Brammer Standard Company, Inc.

Certificate of Analysis

B.S. 177

High Alloy Steel

Certified Elements			Uncertified Elements	
	Certified Value[1]	Estimate of Uncertainty[2]	Information values	
C	**0.344**	0.005	As	0.006
Mn	**3.26**	0.05	B	0.0007
P	**0.029**	0.004	Ca	0.0011
S	**0.010**	0.001	O	0.006
Si	**0.79**	0.02	Sn	0.006
Cu	**0.32**	0.01		
Ni	**7.40**	0.05		
Cr	**23.28**	0.06		
Mo	**0.30**	0.01		
Co	**0.10**	0.01		
V	**0.10**	0.01		
Al	**0.001**	0.0008		
N	**0.32**	0.01		
Nb	**0.042**	0.006		
Ti	**0.002**	0.001		
W	**0.05**	0.01		

Analysis listed as percent by weight

[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.

See reverse side for more information. Certificate Number 177-052193

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

BS 177 analysis listed as percent by weight Certificate 177-052193

Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Co	V
1	0.339	3.22	0.025	0.0092	0.774	0.30	7.34	23.24	0.289	0.091	0.098
2	0.342	3.23	0.026	0.0097	0.779	0.307	7.34	23.25	0.289	0.094	0.10
3	0.340	3.24	0.026	0.010	0.787	0.316	7.38	23.25	0.290	0.094	0.10
4	0.345	3.24	0.029	0.010	0.79	0.32	7.39	23.26	0.300	0.094	0.102
5	0.346	3.24	0.030	0.0107	0.795	0.32	7.40	23.27	0.305	0.094	0.103
6	0.350	3.26	0.0303	0.011	0.795	0.324	7.41	23.27	0.308	0.101	0.105
7		3.26	0.031		0.80	0.325	7.42	23.32	0.31	0.105	0.105
8		3.26	0.033		0.808	0.330	7.43	23.37	0.31	0.11	0.1065
9		3.28			0.811		7.43		0.31	0.11	0.111
10		3.30					7.45				
11		3.30									
12		3.31									
Average	0.3437	3.262	0.0288	0.0101	0.793	0.318	7.399	23.279	0.301	0.099	0.103
Std Dev	0.0041	0.030	0.0028	0.0007	0.012	0.010	0.037	0.044	0.009	0.008	0.004
Certified	0.344	3.26	0.029	0.010	0.79	0.32	7.40	23.28	0.30	0.10	0.10

Analysis	Al	As	B	Ca	N	O	Nb	Sn	Ti	W
1	0.001	0.002	0.00055	0.00046	0.3102	0.00565	0.035	0.0031	0.0013	0.038
2	0.001	0.0044	0.0007	0.0011	0.318	0.0064	0.0365	0.0032	0.002	0.0385
3	0.001	0.0076	0.00075	0.0014	0.318	0.0066	0.044	0.006	0.002	0.044
4	0.0012	0.008		0.0014	0.320		0.044	0.0066	0.002	0.045
5	0.0025				0.3245		0.0447	0.0070	0.0046	0.047
6					0.33		0.046	0.00815		0.0497
7					0.3325			0.011		0.05
8										0.056
Average	0.0013	0.0055	0.0007	0.0011	0.322	0.0062	0.0417	0.0064	0.0024	0.0460
Std Dev	0.0007	0.0028	0.0001	0.0004	0.008	0.0005	0.0047	0.0028	0.0013	0.0060
Certified	0.001	(0.006)	(0.0007)	(0.0011)	0.32	(0.006)	0.042	(0.006)	0.002	0.05

Data in parentheses are not certified but provided for information.

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 353, E 354, 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 73c, 121d, 133b, 160b, 345, 348a, 365
BCS 466/1, 467/1, 475
ECRM 284-1, 286-1, 292-1, 484-1

Co-operating Laboratories: Some of the co-operating laboratories were:

Allegheny Ludlum Steel Corp., Brackenridge, Pennsylvania
Allegheny Ludlum Steel Corp., Lockport, New York
Analytical Associates, Detroit, Michigan
Brammer Standard Co., Inc., Houston, Texas
J. Dirats and Co., Inc., Westfield, Massachusetts
Crucible Specialty Metals, Syracuse, New York
Taussig Associates, Inc., Skokie, Illinois
Hoesch Stahl AG, Dortmund, Germany
VHG Laboratories, Inc., Manchester, New Hampshire

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 Certified Reference Materials -
NIST: SRM C1151, C1152, C1153, C1154
Europe: ECRM 186-1, 191-1, SS 457/1, 458/1
Japan: JSS 169-4, 170-6, 171-4

Source: This material was produced by Crucible Specialty Metals, Syracuse, New York. The material was made by an electric arc furnace. The material was cast into 15 inch ingots, rolled to 4 inch billets, and hot rolled to final bar size. The bar stock is in natural condition since it was not heat treated.

Production Purpose: This type of alloy is used as a valve head in internal combustion engines.

Description and Use: This Reference Material is in the form of a disc, approximately 37 mm (1.50") in diameter and 12 mm (0.50") thick. It 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 bar material, 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: _____ on May 21, 1993.
G. R. Brammer

Certificate Number 177-052193