain information on revisions of certificates from the internet at www.brammerstandard.com.

Safety Notice: A Safety Data Sheet (SDS) 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

Web: www.brammerstandard.com

Fax: (281) 440-4432

Email: contact@brammerstandard.com

Brammer Standard Company, Inc., is accredited by the American Association for Laboratory Accreditation (A2LA) to ISO Standard 17034:2016 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials (our current Certificate Number 656.02 expires 01/31/2027)

Brammer Standard Company's Chemical Laboratory is accredited by A2LA to ISO Standard 17025:2017. (Our current Certificate Number 656.01 expires 01/31/2027)

By current Certificate Number 10539 expiring 01/01/2027, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9001:2015 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

- E826 Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry
- E1019 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques
- E1806 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

ISO Standard 17025:2017 General requirements for the competence of testing and calibration laboratories

ISO Standard 9001:2015 Quality Management Systems - Requirements

ISO Guide 30:2015 Terms and definitions used in connection with reference materials + 2008 amendment

ISO Standard 33401:2024 Reference materials - Contents of certificates, labels and accompanying documentation

ISO Standard 33403:2024 Reference materials – Requirements and recommendations for use

ISO Standard 17034:2016 General requirements for the competence of reference material producers

ISO Standard 33405:2024 Reference Materials – Approaches for characterization and assessment of homogeneity and stability

ASTM documents available from ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428.

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 August 25, 2026.

Beau R. Brammer
President