

Brammer Standard Company, Inc.
Certificate of Analysis

B.S. 151

AISI Stainless Steel Grade 416 Se Reference Material

	Certified Value ¹	Estimate of Uncertainty ²		Certified Value ¹	Estimate of Uncertainty ²
Analysis listed as percent by weight					
C	0.090	0.002	Co	0.018	0.004
Mn	0.41	0.02	N	0.022	0.002
P	0.021	0.002	Nb	0.005	0.001
S	0.018	0.002	O	0.009	0.001
Si	0.65	0.02	Sn	0.005	0.0015
Cu	0.11	0.005	W	0.010	0.003
Ni	0.24	0.01	Informational values		
Cr	13.19	0.05	Al	(0.002)	
Mo	0.088	0.004	As	(0.002)	
Se	0.328	0.010	Pb	(0.0008)	
V	0.046	0.003	Ti	(<0.003)	

¹ The certified value listed is the present best estimate of the true value based on the results of an interlaboratory testing program.

² 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.

Data in parentheses are not certified and are provided for information only.

The requirements of ISO Guide 31 and ISO Guide 35 were generally followed for the preparation of this reference material and certificate of analysis. This is a reference material as defined by ISO Guide 30.

See reverse side for more information.

Certificate Number REV151-010594

Brammer Standard Company, Inc., 14603 Benfer Road, Houston, TX 77069-2895
Telephone (281) 440-9396 Fax (281) 440-4432

Analysis	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Se	V
1	0.088	0.39	0.019	0.0166	0.62	0.107	0.235	13.15	0.084	0.320	0.044
2	0.089	0.394	0.020	0.018	0.62	0.11	0.238	13.16	0.085	0.326	0.044
3	0.0893	0.41	0.020	0.018	0.645	0.111	0.24	13.18	0.087	0.329	0.045
4	0.090	0.418	0.0209	0.0184	0.65	0.111	0.24	13.18	0.088	0.331	0.046
5	0.0912	0.423	0.022	0.0189	0.662	0.111	0.241	13.19	0.089	0.334	0.047
6	0.0918	0.43	0.023	0.0198	0.67	0.112	0.249	13.27	0.091		0.047
7			0.024		0.67	0.114	0.25		0.092		0.049
Average	0.0899	0.411	0.0213	0.0183	0.648	0.111	0.242	13.188	0.0880	0.3280	0.0460
Std Dev	0.0014	0.016	0.0018	0.0011	0.021	0.002	0.006	0.043	0.0029	0.0053	0.0018
Certified	0.090	0.41	0.021	0.018	0.65	0.11	0.24	13.19	0.088	0.328	0.046

Analysis	Co	N	Nb	O	Sn	W	Ti	Al	As	Pb
1	0.015	0.0198	0.004	0.0079	0.0035	0.007	0.0012	0.001	0.0019	0.0002
2	0.0155	0.0214	0.004	0.0080	0.004	0.008	<0.003	0.0013	0.0021	0.0007
3	0.018	0.0215	0.004	0.0085	0.0046	0.010		0.002	0.003	0.0008
4	0.018	0.0220	0.005	0.00855	0.005	0.010		0.003		0.0010
5	0.018	0.0220	0.005	0.0093	0.0056	0.013				0.0012
6	0.020	0.0225	0.005	0.0098	0.007	0.013				
7	0.022	0.0244	0.006							
Average	0.0181	0.02194	0.0047	0.00868	0.0050	0.0102		0.0018	0.0023	0.00078
Std Dev	0.0024	0.00138	0.0008	0.00074	0.0012	0.0025		0.0009	0.0006	0.00038
Certified	0.018	0.022	0.005	0.0087	0.005	0.010	(<0.003)	(0.002)	(0.002)	(0.0008)

Data in parentheses are not certified but 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 284-1, 286-1; BCS 466/1, 467/1, 475; JK 37.

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
 Anderson Laboratories, Inc., Greendale, Wisconsin
 Brammer Standard Co., Inc., Houston, Texas
 Crucible Specialty Steel, Syracuse, New York
 J. Dirats and Co., Inc., Westfield, Massachusetts
 Hoesch Stahl AG, Dortmund, Germany
 Charles C. Kawin Company, Broadview, Illinois
 PTL Testing Laboratory, Inc., Trenton, New Jersey
 Republic Engineered Steels, Inc., Canton, Ohio
 Shiva Technologies, Inc., Cicero, New York
 VHG Laboratories, Inc., Manchester, New Hampshire

References:

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

E 350-90 Standard Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

E 353 - 93 Standard Test Methods for Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

E 572 - 88 Standard Test Method for X-Ray Emission Spectrometric Analysis of Stainless Steel

E 826 - 85 (Reapproved 1990) Standard Practice for Testing Homogeneity of Materials for the Development of Reference Materials

E 1019-93 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys

E 1086 - 85 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 (Third edition, 1990), General requirements for the competence of calibration and testing laboratories.

ISO Guide 30 (Second edition, 1991), Terms and definitions used in connection with reference materials.

ISO Guide 31 (First edition, 1981), Contents of certificates of reference materials.

ISO Guide 33 (First edition, 1989), Uses of certified reference materials.

ISO Guide 35 (Second edition, 1989), Certification of reference materials - General and statistical principles.

Other useful documents available at no cost from NIST, U.S. Department of Commerce, Gaithersburg, MD 20899.

NBS Special Publication 260-100, Handbook for SRM Users

NIST Special Publication 829, Use of NIST Standard Reference Materials for Decisions on Performance of Analytical Chemical Methods and Laboratories

Certificate Number REV151-010594