

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

B.S. 33D

**Reference Material for S-1 Tool Steel**

	Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>		Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>
<b>Carbon</b>	<b>0.515</b>	0.009	<b>Molybdenum</b>	<b>0.050</b>	0.005
<b>Manganese</b>	<b>0.31</b>	0.01	<b>Aluminum</b>	<b>0.008</b>	0.001
<b>Phosphorus</b>	<b>0.016</b>	0.001	<b>Cobalt</b>	<b>0.045</b>	0.006
<b>Sulfur</b>	<b>0.020</b>	0.001	<b>Tin</b>	<b>0.005</b>	0.001
<b>Silicon</b>	<b>0.312</b>	0.007	<b>Vanadium</b>	<b>0.22</b>	0.01
<b>Copper</b>	<b>0.040</b>	0.003	<b>Tungsten</b>	<b>2.65</b>	0.05
<b>Nickel</b>	<b>0.059</b>	0.006			
<b>Chromium</b>	<b>1.28</b>	0.02			

*(analysis listed as percent by weight)*

<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.

Some of the co-operating laboratories were:

Alpha Research Laboratory, Stevensville, MI  
Crucible Inc./Specialty Metals Div., Syracuse, NY  
Midstates Analytical Laboratories, Inc., Tulsa, OK  
Turret Alloys Ltd., Analytical Services, Sheffield, England  
VHG Labs, Andover, MA

This Reference Material was produced by hot-rolling and annealing. This Reference Material should be used and compared with material of similar metallurgical history as it may not plot well with chill cast materials on some instruments.

Chemical analyses were performed on chips taken from cross-sections of the discs. The individual values listed above are the average of each analyst's results.

See the following page for more information.

Original Certificate Number 33D-120185  
New Certificate Number **REV-33D-120909**

**New Certificate Number REV-33D-120909 Revised to show uncertainty values on December 9, 2009**

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

Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo
1	0.500	0.289	0.016	0.019	0.30	0.037	0.050	1.27	0.044
2	0.508	0.300	0.016	0.019	0.309	0.0376	0.056	1.27	0.046
3	0.510	0.300	0.016	0.020	0.310	0.039	0.056	1.28	0.048
4	0.518	0.308	0.016	0.020	0.311	0.040	0.0565	1.29	0.050
5	0.520	0.310	0.0162	0.021	0.315	0.041	0.060	1.29	0.050
6	0.523	0.312	0.018	0.021	0.32	0.042	0.063	1.30	0.055
7	0.524	0.320		0.0213	0.32	0.044	0.070		0.056
Average	0.5147	0.3056	0.0164	0.0202	0.312	0.0401	0.0588	1.283	0.0499
Std Dev	0.0089	0.0101	0.0008	0.0010	0.007	0.0025	0.0064	0.012	0.0044
Certified	0.515	0.31	0.016	0.020	0.312	0.040	0.059	1.28	0.050
t	2.45	2.45	2.57	2.45	2.45	2.45	2.45	2.57	2.45
C(95%)	0.0082	0.0093	0.0008	0.0009	0.006	0.0023	0.0059	0.013	0.0041

continued from above

Analysis	Al	Co	Sn	V	W
1	0.007	0.040	0.003	0.21	2.59
2	0.007	0.040	0.0037	0.22	2.61
3	0.008	0.042	0.004	0.22	2.62
4	0.008	0.044	0.005	0.22	2.63
5	0.009	0.046	0.006	0.225	2.65
6		0.050	0.006	0.23	2.68
7		0.055			2.70
8					2.72
Average	0.0079	0.0453	0.0046	0.221	2.650
Std Dev	0.0009	0.0056	0.0012	0.007	0.046
Certified	0.008	0.045	0.005	0.22	2.65
t	2.78	2.45	2.57	2.57	2.36
C(95%)	0.0011	0.0051	0.0013	0.007	0.038

$C(95\%) = (t \times sd) / \sqrt{n}$  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](http://www.global.ihs.com)

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

**Certificate Number:** The unique identification number for this certificate of analysis is REV-33D-120909. This BS 33D Certificate of Analysis is revised to show the estimate of uncertainty for the certified values. Also, the certified value for vanadium was changed from 0.221% to 0.22% a Manganese certified value was changed from 0.306% to 0.30%.

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.

**Form:** This Reference Material is machined in the form of a disc, approximately 41 mm diameter and 12 mm thick by Brammer Standard Company

**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:

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Revision Certified by: \_\_\_\_\_ on December 9, 2009.

Beau R. Brammer