Brammer Standard Company, Inc.

Certificate of Analysis

B.S. CA316-4

AISI Grade 316 Calcium Treated Stainless Steel

Certified Elements			Uncertified Elements	
	Certified Value[1]	Estimate of Uncertainty[2]	Information values	
C	**0.018**	0.003	Al	0.008
Mn	**1.43**	0.03	As	0.010
P	**0.028**	0.002	B	0.0004
S	**0.027**	0.003	Sn	0.012
Si	**0.46**	0.02	Ti	0.036
Cu	**0.42**	0.02		
Ni	**11.00**	0.06		
Cr	**17.60**	0.06		
Mo	**2.03**	0.03		
Co	**0.24**	0.01		
V	**0.054**	0.006		
Ca	**0.0056**	0.0003		
N	**0.045**	0.015		
O	**0.009**	0.001		
Nb	**0.012**	0.002		
W	**0.06**	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 CA316-4-032293

Brammer Standard Company, Inc., 14603 Benfer Road, Houston, TX 77069-2895
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BS CA316-4 analysis listed as percent by weight Certificate CA316L-4-032293

Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Co	V
1	0.0138	1.406	0.026	0.024	0.432	0.40	10.922	17.529	1.99	0.226	0.048
2	0.015	1.41	0.0268	0.0241	0.44	0.4025	10.955	17.55	2.014	0.230	0.048
3	0.0175	1.416	0.027	0.0246	0.44	0.405	10.97	17.58	2.015	0.232	0.052
4	0.0175	1.423	0.0275	0.027	0.448	0.410	10.97	17.58	2.02	0.234	0.052
5	0.018	1.424	0.0277	0.027	0.449	0.410	10.99	17.585	2.023	0.239	0.053
6	0.0181	1.425	0.0285	0.027	0.45	0.413	10.99	17.59	2.023	0.240	0.054
7	0.0189	1.43	0.0285	0.027	0.459	0.416	11.01	17.60	2.029	0.241	0.055
8	0.022	1.436	0.0285	0.0275	0.459	0.422	11.02	17.61	2.0345	0.242	0.060
9		1.436	0.0285	0.029	0.462	0.424	11.02	17.614	2.04	0.243	0.061
10		1.44	0.0285	0.0309	0.464	0.426	11.028	17.629	2.045	0.243	
11		1.46	0.029		0.464	0.431	11.028	17.629	2.05	0.246	
12		1.46			0.470	0.437	11.05	17.65			
13		1.465			0.481	0.44		17.675			
Average	0.0176	1.433	0.0279	0.0268	0.455	0.418	10.996	17.602	2.026	0.2378	0.0537
Std Dev	0.0025	0.019	0.0009	0.0022	0.014	0.013	0.037	0.040	0.017	0.0064	0.0046
Certified	0.018	1.43	0.028	0.027	0.46	0.42	11.00	17.60	2.03	0.24	0.054

Analysis	Al	As	B	Ca	N	O	Nb	Sn	Ti	W
1	0.006	0.009	0.0001	0.0054	0.0434	0.0084	0.0098	0.011	0.036	0.046
2	0.0076	0.0099	0.0005	0.0055	0.0442	0.0084	0.010	0.0120	0.036	0.053
3	0.008	0.010	0.0005	0.00557	0.0443	0.0088	0.0102	0.013	0.037	0.0565
4	0.011	0.012	0.0006	0.0056	0.0454	0.0095	0.011			0.058
5				0.0058	0.0455	0.0099	0.0115			0.060
6					0.0460		0.0125			0.060
7					0.0460		0.0125			0.062
8							0.013			
9							0.0135			
Average	0.0082	0.0102	0.0004	0.00557	0.0450	0.0090	0.0116	0.0120	0.0363	0.0565
Std Dev	0.0021	0.0013	0.0002	0.00015	0.0010	0.0007	0.0014	0.0010	0.0006	0.0055
Certified	(0.008)	(0.010)	(0.0004)	0.0056	0.045	0.009	0.012	(0.012)	(0.036)	0.06

Data in parentheses are not certified but provided for information.

Analysis: Chemical analyses were made on chips prepared by a lathe from the certified portion of the discs. 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 572, E 1086, 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, 101g, 121d, 133b, 160b, 345, 348a, 364; BAM 044-1; BCS 466/1, 467/1, 475; ECRM 088-1, 096-1, 284-1, 286-1, 292-1; IRSID 127/3

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

Allegheny Ludlum Corporation, Brackenridge, Pennsylvania
Allegheny Ludlum Corporation, Lockport, New York
Analytical Associates, Detroit, Michigan
Anderson Laboratories, Greendale, Wisconsin
Brammer Standard Co., Inc., Houston, Texas
Jessop Steel Company, Washington, Pennsylvania
J. Dirats and Co., Inc., Westfield, Massachusetts
Republic Engineered Steels, Canton, Ohio
Slater Steels Corporation, Fort Wayne, Indiana
Taussig Associates, Inc., Skokie, Illinois
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: SS 466/1, 474

Source: This material was melted and cast by Avesta Stainless, Inc., Schaumburg, Illinois.

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.

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

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.

Data from routine analysis: The data presented on the last page of this certificate is the result of this material being tested as an unknown specimen by routine analysis. This material was used as an unknown specimen in one of Brammer Standard Company's Proficiency Testing Programs (PTP). The PTP was designed to show how one laboratory's routine analysis compares with that of other laboratories. Each laboratory participating in the PTP was asked to analyze the sample using its routine methods and normal number of analyses. This information may be useful if you analyze this material as an unknown by your routine methods. When using non-CRMs as unknown specimens in a PTP, the general criteria for acceptable analysis is that a laboratory's analysis should be within two standard deviation of the grand mean (average of the laboratories' averages). A laboratory's analysis is considered more acceptable if it is within one standard deviation of the grand mean. Any laboratory with an analysis showing a difference of greater than two standard deviations from the grand mean would be advised to investigate its analytical procedures.

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 March 22, 1993
G. R. Brammer

Certificate Number CA316-4-032293