

Brammer Standard Company, Inc.

Certificate of Analysis

BS 32D

Reference Material for M-2 Grade Tool Steel

	Certified Value ¹	Estimate of Uncertainty ²		Certified Value ¹	Estimate of Uncertainty ²
Analysis listed as percent by weight					
C	0.85	0.006	V	1.82	0.02
Mn	0.30	0.01	Al	0.018	0.003
P	0.027	0.002	Co	0.010	0.002
S	0.0022	0.004	N	0.018	0.001
Si	0.25	0.008			
Cu	0.039	0.003		Informational Value ³	
Ni	0.053	0.004	As	(0.006)	
Cr	4.14	0.02	O	(0.002)	
Mo	4.92	0.05	Sn	(0.005)	
W	6.15	0.05			

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

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

- Allegheny Ludlum Steel Corporation, Lockport, New York
- Anarem, Prague, Czech Republic
- Brammer Standard Co., Inc., Houston, Texas
- Climax Research Services, Farmington Hills, Michigan
- Crucible Specialty Metals, Syracuse, New York
- J. Dirats and Co., Inc., Westfield, Massachusetts
- LECO Corporation, St. Joseph, Michigan
- Spectrochemical Laboratories, Pittsburgh, Pennsylvania
- VHG Laboratories, Inc., Manchester, New Hampshire

See the following pages for more information.

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Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	W	V
1	0.835	0.28	0.023	0.0017	0.24	0.036	0.045	4.12	4.84	6.06	1.79
2	0.843	0.29	0.025	0.00193	0.245	0.037	0.0482	4.12	4.87	6.10	1.80
3	0.8435	0.291	0.025	0.00193	0.246	0.0374	0.051	4.13	4.895	6.10	1.80
4	0.849	0.295	0.0264	0.0020	0.25	0.038	0.052	4.13	4.90	6.13	1.80
5	0.851	0.299	0.0277	0.00203	0.251	0.0388	0.052	4.14	4.91	6.14	1.80
6	0.853	0.30	0.028	0.00228	0.253	0.039	0.0535	4.14	4.91	6.15	1.815
7	0.853	0.300	0.0283	0.0023	0.255	0.039	0.055	4.14	4.917	6.17	1.818
8	0.8537	0.300	0.0297	0.0025	0.259	0.039	0.055	4.15	4.92	6.17	1.82
9	0.8547	0.301	0.030	0.0030	0.260	0.0415	0.0567	4.155	4.925	6.18	1.825
10	0.857	0.302			0.26	0.042	0.059	4.16	4.93	6.18	1.829
11	0.858	0.304			0.262	0.042		4.18	4.98	6.22	1.833
12	0.858	0.31			0.262	0.043			4.99		1.84
13									5.00		1.86
Average	0.8507	0.298	0.0270	0.0022	0.254	0.0394	0.0527	4.142	4.922	6.145	1.818
Std Dev	0.0070	0.008	0.0023	0.0004	0.007	0.0022	0.0041	0.018	0.046	0.046	0.020
Certified	0.85	0.30	0.027	0.0022	0.25	0.039	0.053	4.14	4.92	6.15	1.82
C(95%)	0.0045	0.005	0.0018	0.0003	0.005	0.0014	0.0029	0.012	0.028	0.031	0.012

continued from above

Analysis	Al	Co	N	As	O	Sn
1	0.0137	0.007	0.0175	0.0030	0.00136	0.0029
2	0.015	0.008	0.0179	0.0042	0.00147	0.0045
3	0.0175	0.009	0.0183	0.0049	0.0018	0.0050
4	0.0180	0.0092	0.0192	0.0058	0.0028	0.0050
5	0.019	0.0094	0.0193	0.006		0.007
6	0.020	0.010		0.009		0.0074
7	0.0203	0.0115				
8	0.021	0.0125				
9	0.021	0.013				
Average	0.0184	0.0100	0.0184	0.0055	0.0019	0.0053
Std Dev	0.0026	0.0020	0.0008	0.0020	0.0007	0.0017
Certified	0.018	0.010	0.018	(0.006)	(0.002)	(0.005)
C(95%)	0.0020	0.0015	0.0010			

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

Production of melt: This material was produced by Jorgensen Steel Corporation. The material was made in an electric arc furnace and cast into ingots.

Fabrication: The ingots were hot rolled and annealed. 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.

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)

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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

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