

Brammer Standard Company, Inc.
Certificate of Analysis

B.S. 4820A

Certified Reference Material for Low Alloy Steel Grade 4820

	Certified Value ¹	Estimate of Uncertainty ²		Certified Value ¹	Estimate of Uncertainty ²
Analysis listed as percent by weight					
C	0.203	0.004	Mg	0.0003	0.0001
Mn	0.64	0.01	N	0.0076	0.0004
P	0.008	0.001	O	0.0011	0.0002
S	0.014	0.002	Sb	0.0024	0.0005
Si	0.185	0.006	Sn	0.0097	0.0004
Cu	0.212	0.006	Ti	0.0012	0.0004
Ni	3.28	0.03	V	0.0010	0.0003
Cr	0.116	0.004			
Mo	0.203	0.005			
Al	0.029	0.002	Informational values ³		
As	0.006	0.002	Nb	(0.002)	
B	0.0002	0.0001	Pb	(0.0002)	
Ca	0.0003	0.0001	W	(0.002)	
Co	0.008	0.001			

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 the 95% confidence interval. The half-width confidence interval C(95%) is shown on page 2.

³ Values in parentheses are not certified and are provided for information only

The requirements of ISO Guides 31, 34 and 35 were followed for the preparation of this certified reference material and certificate of analysis. This is a Certified Reference Material as defined by ISO Guide 30.

Certificate Number 4820A-022211p1/4

BS 4820A		* code for analytical method										analysis listed as percent by weight										Certificate Number 4820A-022211p2/4									
Analysis	C	Mn		P		S		Si		Cu		Ni		Cr		Mo		Al													
1	1	0.199	3	0.632	5	0.0066	1	0.0117	4	0.17575	4	0.2053	4	3.2449	4	0.1115	4	0.1924	4	0.0253											
2	1	0.1995	4	0.63225	4	0.0068	1	0.0130	4	0.181	4	0.206	3	3.25	5	0.112	4	0.1987	4	0.027											
3	1	0.1998	4	0.6344	4	0.0069	1	0.0138	6	0.182	3	0.208	4	3.255	4	0.1136	4	0.201	3	0.0288											
4	1	0.2003	4	0.6370	3	0.007	1	0.01395	3	0.184	4	0.2109	4	3.26	4	0.115	4	0.202	4	0.0294											
5	1	0.20225	4	0.646	4	0.008	1	0.0140	4	0.1870	4	0.211	4	3.300	4	0.11725	5	0.204	4	0.0295											
6	1	0.2041	4	0.647	7	0.008165	3	0.0141	4	0.189	4	0.212	4	3.306	4	0.1175	4	0.20475	3	0.0298											
7	1	0.205	8	0.6495	4	0.0082	1	0.0143	5	0.190	8	0.215	3	3.318	3	0.118	3	0.207	5	0.03015											
8	1	0.207	4	0.652	3	0.0087	3	0.015	4	0.191	4	0.21625			4	0.119	3	0.207	4	0.0307											
9	1	0.207	4	0.653	4	0.009375	1	0.0157			3	0.221			3	0.122	7	0.208	4	0.031											
10					4	0.009445	1	0.0160							4	0.209	5	0.0315													
Average		0.2027		0.6426		0.0079		0.0142		0.1850		0.2117		3.276		0.1162		0.2034		0.0293											
Std Dev		0.0032		0.0086		0.0010		0.0013		0.0052		0.0051		0.030		0.0034		0.0051		0.0019											
RSD%		1.58		1.34		13.14		9.21		2.84		2.40		0.96		2.93		2.49		6.50											
Certified		0.203		0.64		0.008		0.014		0.185		0.212		3.28		0.116		0.203		0.029											
t		2.31		2.31		2.26		2.26		2.36		2.31		2.45		2.31		2.26		2.26											
C(95%)		0.0025		0.0070		0.0007		0.0009		0.0044		0.0039		0.028		0.0026		0.0036		0.0014											

Analysis	As	B		Ca		Co		Mg		N		O		Sb		Sn				
1	4	0.005	5	0.00008	4	0.0002	4	0.0061	4	0.0002	2	0.00677	2	0.00088	5	0.00187	5	0.0088		
2	4	0.0051	7	0.00011	4	0.00026	5	0.0068	5	0.0002	2	0.0073	2	0.0011	5	0.0019	5	0.0093		
3	5	0.0055	5	0.0002	3	0.00029	4	0.0073	5	0.0002	2	0.0077	2	0.0011	9	0.00194	5	0.0095		
4	9	0.00710	3	0.0002	4	0.0003	8	0.0076	4	0.0003	4	0.0077	2	0.0012	5	0.0022	3	0.0097		
5	4	0.0071	3	0.00031	4	0.00034	4	0.0080	4	0.00035	2	0.0077	2	0.00133	5	0.0025	5	0.009785		
6	3	0.0071			4	0.0004	3	0.0087	3	0.00045	2	0.0078			4	0.0029	4	0.0099		
7							3	0.00925			2	0.0078		9	0.00318	7	0.00997			
8						4	0.00943				2	0.0078				4	0.010			
9											2	0.0081				8	0.010			
Average		0.0061		0.00018		0.00030		0.0079		0.00028		0.00763		0.00112		0.00236		0.00966		
Std Dev		0.0011		0.00009		0.00007		0.0012		0.00010		0.00038		0.00017		0.00052		0.00040		
RSD%		28.51		49.13		22.87		14.90		36.45		5.35		14.88		22.12		4.17		
Certified		0.006		0.0002		0.0003		0.008		0.0003		0.0076		0.0011		0.0024		0.0097		
t		2.57		2.78		2.57		2.36		2.57		2.31		2.78		2.45		2.31		
C(95%)		0.0011		0.00011		0.00007		0.0010		0.00011		0.00029		0.00021		0.00048		0.00031		

Analysis	Ti	V		Nb		Pb		W		
1	4	0.0007	5	0.0007	4	0.0003	5	0.000075	5	0.0006
2	5	0.0008	5	0.0008	3	0.0025	5	0.00008	5	0.0007
3	4	0.0009	4	0.0008	5	0.00267	5	0.0001	5	0.000975
4	4	0.00135	4	0.0010			5	0.0002	4	0.001
5	3	0.00145	3	0.0014			3	0.0003	4	0.004
6	4	0.00168	3	0.00145					3	0.0048
Average		0.00115		0.00103		0.0018		0.00015		0.0020
Std Dev		0.00040		0.00033		0.0013		0.00010		0.0019
RSD%		34.84		42.60		72.50		66.67		93.03
Certified		0.0012		0.0010		(0.002)		(0.0002)		(0.002)
t		2.57		2.57		4.30		2.78		2.57
C(95%)		0.00042		0.00034		0.0033		0.00012		0.0020

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

* Code for analytical method

1	Combustion (ASTM E1019)	6	Gravimetric	AAS	=	Atomic Absorption Spectrometry
2	Fusion (ASTM E 1019)	7	Spectro-photometric	AES	=	Atomic Emission Spectrometry
3	Spark AES	8	AAS	MS	=	Mass Spectrometry
4	ICP-AES	9	GFAAS Graphite Furnace AAS			
5	ICP-MS					

Co-operating Laboratories: The co-operating laboratories were:

Laboratory	Accredited/Registered by
Anderson Laboratories, Inc., Greendale, WI	A2LA - 17025
Brammer Standard Company, Inc., Houston, TX	A2LA - ISO 17025, ISO Guide 34
Dirats Laboratory, Westfield, MA	Nadcap - 17025
IMZ - Instytut Metalurgii Zelaza, Gliwice, Poland	PCA - AB 554
Laboratory Testing Inc, Hatfield, PA	Nadcap - 17025
Leco Technical Services Laboratory, St. Joseph, MI	BSI - ISO 9001
National Analysis Center for Iron and Steel, Beijing, China	CNAS - 17025
NSL Analytical, Cleveland, OH	ACCLASS -017025
Northern Analytical Laboratory Inc., Londonderry, NH	Nadcap - ISO 17025
VHG Labs, Manchester, NH	URS - ISO 17025

Analysis: Chemical analyses were made on chips prepared by a lathe from the certified portion of the discs in accordance with ASTM Standard Practice E 1806. The laboratories participating in the testing followed the requirements of ISO Standard 17025. Methods of analysis used were a combination of ASTM Standard Test Method E 1019 plus additional ICP and AA spectrometric methods and other methods listed on page 2.

Traceability: The following Certified Reference Materials were used to validate the analytical data listed on page 2: NIST SRM 94, 106a, 291, 361, 364a, 3010a, 3102a, 3103a, 3107, 3109a, 3112a, 3113, 3114, 3128, 3131a, 3132, 3134, 3136, 3137, 3139a, 3150, 3161a, 3162a, 3163, 3165; BCS 219, 320, 322, 325, 327, 458; ECRM 077-2, 085-1, 086-1, 087-1; IMZ 75/1, 1.8/3, 112, 130, 139; JSS GS-5d.

Homogeneity: This Certified Reference Material (CRM) was tested for homogeneity using ASTM Standard Method E 826 and found acceptable. It was also examined by spark atomic emission spectrometry and found to be compatible with the following Reference Materials: CMSI 2063, 2064, 2065; BS 55E, 68A, 68B, 2941.

Validity statement: ISO Guide 31 states that the certification should contain an expiration date for all materials where instability has been demonstrated or is considered possible, after which the certified value is no longer guaranteed by the certifying body. The certification of BS 68E is valid indefinitely. The certification is nullified if this CRM is damaged, contaminated, or otherwise modified.

Source: The bar stock for this CRM was produced by Republic Engineered Products, Buffalo, NY

Form: This CRM is machined in the form of a disc, approximately 38 mm in diameter and 19 mm thick by Brammer Standard Company, Inc.

Use: This CRM is intended for use in spark atomic emission and x-ray spectrometric methods of analysis. Refer to ISO Guide 33 for information about the use of Reference Materials.

Certified area: 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.

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 4820A-022211. You may obtain information on revisions of certificates from the internet at www.brammerstandard.com.

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. 14603 Benfer Road Houston, Texas 77069-2895 USA	Phone: (281) 440-9396 Fax: (281) 440-4432	web: www.brammerstandard.com e-mail: contact@brammerstandard.com
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Certified by: _____ on February 16, 2011.
Beau R. Brammer

Brammer Standard Company, Inc., is accredited to ISO Guide 34 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials by A2LA (Certificate Number 656.02)

Brammer Standard Company's Chemical Laboratory is accredited to ISO Standard 17025 by A2LA. (Certificate Number 656.01)

By Certificate Number 10539, the Quality System of Brammer Standard Company, Inc., is registered to ISO 9001:2008 by National Quality Assurance, U.S.A.

The scopes of accreditation are listed on the website: www.brammerstandard.com

References:

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

Versions used were those available at the time of interlaboratory testing

- E 826 Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry
- E 1019 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques
- E 1806 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

ISO Guides and Standards available from Global Engineering - www.global.ihs.com

ISO Standard 17025:2005 General requirements for the competence of testing and calibration laboratories

ISO Standard 9001:2008 Quality Management Systems - Requirements

ISO Guide 30:1992 Terms and definitions used in connection with reference materials + 2008 amendment

ISO Guide 31:2000 Reference materials -Contents of certificates and labels

ISO Guide 33:2000 Uses of certified reference materials

ISO Guide 34:2009 General requirements for the competence of reference material producers

ISO Guide 35:2006 Reference Materials - General and statistical principles for certification

Other useful documents available from NIST, U.S. Department of Commerce, Gaithersburg, MD 20899.

NIST 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