

Brammer Standard Company, Inc.
Certificate of Analysis

B.S. 38C

Reference Material for S-5 Tool Steel

	Certified Value ¹	Estimate of Uncertainty ²		Certified Value ¹	Estimate of Uncertainty ²
Analysis listed as percent by weight					
C	0.60	0.01	As	0.011	0.003
Mn	0.81	0.01	Co	0.036	0.002
P	0.011	0.001	N	0.0081	0.0005
S	0.012	0.001	Pb	0.022	0.002
Si	2.08	0.02	Sn	0.022	0.001
Cu	0.26	0.01	Ti	0.007	0.002
Ni	0.24	0.01	V	0.214	0.005
Cr	0.28	0.01	W	0.004	0.001
Mo	0.41	0.01			
Al	0.015	0.002	Nb	(0.002) ³	

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 possible bias in the determined analytical values. No attempt is made to derive exact statistical measurements of imprecision because several methods were used in the determination of most constituents.

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

See the following pages for more information.

Original Certificate Number 38C-031392
Revised Certificate Number REV-38C-120409

New Certificate Number REV-38C-120409 Revised to show uncertainty values on December 4, 2009

BS 38C analysis listed as percent concentration Certificate Number REV-38C-120409

Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al
1	0.5885	0.80	0.010	0.011	2.05	0.25	0.235	0.269	0.394	0.0138
2	0.594	0.803	0.0102	0.0118	2.08	0.256	0.236	0.271	0.399	0.014
3	0.597	0.806	0.0104	0.0120	2.08	0.257	0.237	0.274	0.404	0.015
4	0.60	0.808	0.011	0.012	2.08	0.258	0.24	0.28	0.41	0.0155
5		0.81	0.011	0.012	2.081	0.26	0.24	0.282	0.41	0.016
6		0.818	0.0123	0.0132	2.091	0.266	0.242	0.283	0.420	0.017
7		0.82				0.27	0.25	0.287	0.42	
8						0.27				
Average	0.595	0.809	0.0108	0.012	2.077	0.261	0.24	0.278	0.408	0.0152
Std Dev	0.005	0.007	0.0008	0.0007	0.014	0.007	0.005	0.007	0.01	0.0012
Certified	0.60	0.81	0.011	0.012	2.08	0.26	0.24	0.28	0.41	0.015
t	3.18	2.45	2.57	2.57	2.57	2.36	2.45	2.45	2.45	2.57
C(95%)	0.008	0.007	0.0009	0.0007	0.015	0.006	0.005	0.006	0.0092	0.0013

Analysis	As	Co	N	Pb	Sn	Ti	V	W	Nb
1	0.0095	0.034	0.0078	0.0196	0.021	0.0049	0.21	0.004	0.001
2	0.011	0.034	0.0078	0.021	0.021	0.0059	0.21	0.004	0.001
3	0.011	0.0346	0.0082	0.021	0.0220	0.0062	0.212	0.005	0.003
4	0.0134	0.036	0.0084	0.0215	0.023	0.0067	0.213		0.003
5		0.0361		0.022	0.023	0.008	0.214		
6		0.038		0.0246	0.0231	0.008	0.214		
7					0.024		0.217		
8									
Average	0.0112	0.0355	0.00805	0.0216	0.0224	0.0066	0.214	0.004	0.0020
Std Dev	0.0016	0.0016	0.0003	0.0017	0.0011	0.0012	0.003	0.001	0.0012
Certified	0.011	0.026	0.0081	0.022	0.022	0.007	0.214	0.004	(0.002)
t	3.18	2.57	3.18	2.57	2.45	2.57	2.36	4.30	3.18
C(95%)	0.0026	0.0016	0.00048	0.0017	0.0011	0.0013	0.003	0.001	0.0018

$C(95\%) = (t \times sd) / \sqrt{n}$ 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 35:2006 section 6.

ISO Guides and Standards available from Global Engineering - www.global.ihs.com

ISO Guide 35 Reference Materials - General and statistical principles for certification

Some of the co-operating laboratories were:

- Allegheny Ludlum Steel Corp., Brackenridge, Pennsylvania
- Allegheny Ludlum Steel Corp., Lockport, New York
- Brammer Standard Co., Inc., Houston, Texas
- Crucible Specialty Steel, Syracuse, New York
- J. Dirats and Co., Inc., Westfield, Massachusetts
- Hoesch Stahl AG, Dortmund, Germany
- Charles C. Kawin Company, Broadview, Illinois
- VHG Laboratories, Inc., Manchester, New Hampshire

Certification Process: The requirements of ISO Guide 31, ISO Guide 34, and ISO Guide 35 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.

Analysis: Chemical analyses were made on millings from cross-sections of the bars. The individual values listed above are the average of each analyst's results.

Analytical Methods: Methods of analysis used were a combination of ASTM Standard Methods E 350, E 415, E 1019, plus additional ICP, and AA spectrometric methods.

Traceability: The following Certified Reference Materials were used to validate the analytical data listed above: NIST SRM 32e, 125b, 361 to 365; BAM 039-2, 044-1; BCS 455/1, 456/1, 458/1; ECRM 085-1, 088-1, 096-1, 184-1, 481-1; GBW 01402; IMZ 1.22, 1.74

Homogeneity: This Reference Material was tested for homogeneity using ASTM Standard Method E 826 and found acceptable. It was also examined by spark atomic emission spectrometry and found to be compatible with the following NIST Certified Reference Materials:

SRM 1134, 1135, 1222, 1224, 1225, 1261A to 1265A, 1761 to 1767

Form: This Reference Material is machined in the form of a disc, approximately 38 mm diameter and 12 mm thick by Brammer Standard Company. The bar stock used for this material was produced by hot-rolling billets and annealing.

Use: This Reference Material 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 Reference Materials.

Certified area: The entire depth of the disc may be used.

Caution: As with any bar material, avoid spark atomic emission spectrometric burns in the center of the disc (5 mm radius), as some segregation may be present.

Certificate Number: The unique identification number for this certificate of analysis is REV-38C-120409. This BS 38C Certificate of Analysis was revised to show the estimate of uncertainty for the certified values. After reviewing the analytical and statistical data, a third decimal place was added to the certified value for vanadium and the niobium value was changed to uncertified.

Refer to the "Certificates" section of the Brammer Standard Company website for any revision to this or other Brammer Standard Company's Certificates of Analysis.

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 web: brammerstandard.com
14603 Benfer Road
Houston, Texas 77069-2895 USA Fax: (281) 440-4432 email: contact@brammerstandard.com

Certified by: _____ on December 4, 2009
Beau R. Brammer

Referenced Documents

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

Versions available at time of interlaboratory testing

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

E 415 - 85 (Reapproved 1989) Standard Test Method for Optical Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel

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

Current ISO Guides and Standards available from Global Engineering - www.global.ihs.com

ISO Guide 30:1992 Terms and definitions used in connection with reference materials plus amendment of 2008

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

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