

**Brammer Standard Company, Inc.**  
**Certificate of Analysis**

**BS 37G**

**Certified Reference Material for D-2 Tool Steel (UNS Number T30402)**

	Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>		Certified Value	Estimate of Uncertainty <sup>2</sup>
	Analysis listed as percent by weight			Analysis listed as percent by weight	
<b>C</b>	<b>1.663</b>	0.008	<b>N</b>	<b>0.0310</b>	0.0006
<b>Mn</b>	<b>0.326</b>	0.008	<b>Nb</b>	<b>0.0026</b>	0.0003
<b>P</b>	<b>0.021</b>	0.001	<b>Pb</b>	<b>0.0005</b>	0.0001
<b>S</b>	<b>0.0007</b>	0.0001	<b>Sb</b>	<b>0.0009</b>	0.0002
<b>Si</b>	<b>0.352</b>	0.008	<b>Sn</b>	<b>0.0010</b>	0.0003
<b>Cu</b>	<b>0.044</b>	0.002	<b>Ti</b>	<b>0.0025</b>	0.0005
<b>Ni</b>	<b>0.152</b>	0.005	<b>W</b>	<b>0.034</b>	0.003
<b>Cr</b>	<b>11.77</b>	0.05			
<b>Mo</b>	<b>0.78</b>	0.01			
<b>Al</b>	<b>0.0060</b>	0.0005			
<b>V</b>	<b>0.70</b>	0.01			
<b>As</b>	<b>0.0026</b>	0.0006			
<b>B</b>	<b>0.0003</b>	0.0001			
<b>Ca</b>	<b>0.0014</b>	0.0002			
<b>Co</b>	<b>0.0166</b>	0.0007			

<sup>1</sup> The certified value listed is the present best estimate of the true value based on the results of an interlaboratory testing program.

<sup>2</sup> 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.

See the following pages for more information.

Certificate Number 37G-081809p1

BS 37G		* code for analytical method										analysis listed as percent by weight					Certificate No. 37G-081809p2					
Analysis	*	C	*	Mn	*	P	*	S	*	Si	*	Cu	*	Ni	*	Cr	*	Mo	*	Al	*	V
1	1	1.648	3	0.303	11	0.0188	1	0.0005	5	0.336	7	0.0396	3	0.143	8	11.68	3	0.7623	12	0.0054	5	0.687
2	1	1.649	3	0.315	11	0.0193	1	0.0005	5	0.341	5	0.041	3	0.145	8	11.7046	5	0.768	12	0.0055	5	0.689
3	1	1.652	3	0.315	5	0.020	1	0.0006	5	0.342	7	0.0415	5	0.147	5	11.73	5	0.769	3	0.0058	3	0.691
4	1	1.660	3	0.320	5	0.020	1	0.0005	3	0.343	5	0.042	5	0.148	8	11.74	5	0.773	3	0.0059	5	0.692
5	1	1.66	5	0.323	3	0.0202	1	0.00069	5	0.345	3	0.043	5	0.148	3	11.75	5	0.774	3	0.0061	5	0.694
6	1	1.660	5	0.326	3	0.0205	1	0.0007	5	0.348	3	0.0437	3	0.148	8	11.75	5	0.774	3	0.0063	5	0.694
7	1	1.660	3	0.3263	3	0.0206	1	0.0007	9	0.348	3	0.0438	3	0.149	5	11.76	3	0.778	3	0.0067	3	0.716
8	1	1.661	10	0.327	5	0.021	1	0.0007	9	0.352	3	0.044	5	0.150	8	11.78	3	0.799			3	0.719
9	1	1.663	3	0.3279	5	0.021	1	0.0007	3	0.353	3	0.0444	3	0.1503	5	11.78	3	0.802				
10	1	1.664	5	0.328	5	0.021	1	0.00073	3	0.3532	3	0.045	5	0.153	8	11.79						
11	1	1.666	5	0.330	3	0.022	1	0.00073	3	0.354	5	0.045	3	0.155	8	11.80						
12	1	1.670	5	0.331	3	0.022	1	0.00074	3	0.355	3	0.045	7	0.159	5	11.80						
13	1	1.67	10	0.332	3	0.022	1	0.0008	9	0.355	3	0.045	7	0.160	5	11.81						
14	1	1.670	3	0.338	3	0.022	1	0.0008	3	0.356	3	0.0451	3	0.161	8	11.83						
15	1	1.67	3	0.341	3	0.023			9	0.357	5	0.047	3	0.162	8	11.85						
16	1	1.671	3	0.341	3	0.0244			3	0.3577	5	0.047										
17	1	1.6748							9	0.362												
18									9	0.363												
19									3	0.364												
20									3	0.365												
Average		1.663		0.3265		0.0211		0.00068		0.3525		0.0439		0.1519		11.770		0.7777		0.00596		0.6978
Std Dev		0.008		0.0100		0.0014		0.00009		0.0082		0.0020		0.0061		0.046		0.0137		0.00045		0.0124
Certified		1.663		0.326		0.021		0.0007		0.352		0.044		0.152		11.77		0.78		0.0060		0.70
t		2.12		2.13		2.13		2.16		2.09		2.13		2.14		2.14		2.31		2.45		2.36
C(95%)		0.004		0.0053		0.0008		0.00005		0.0038		0.0011		0.0034		0.026		0.0105		0.00042		0.0104

Data listed as ppm by weight (mg/kg) except for W

Analysis	*	As	*	B	*	Ca	*	Co	*	N	*	Nb	*	Pb	*	Sb	*	Sn	*	Ti	*	W %
1	6	18.36	3	1	3	12	7	155	2	299	12	19	12	3.4	12	4	6	6	5	19	3	0.0307
2	6	19.45	3	2	3	12	7	158	2	299	3	24	6	5	4	7	6	6	5	20	3	0.031
3	6	19.76	4	2.4	3	13	4	158	2	299	4	26	4	6	12	7.4	6	7	5	20	3	0.032
4	6	20.14	12	2.6	3	13	3	160	2	305	5	26	6	6	12	7.7	6	7	5	20	3	0.032
5	6	24	12	2.7	3	14	3	160	2	308	5	27	6	6	6	10	3	11	5	20	3	0.032
6	6	25	11	3.5	3	14	3	160	2	310	5	28	6	6	6	11	4	13	12	26	3	0.033
7	3	33	11	3.7	3	15	5	167	2	311	3	28	6	6	6	11	12	14	3	26	4	0.0347
8	4	33			4	17.3	5	168	2	312	3	28	3	11	3	11	12	14	3	27	3	0.0366
9	6	34			3	18	5	169	2	315	5	29	6	6	6	12	12	14	3	27	3	0.0392
10	3	36					5	170	2	317	5	29							3	27	3	0.0393
11							5	173	2	318									3	28		
12							5	174	2	318									4	28		
13							3	184	2	318									3	34		
Average		26.3		2.6		14.3		165.8		309.9		26.4		5.4		9.0		10.2		24.8		0.0340
Std Dev		7.0		0.9		2.2		8.3		7.4		3.0		1.1		2.6		3.7		4.5		0.0032
Certified		26		3		14		166		310		26		5		9		10		25		0.034
t		2.26		2.45		2.31		2.18		2.18		2.26		2.57		2.31		2.31		2.18		2.26
C(95%)		5.0		0.8		1.7		5.0		4.5		2.2		1.1		2.0		2.8		2.7		0.0023

\* Methods of Analysis are listed below.

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

\* Methods of Analysis used

1	Combustion	5	XRF Spectrometry	9	Gravimetric
2	Fusion	6	Graphite Furnace Atomic Absorption Spectrometry	10	Colorimetric
3	ICP-AES	7	Flame Atomic Absorption Spectrometry	11	Photometric
4	Spark-AES	8	Titrimetric	12	ICP - Mass Spectrometry

AES = Atomic Emission Spectrometry

**Co-operating Laboratories:** The co-operating laboratories were:

**Laboratory**

Brammer Standard Company, Inc., Houston, TX  
Dirats Laboratory, Westfield, MA  
IMZ - Instytut Metalurgii Zelaza, Gliwice, Poland  
Laboratory Testing Inc, Hatfield, PA  
Leco Technical Services Laboratory, St. Joseph, MI  
National Analysis Center Iron and Steel, Beijing, China  
VHG Labs, Manchester, NH

**Accredited/Registered by**

A2LA - ISO 17025, ISO Guide 34  
Nadcap - 17025  
PCA - AB 554  
Nadcap - 17025  
BSI - ISO 9001  
CNAS - L0272  
URS - ISO 17025

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

**Analysis:** Chemical analyses were made on chips prepared by a lathe from the certified portion of the discs in accordance with ASTM Standard Practice E 1806. The laboratories participating in the testing normally followed the requirements of ISO Standard 17025. Methods of analysis used were a combination of ASTM Standard Test Method E 1019 plus additional, spark-AES, ICP-AES, AA spectrometric, and classical wet chemical methods.

**Traceability:** The following Certified Reference Materials were used to validate the analytical data listed on page 2: NIST SRM 16f, 133b, 168, 324, 341, 867, 2159, 3101a, 3102a, 3107, 3109a, 3112a, 3114, 3128, 3132, 3134, 3136, 3137, 3139a, 3150, 3161a, 3162a, 3163, 3165, 3168a; ECRM 065-1, 085-1, 086-1, 087-1, 179-2, 296; BAS BCS 265/2, 320, 322, 326, 402, 431, 459, 464; IMZ 1.10/1, 1.25/3, 1.4/3, 112, 119, 124, 130, 139, 153, 171; JSS GS-5d;

**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 Reference Materials: ECRM 288-1; Brammer BS 37D, 48, 9932, 9905.

**Validity statement:** ISO Guide 31 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. Whereas this material is in a solid form and stable, no expiration date is specified.

**Source:** The bar stock for this CRM was produced by Carpenter Specialty Alloys, Reading, Pennsylvania, in an electric arc furnace.

**Form:** This CRM is machined in the form of a disc, approximately 34 mm (1.375") in diameter and 19 mm (0.75") thick by Brammer Standard Company, Inc.

**Use:** This CRM 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.

**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 disc during surface preparation.

**Certificate Number:** The unique identification number for this certificate of analysis is 37G-081809-px, where x indicates the page number.

**Revisions:** Refer to the Brammer Standard Company website ([www.brammerstandard.com](http://www.brammerstandard.com)) "Certificates" section for information on any revisions to this or other Brammer Standard reference materials.

**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

web: [www.brammerstandard.com](http://www.brammerstandard.com)  
e-mail: [contact@brammerstandard.com](mailto:contact@brammerstandard.com)

Certified by: \_\_\_\_\_ on August 18, 2009  
Beau R. Brammer

**Brammer Standard Company, Inc., is accredited to ISO Guide 34 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials by A2LA (Certificate Number 656.02)**  
The scope of accreditation is listed on the website: [www.brammerstandard.com](http://www.brammerstandard.com)

**Brammer Standard Company's Chemical Laboratory is accredited to ISO Standard 17025 by A2LA.**  
(Certificate Number 656.01)

**By Certificate Number 10539, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9001:2000 by National Quality Assurance, U.S.A.**

#### **References:**

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

- E 826 - 08 Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry
- E 1019 - 08 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques
- E 1724 - 95 (Reapproved 2001) Standard Guide for Testing and Certification of Metal and Metal-Related Reference Materials
- E 1806 - 09 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

*ISO Guides and Standards available from Global Engineering - [www.global.ihs.com](http://www.global.ihs.com)*

- ISO Standard 17025:2005 General requirements for the competence of testing and calibration laboratories
- ISO Guide 30:1992 Terms and definitions used in connection with reference materials
- ISO Guide 31:2000 Reference materials -Contents of certificates and labels
- ISO Guide 33:2000 Uses of certified reference materials
- ISO Guide 34:2000 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