

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

B.S. CA 316-2

**AISI Stainless Steel Grade 316L Calcium Treated Reference Material**

	Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>		Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>
Analysis listed as percent by weight					
<b>C</b>	<b>0.023</b>	0.002	<b>Co</b>	<b>0.31</b>	0.01
<b>Mn</b>	<b>1.54</b>	0.03	<b>N</b>	<b>0.046</b>	0.001
<b>P</b>	<b>0.026</b>	0.001	<b>Nb</b>	<b>0.021</b>	0.003
<b>S</b>	<b>0.019</b>	0.002	<b>O</b>	<b>0.0033</b>	0.0004
<b>Si</b>	<b>0.46</b>	0.02	<b>Sn</b>	<b>0.013</b>	0.003
<b>Cu</b>	<b>0.427</b>	0.006	<b>Ti</b>	<b>0.030</b>	0.003
<b>Ni</b>	<b>11.21</b>	0.08	<b>V</b>	<b>0.062</b>	0.006
<b>Cr</b>	<b>17.44</b>	0.04	<b>W</b>	<b>0.074</b>	0.004
<b>Mo</b>	<b>2.08</b>	0.03			
<b>Al</b>	<b>0.004</b>	0.001	Informational values <sup>3</sup>		
<b>B</b>	<b>0.0006</b>	0.0002	As	(0.005)	
<b>Ca</b>	<b>0.0046</b>	0.0004	Sb	(0.0028)	

<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 possible bias in the determined analytical values. No attempt is made to derive exact statistical measurements of imprecision because several methods were used in the determination of most constituents.

<sup>3</sup> Values in parentheses are not certified and are provided for information only

See the following pages for more information.

Certificate Number REV-CA316-2-081210

**New Certificate Number REV-CA316-2-081210 was Revised on August 12, 2010 to show estimates of uncertainty**

BS CA 316-2		Analysis listed as percent by weight						Certificate number REV-316-2-081210				
Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al	B	
1	0.0207	1.507	0.0243	0.0173	0.445	0.422	11.09	17.41	2.03	0.0031	0.0005	
2	0.0214	1.537	0.026	0.018	0.452	0.423	11.13	17.41	2.05	0.0033	0.00053	
3	0.023	1.54	0.026	0.0183	0.458	0.429	11.21	17.45	2.07	0.0036	0.00058	
4	0.024	1.543	0.0263	0.0188	0.46	0.43	11.23	17.46	2.07	0.005	0.0007	
5	0.024	1.546	0.0267	0.0198	0.463	0.431	11.27	17.46	2.09	0.0053		
6	0.0243	1.557	0.0267	0.0205	0.47		11.27	17.48	2.09	0.0052		
7		1.583	0.0275		0.486		11.29		2.10	0.0057		
8									2.11			
Average	0.0229	1.545	0.0262	0.0188	0.4620	0.4270	11.213	17.445	2.076	0.0045	0.00058	
Std Dev	0.0015	0.023	0.0010	0.0012	0.0132	0.0042	0.076	0.029	0.027	0.0011	0.00009	
Certified	0.023	1.54	0.026	0.019	0.46	0.427	11.21	17.44	2.08	0.004	0.0006	
t	2.57	2.45	2.45	2.57	2.45	2.78	2.45	2.57	2.36	2.45	3.18	
C(95%)	0.0016	0.021	0.0009	0.0012	0.0122	0.0052	0.070	0.030	0.022	0.0010	0.00014	

continued from above

Analysis	Ca	Co	N	Nb	O	Sn	Ti	V	W	As	Sb
1	0.0042	0.292	0.0451	0.018	0.0030	0.0097	0.027	0.054	0.070	0.005	0.0027
2	0.0043	0.313	0.0454	0.019	0.0030	0.010	0.029	0.059	0.070		0.0029
3	0.0044	0.317	0.0454	0.020	0.0033	0.012	0.029	0.061	0.075		
4	0.0045	0.320	0.0456	0.021	0.00358	0.014	0.029	0.063	0.076		
5	0.0047	0.32	0.0462	0.021	0.0037	0.014	0.029	0.065	0.076		
6	0.0048	0.32	0.0466	0.022		0.015	0.031	0.066	0.078		
7	0.0050		0.047	0.025		0.015	0.031	0.069			
8	0.0051		0.0471	0.025			0.034				
Average	0.00463	0.314	0.0461	0.0214	0.00332	0.0128	0.0299	0.0624	0.0742		0.0028
Std Dev	0.00033	0.011	0.0008	0.0026	0.00032	0.0023	0.0021	0.0050	0.0034		0.0001
Certified	0.0046	0.31	0.046	0.021	0.0033	0.013	0.030	0.062	0.074	(0.005)	(0.0028)
t	2.36	2.57	2.36	2.36	2.78	2.45	2.36	2.45	2.57		12.71
C(95%)	0.00027	0.012	0.0007	0.0021	0.00040	0.0021	0.0018	0.0046	0.0035		0.0013

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

Values in parentheses are not certified and are provided for information only

**Analysis:** Chemical analyses were made on chips prepared by a lathe from the certified portion of the discs. The laboratories participating in the testing normally followed the requirements of ISO Guide 25. 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 353, E 572, E 1019, E 1086, 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, 160b, 344, 345, 348a; ECRM 252-1, 284-1, 286-1; BCS 466/1, 467/1, 475; JK 37; IMZ 127/3.

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

Armco Inc., Research & Technology, Middletown, Ohio	Hoesch Stahl AG, Dortmund, Germany
Allegheny Ludlum Steel Corp., Brackenridge, Pennsylvania	Charles C. Kawin Company, Broadview, Illinois
Allegheny Ludlum Steel Corp., Lockport, New York	Midstates Analytical Laboratories, Tulsa, Oklahoma
Analytical Associates, Inc., Detroit, Michigan	PTL Testing Laboratory, Inc., Trenton, New Jersey
Anderson Laboratories, Inc., Greendale, Wisconsin	Republic Engineered Steels, Inc., Canton, Ohio
Brammer Standard Co., Inc., Houston, Texas	A. B. Sandvik Steel, Sandviken, Sweden
Crucible Specialty Steel, Syracuse, New York	Slater Steel Company, Ft. Wayne, Indiana
J. Dirats and Co., Inc., Westfield, Massachusetts	VHG Laboratories, Inc., Manchester, New Hampshire

**Homogeneity:** This Reference Material was tested for homogeneity using ASTM Standard Practice E 826 and found acceptable.

**Traceability:** This Reference Material was also examined by spark atomic emission spectrometry and found to be compatible with the following Certified Reference Materials: NIST SRM C1151, C1152, C1153, C1154, 1155.

**Source:** This material was produced by Avesta Stainless Inc.. The material was made in an electric arc furnace and cast into ingots. The bar stock was hot rolled, cold finished and annealed.

**Available Form:** This Reference Material is available only in the form of a disc, approximately 38 mm (1.50") in diameter and 12 mm (0.50") thick.

**Use:** This Reference Material is intended for use in spark atomic emission and x-ray spectrometric methods of analysis. 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. 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.

**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 REV-CA316-2-081210. This BS CA316-2 Certificate of Analysis was revised to show the estimate of uncertainty for the certified values and a third decimal place was certified for copper. The certified nitrogen and oxygen values shown on this certificate of analysis were established on January 5, 1994, after a new interlaboratory testing program. The original certificate of analysis for BS CA316-2 was certified on March 12, 1991. 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.

**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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14603 Benfer Road  
Houston, Texas 77069-2895 USA

Phone: (281) 440-9396

website: [brammerstandard.com](http://brammerstandard.com)

Fax: (281) 440-4432

email: [contact@brammerstandard.com](mailto:contact@brammerstandard.com)

Certified by: \_\_\_\_\_ on August 12, 2010.  
Beau R. Brammer

## Referenced Documents

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

*Versions used were those available at the time of interlaboratory testing*

- E 350 Standard Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron
- E 353 Standard Test Methods for Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
- E 572 Standard Test Method for X-Ray Emission Spectrometric Analysis of Stainless Steel
- E 826 Standard Practice for Testing Homogeneity of Materials for the Development of Reference Materials
- E 1019 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys
- E 1086 Standard Method for Optical Emission Vacuum Spectrometric Analysis of Stainless Steel by the Point-to-Plane Excitation Technique

*ISO Guides available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.*

- ISO Guide 25:1990 General requirements for the competence of calibration and testing laboratories (now replaced by ISO 17025)
- ISO Guide 35:2006 Certification of reference materials - General and statistical principles.

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