

Brammer Standard Company, Inc.
Certificate of Analysis

B.S. 3952

Reference Material for Carbon-Molybdenum Steel

	Certified Value ¹	Estimate of Uncertainty ²		Certified Value ¹	Estimate of Uncertainty ²
Analysis listed as percent by weight					
C	0.208	0.004	Cr	0.105	0.004
Mn	0.546	0.005	Mo	0.519	0.005
P	0.011	0.002	Al	0.048	0.002
S	0.021	0.001			
Si	0.264	0.005			
Cu	0.202	0.004		Informational Value ³	
Ni	0.112	0.003	N	(0.0005)	

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 The value in parentheses is not certified and is provided for information only.

Co-operating Laboratories: The laboratories participating in the testing of this Reference Material were:

Auburn Analytical Lab, Inc., Auburn, Michigan
Brammer Standard Co., Inc., Houston, Texas
Charles C. Kawin Company, Broadview, Illinois
Climax Research Services, Farmington Hills, Illinois
Crucible Specialty Metals, Syracuse, New York
J. Dirats and Co., Inc., Westfield, Massachusetts
LECO Corporation, St. Joseph, Michigan
VHG Laboratories, Inc., Manchester, New Hampshire
W. B. Coleman Testing Laboratories, West Chester, Pennsylvania

See the following pages for more information

Certificate Number 3952-062696p1

Brammer Standard Company, Inc., 14603 Benfer Road, Houston, TX 77069-2895
Telephone (281) 440-9396 Fax (281) 440-4432

Analysis Number	C	Mn	P	S	Si	Cu	Ni	Cr	Mo ⁽¹⁾	Al	N
1	0.203	0.5415	0.00785	0.0195	0.2612	0.200	0.109	0.1012	0.5125	0.0435	0.00025
2	0.2045	0.5420	0.0105	0.01965	0.2615	0.200	0.1095	0.1035	0.5190	0.04708	0.00055
3	0.206	0.544	0.01072	0.02005	0.2625	0.2002	0.1115	0.105	0.5205	0.0475	0.00055
4	0.206	0.5455	0.0125	0.0202	0.2665	0.2005	0.1125	0.1055	0.5205	0.048	0.0007
5	0.2067	0.5455	0.0125	0.02045	0.2680	0.2020	0.1135	0.1065	0.5213	0.0485	----
6	0.2097	0.5505	----	0.0205	----	0.2060	0.1135	0.1115	0.5213	0.0485	----
7	0.2135	0.553	----	0.0216	----	0.2085	0.115	----	----	0.050	----
8	0.214	----	----	0.02285	----	----	----	----	----	----	----
Average	0.2079	0.5460	0.01082	0.02060	0.2639	0.2025	0.1121	0.1055	0.5192	0.0476	0.00051
sd	0.0041	0.0043	0.00191	0.00111	0.0031	0.0034	0.0022	0.0035	0.0034	0.0020	0.00019
C(95%) ⁽²⁾	0.0034	0.0040	0.0024	0.0009	0.0039	0.0031	0.0020	0.0036	0.0034	0.0019	0.00030

ALL DATA ARRANGED BY LABORATORY

ANALYSIS LISTED AS PERCENT BY WEIGHT

Lab Number	C	Mn	P	S	Si	Cu	Ni	Cr	Mo ⁽¹⁾	Al	N
1A	0.2097	0.5420	0.01072	0.02285	0.2612	0.2002	0.115	0.1055	0.5205	0.04708	----
1B	----	0.544	----	----	0.2625	0.200	0.1095	0.10115	0.5213	0.0475	----
2	0.214	0.553	0.00785	0.0205	[0.2815]	0.2085	0.1115	0.105	0.5213	0.0485	0.0007
3	0.203	0.5415	0.0105	0.0216	0.2665	0.200	0.1125	0.1035	0.5205	0.050	0.00055
4	0.206	0.5455	0.0125	0.02045	0.2615	0.2005	0.1135	0.1065	0.5190	0.0435	----
5	0.2067	0.5505	0.0125	0.0202	0.2680	0.2060	0.109	[0.088]	0.5125	0.048	----
6	----	0.5455	----	0.0195	[0.246]	0.2020	0.1135	0.1115	[0.5403]	0.0485	----
7	0.2135	----	----	[0.0254]	----	----	----	----	----	----	----
8	0.206	----	----	0.01965	----	----	----	----	----	----	0.00055
9	0.2045	----	----	0.02005	----	----	----	----	----	----	0.00025

all data

Average	0.2079	0.5460	0.01082	0.02113	0.2639	0.2025	0.1121	0.1030	0.5222	0.0476	0.00051
sd	0.0041	0.0043	0.00191	0.00191	0.0106	0.0034	0.0022	0.0073	0.0086	0.0020	0.00019

excluding data in brackets

Average				0.02060	0.2640			0.1055	0.5192		
standard deviation				0.00111	0.0031			0.0035	0.0034		
standard deviation improvement				41.7%	70.7%			52.8%	60.5%		

ASTM PROFICIENCY TESTING PROGRAM DATA FROM THE THIRD QUARTER OF 1995

	C ⁽³⁾	Mn	P	S ⁽³⁾	Si	Cu	Ni	Cr	Mo	Al	N
Average	0.2069	0.5391	0.0107	0.0219	0.2625	0.1968	0.1129	0.1000	0.5256	0.0481	0.0006
sd	0.0069	0.0115	0.0016	0.0015	0.0118	0.0083	0.0065	0.0049	0.0129	0.0038	0.0004
Labs ⁽⁴⁾	44	85	74	38	75	83	85	85	84	69	34

ANALYTICAL METHODS USED

Elements	Methods/Labs ICP	AAS	wet	Validation NIST CRMs	Element	Methods/Labs Combustion	Fusion	Validation CRMs
Al	1A, 2, 3, 5, 6	1B,	4	13g, 293	C	all		NIST 291, 293
Cr	1A, 2, 3, 5, 6	1B,	4	19h, 364	S	all		NIST 291, 293
Cu	1A, 2, 3, 5, 6	1B,	4	11h, 364	N		all	ECRM 184-1 BCS 404/1
Mn	1A, 2, 3, 5, 6	1B,	4	291, 293				
Mo	1A, 2, 3, 4, 5, 6	1B		291, 364				
Ni	1A, 2, 3, 5, 6	1B,	4	13g, 364				
Si	1A, 2, 3, 5, 6	1B	4	19h, 293				
P	1A, 2, 3, 5	1B	4	11h, 293				

- (1) The molybdenum values were adjusted for the average bias of the CRM used for validation.
- (2) $C(95\%) = (t \times sd) / \sqrt{n}$ 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.
- (3) Carbon and Sulfur data was produced by combustion methods only.
- (4) Number of laboratories included in the grand mean and standard deviation calculations.

Production of melt: This material was produced by Carpenter Technology Corporation, Reading, Pennsylvania. The metal was melted in an electric arc furnace and cast into ingots.

Fabrication: The bar stock was forged from the ingots and annealed by Braeburn Alloy Steel, Lower Burrell, Pennsylvania. The resulting bar stock was machined by Brammer Standard Company, Inc.

Certification Process: The requirements of ISO Guide 31, ISO Guide 34, ISO Guide 35, and ASTM Standard Guide E 1724 were generally followed for the preparation of this reference material and certificate of analysis. This is a reference material as defined by ISO Guide 30.

Homogeneity: This Reference Material was tested for homogeneity using ASTM Standard Practice E 826 and found acceptable.

Chemical Analysis: Chemical analyses were made on chips prepared by a lathe from the certified portion of the bars in accordance with ASTM Standard Practice E 59. The laboratories participating in the testing normally followed the requirements of ISO Guide 25. The individual values listed on page two are the average of each duplicate analysis. Methods of analysis used were a combination of ASTM Standard Methods E 350, E 1019, plus additional ICP and AA spectrometric methods. See page two for more information on the methods of analysis.

Traceability: The Certified Reference Materials used to validate the analytical methods are listed on page two. This Reference Material was also examined by optical emission spectrometry and found to be compatible with the following Certified Reference Materials: NIST SRM C1173, 1261a - 1265a, 1761 - 1767; ECRM 186-1, 191-1; SS 457/1, 458/1; JSS 169-4, 170-6, 171-4.

Available Form: This Reference Material is available only in the form of a disc, approximately 38 mm (1.50") in diameter and 19 mm (0.75") thick.

Intended Use: This Reference Material is intended for use in optical emission and x-ray spectrometric methods of analysis. The entire depth of the disc may be used.

Caution: As with any disc material produced from hot-working bulk material into bars, avoid optical emission spectrometric burns in the center of the disc (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 material 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.
14603 Benfer Road
Houston, Texas 77069-2895 USA

Phone: (281) 440-9396
Fax: (281) 440-4432

Certified by: _____ on June 26, 1996.
G. R. Brammer

Certificate Number 3952-062696p3

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)**

Referenced Documents

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

E 59 - 93 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

E 350 - 90 Standard Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

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

E 1019 - 93 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys

E 1724 - 95 Standard Guide for Testing and Certification of Metal and Metal-Related Reference 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, 1995), 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.

NBS 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

Certificate Number 3952-062696p4