

Brammer Standard Company, Inc.
Certificate of Analysis

BS 37E

Reference Material for D-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	1.51	0.02	As	0.002	0.0005
Mn	0.29	0.006	B	0.0011	0.0002
P	0.024	0.002	N	0.052	0.002
S	0.002	0.0005	Sn	0.003	0.001
Si	0.37	0.01	Ti	0.002	0.0008
Cu	0.053	0.008	W	0.021	0.005
Ni	0.34	0.01			
Cr	11.54	0.06	Informational Value ³		
Mo	0.79	0.015	O	(0.0025)	
V	0.78	0.025	Nb	(0.003)	
Co	0.021	0.005	Pb	(0.0005)	
Al	0.002	0.001	Sb	(<0.002)	

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.

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)

See the following pages for more information.

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Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	V	Co
1	1.48	0.28	0.020	0.0015	0.359	0.0475	0.326	11.47	0.760	0.73	0.014
2	1.480	0.284	0.0235	0.00167	0.36	0.052	0.33	11.52	0.76	0.746	0.015
3	1.4905	0.286	0.0237	0.0019	0.368	0.0526	0.33	11.52	0.771	0.772	0.019
4	1.503	0.286	0.024	0.0020	0.368	0.053	0.334	11.52	0.784	0.782	0.0199
5	1.509	0.29	0.024	0.0022	0.37	0.0535	0.335	11.524	0.788	0.787	0.021
6	1.512	0.29	0.0243	0.00220	0.372	0.054	0.337	11.58	0.793	0.795	0.0237
7	1.52	0.291	0.0248	0.0026	0.373	0.055	0.338	11.60	0.795	0.80	0.0254
8	1.52	0.293	0.025	0.003	0.38	0.0550	0.34	11.62	0.795	0.802	0.027
9	1.523	0.295	0.0268		0.382	0.0555	0.34		0.80	0.804	
10	1.533	0.30			0.383	0.056	0.341		0.803		
11							0.346		0.81		
Average	1.507	0.290	0.0240	0.0021	0.372	0.0534	0.336	11.544	0.787	0.780	0.0206
Std Dev	0.018	0.006	0.0018	0.0005	0.008	0.0025	0.006	0.050	0.017	0.026	0.0047
Certified	1.51	0.29	0.024	0.002	0.37	0.053	0.34	11.54	0.79	0.78	0.021
C(95%)	0.013	0.004	0.0014	0.0004	0.006	0.0018	0.004	0.042	0.011	0.020	0.0039

continued from above

Analysis	Al	As	B	N	Sn	Ti	W	O	Nb	Pb	Sb
1	0.001	0.0019	0.0009	0.0504	0.0015	0.0017	0.0160	0.0018	0.003	0.0001	<0.002
2	0.0013	0.0022	0.0010	0.051	0.0017	0.002	0.019	0.00240	0.003	0.0008	0.0012
3	0.0018	0.0023	0.0011	0.0511	0.003	0.002	0.020	0.00245	0.0032		
4	0.002	0.0024	0.00114	0.0524	0.0031	0.0026	0.0209	0.0033			
5	0.0025	0.003	0.0012	0.0532	0.0036	0.0028	0.024				
6					0.004	0.0028	0.0265				
Average	0.0017	0.0024	0.00107	0.0516	0.0028	0.0023	0.0211	0.0025	0.0031	0.0005	
Std Dev	0.0006	0.0004	0.00012	0.0011	0.0010	0.0005	0.0037	0.0006	0.0001	0.0005	
Certified	0.002	0.002	0.0011	0.052	0.003	0.002	0.021	(0.0025)	(0.003)	(0.0005)	(<0.002)
C(95%)	0.0007	0.0005	0.00015	0.0014	0.0011	0.0005	0.0039				

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

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

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

Production of melt: This material was produced by Crucible Specialty Metals, Syracuse, New York. 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.

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

Traceability: The Certified Reference Materials used to validate the analytical methods were NIST SRM 11h, 12g, 13g, 15h, 16f, 19h, 32e, 132b, 155, 291, 337a, 341, 345, 346a, 348a, 361, 362, 363, 364, 365, 1270, 2165, 2166, 2167; BCS 404/2, 455/1, 456/1, 458, 486, 487/1; ECRM 085-1, 088-1, 096-1, 097-1, 184-1, 481-1; BAM 044-1; IRSID 276-1.

This Reference Material was also examined by optical emission spectrometry and found to be compatible with the following Certified Reference Materials:
SS 486/1; CMSI 2175 - 2180.

Available Form: This Reference Material is available only in the form of a disc, approximately 41 mm (1.65") in diameter and 13 mm (0.50") 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.

Because this Reference Material contains a high percent of carbon and chromium, care must be taken in its application. Make certain that corrections are made for possible element interference and dilution effects.

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. Proper surface preparation is crucial when using XRF spectrometric analytical methods. 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. Phone: (281) 440-9396
14603 Benfer Road
Houston, Texas 77069-2895 USA Fax: (281) 440-4432

Certified by: _____ on June 13, 1996.
G. R. Brammer

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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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