

Brammer Standard Company, Inc.

Certificate of Analysis

B.S. 51F

**AISI Grade 4620
Low Alloy Steel**

Certified Elements			Uncertified Elements	
	Certified Value ¹	Estimate of Uncertainty ²	Information values	
	Analysis listed as percent by weight		Analysis listed as µg/g (ppm by weight)	
C	0.190	0.005	As	24
Mn	0.52	0.01	B	1
P	0.016	0.001	Ca	5
S	0.018	0.001	Hg	<0.1
Si	0.24	0.02	Mg	1
Cu	0.231	0.005	Nb	5
Ni	1.68	0.03	Pb	0.7
Cr	0.157	0.01	Sb	11
Mo	0.224	0.005	Ti	12
Al	0.021	0.002	W	30
Co	0.009	0.001	Zn	2
Sn	0.009	0.001		
V	0.003	0.001		
N	0.0060	0.0002		
O	0.0020	0.0003		

¹ The certified value listed is the present best estimate of the true value.

² The uncertainties listed are based on value judgments of the material inhomogeneity and possible bias in the determined analytical values.

Some of the co-operating laboratories were:

Brammer Standard Co., Inc., Houston, Texas
Crucible Specialty Metals, Syracuse, New York
Hoesch Stahl AG, Dortmund, Germany
J. Dirats and Co., Inc., Westfield, Massachusetts

Northern Analytical Laboratory, Inc., Merrimach, New Hampshire
Shiva Technologies, Inc., Cicero, New York
VHG Laboratories, Inc., Manchester, New Hampshire

See reverse side for more information.

Certificate Number 51F-081092

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

BS 51F	analysis listed as percent by weight												Certificate 51F-081092		
Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al	Co	Sn	V	N	O
1	0.188	0.514	0.0153	0.017	0.224	0.228	1.639	0.150	0.216	0.019	0.0075	0.0080	0.0024	0.0060	0.0018
2	0.189	0.514	0.0154	0.017	0.227	0.228	1.65	0.154	0.221	0.020	0.0085	0.0080	0.0024	0.0060	0.0019
3	0.189	0.516	0.016	0.0173	0.235	0.229	1.68	0.156	0.222	0.020	0.0088	0.0082	0.0025	0.0061	0.0022
4	0.190	0.516	0.016	0.0175	0.241	0.230	1.68	0.157	0.222	0.0205	0.0090	0.009	0.003	0.0061	
5	0.192	0.520	0.0164	0.0181	0.248	0.230	1.68	0.158	0.223	0.022	0.0095	0.009	0.0031		
6	0.195	0.521	0.0164	0.0189	0.251	0.233	1.70	0.158	0.226	0.022	0.010	0.0093	0.0034		
7		0.531	0.0165	0.019	0.252	0.234	1.71	0.158	0.229	0.022			0.0035		
8			0.017		0.258	0.239		0.165	0.232						
Average	0.1905	0.5189	0.0161	0.0178	0.2420	0.2314	1.677	0.1570	0.2239	0.0208	0.0089	0.0086	0.0029	0.00605	0.00197
Std Dev	0.0026	0.0060	0.0006	0.0009	0.0124	0.0038	0.025	0.0042	0.0050	0.0012	0.0009	0.0006	0.0005	0.00006	0.00021
Certified	0.190	0.52	0.016	0.018	0.24	0.231	1.68	0.157	0.224	0.021	0.009	0.009	0.003	0.0060	0.0020

Information values on uncertified elements												analysis listed as µg/g (ppm by weight)
Analysis	As	B	Ca	Hg	Mg	Nb	Pb	Sb	Ti	W	Zn	Instrument Used
1		1.1	6.7	<0.1	1.5	5.1	0.6		12	31	2.5	Glow Discharge - Mass Spectrometer
2	25	0.6	5	<0.03	0.8	5	0.7		11	15	1	Glow Discharge - Mass Spectrometer
3	23		3.7		1			11		34		ICP Spectrometer
4		0.9	3.2		1							Optical Emission Spectrometer
5	24		7.2				0.8	11				Graphite Furnace AA Spectrometer
Best Estimate	24	1	5	<0.1	1	5	0.7	15	12	30	2	

Analysis: Chemical analyses were made on chips prepared by a lathe from cross-sections of the bars. The individual values listed above are the average of each analyst's results. Methods of analysis used were a combination of ASTM Standard Methods E 350, E 415, E 1019, plus additional ICP, and AA spectrometric methods. 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 optical emission spectrometry and found to be compatible with the following NIST Certified Reference Materials: SRM 1222, 1224, 1225, 1261A to 1265A, 1761 to 1767

Source: This material was produced by Copperweld Steel Company, Warren, Ohio, by electric arc furnace, vacuum degassing, and casting into ingots. The bar stock material was produced by hot-rolling.

Description and Use: This Reference Material is in the form of a disc, approximately 40 mm (1-1/2") in diameter and 19 mm (3/4") thick. It is intended for the use in optical emission and x-ray spectrometric methods of analysis. The entire depth of the disc may be used.

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

Preparation: Use the same method for preparing the analytical surface on all reference materials and specimens for best results.

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: G. R. Brammer on August 10, 1992.