

# Brammer Standard Company, Inc.

## Certificate of Analysis

### BS XCAS

Certified Reference Material for Carbon Steel Grade 1008 - UNS Number G10080

	Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>	Certified Values <sup>3</sup>	Certified Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>
<b>As</b>	<b>0.0016</b>	0.0005	<b>Ni</b>	<b>0.031</b>	0.003
<b>C</b>	<b>0.024</b>	0.002	<b>O</b>	<b>0.008</b>	0.001
<b>Co</b>	<b>0.0086</b>	0.0006	<b>P</b>	<b>0.008</b>	0.001
<b>Cr</b>	<b>0.035</b>	0.003	<b>S</b>	<b>0.0064</b>	0.0008
<b>Cu</b>	<b>0.020</b>	0.002	<b>Sb</b>	<b>0.0006</b>	0.0003
<b>Fe</b>	<b>99.0</b>	0.1	<b>Si</b>	<b>0.339</b>	0.009
<b>Mn</b>	<b>0.471</b>	0.007	<b>Sn</b>	<b>0.0017</b>	0.0005
<b>Mo</b>	<b>0.0069</b>	0.0008	<b>Ti</b>	<b>0.0010</b>	0.0003
<b>N</b>	<b>0.0055</b>	0.0006	<b>V</b>	<b>0.020</b>	0.001

	Reference Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>	Reference Values <sup>3,4</sup>	Reference Value <sup>1</sup>	Estimate of Uncertainty <sup>2</sup>
<b>Al</b>	<b>0.027</b>	0.005	<b>Nb</b>	<b>0.0015</b>	0.0008
<b>B</b>	<b>0.0002</b>	0.0001	<b>Pb</b>	<b>0.0007</b>	0.0006
<b>Ca</b>	<b>&lt;0.005</b>		<b>W</b>	<b>0.006</b>	0.005
<b>Mg</b>	<b>0.0002</b>	0.0001	<b>Zr</b>	<b>0.0009</b>	0.0005

<sup>1</sup> For each element, the certified value listed is the present best estimate of the true value based on the mean of the weighted results of an interlaboratory testing program. See page 3 for more information on its calculation.

<sup>2</sup> For each element, the uncertainty listed is based on a statistical evaluation of the contributions of homogeneity and the interlaboratory testing program. See page 3 for more information on its calculation.

<sup>3</sup> Values are given in weight percent. Values in brackets are reported by difference.

<sup>4</sup> Reference values are not certified and are provided for information only.

Trace element information values for Be, Bi, Cl, Ga, Ge, Li, Se, Ta, and Zn are shown on page 4.

The requirements of ISO Guides 30, 31, and 35 were followed for the preparation of this Certified Reference Material and certificate of analysis.

Analysis	*	As	*	C	*	Co	*	Cr	*	Cu	*	Fe	*	Mn	*	Mo	*	N	*	Ni	
1	10	0.0013	1	0.0206	5	0.00796667	4	0.008	3	0.0167	16	[98.89]	11	0.464	3	0.006	2	0.0047667	4	0.02567	
2	5	0.0013	1	0.02175	5	0.00799667	12	0.0216667	3	0.018	16	[98.92]	4	0.4649667	4	0.0061	2	0.0050667	4	0.02637	
3	12	0.001367	1	0.02176667	3	0.008	4	0.0352	4	0.018467	10	98.9333333	4	0.46575	5	0.006133	2	0.0053	3	0.02877	
4	5	0.00138	1	0.02243333	4	0.0081	4	0.0353667	5	0.018633	16	[98.96]	4	0.4683333	4	0.0064	2	0.0053	5	0.02963	
5	4	0.001633	1	0.02283333	4	0.00826667	5	0.0363333	4	0.018833	4	98.9603667	3	0.469	10	0.006467	2	0.0053667	4	0.0304	
6	3	0.0017	1	0.0231	10	0.0083	8	0.037	10	0.019167	13	98.963	3	0.4693333	4	0.006633	2	0.00543	4	0.03083	
7	4	0.001767	11	0.0233	4	0.0083	3	0.0371667	4	0.0192	3	98.9666667	14	0.4696667	10	0.0067	2	0.00545	3	0.031	
8	3	0.0019	1	0.0235	3	0.0084	3	0.0373	4	0.019467	16	[98.98]	4	0.4696667	4	0.0067	2	0.0054667	3	0.031	
9	9	0.002067	1	0.02366667	3	0.0085	4	0.0375667	5	0.02	4	98.99	4	0.4698333	3	0.006767	2	0.0055333	10	0.03117	
10	4	0.002067	1	0.0237	5	0.0085	10	0.0376	11	0.0202	16	[98.9918]	3	0.47	5	0.006867	2	0.0055333	3	0.0313	
11			3	0.024	3	0.00893333	4	0.0376	4	0.020433	16	[98.993567]	8	0.47	4	0.007033	2	0.0061	14	0.03163	
12			1	0.0243	4	0.00893333	3	0.0377	14	0.020433	14	99.0	4	0.470	3	0.0071	2	0.0066667	4	0.0318	
13			1	0.025	3	0.009	4	0.0377667	10	0.021	16	[99.0167]	4	0.4707067	3	0.0074	2	0.007	4	0.03193	
14			1	0.0283	4	0.0091	4	0.0378667	3	0.0219	16	[99.067]	3	0.472	5	0.00742			8	0.032	
15			1	0.02877	14	0.0093	14	0.0379333	3	0.022			3	0.474	14	0.0075			4	0.03203	
16			3	0.0291	11	0.0095	3	0.038	4	0.0221			4	0.4823333	3	0.008			11	0.0324	
17							3	0.038					10	0.483					4	0.03247	
18							11	0.0387					4	0.4856667					10	0.0325	
19							4	0.0389											3	0.0328	
20							10	0.0398667													
Average		0.00165		0.02448		0.00858		0.03538		0.019783		98.9921		0.4710		0.00693		0.00555		0.03111	
Std Dev		0.00010		0.00082		0.00027		0.00099		0.000079		0.0030		0.0036		0.00025		0.00022		0.00088	
H		0.00052		0.0016		0.0010		0.0019		0.0015		0.19		0.0071		0.00092		0.00084		0.0018	
U <sub>1</sub>		0.00052		0.0018		0.0010		0.0022		0.0015		0.19		0.0080		0.00096		0.00087		0.0020	
t-statistic		2.26		2.13		2.13		2.09		2.13		2.16		2.11		2.13		2.18		2.10	
U <sub>2</sub>		0.0012		0.0039		0.0022		0.0045		0.0031		0.42		0.017		0.0020		0.0019		0.0042	
U <sub>3</sub>		0.00038		0.0010		0.00056		0.0010		0.00078		0.11		0.0040		0.00051		0.00052		0.0010	
Certified		<b>0.0016</b>		<b>0.024</b>		<b>0.0086</b>		<b>0.035</b>		<b>0.020</b>		<b>99.0</b>		<b>0.471</b>		<b>0.0069</b>		<b>0.0055</b>		<b>0.031</b>	
Uncertainty		0.0005		0.002		0.0006		0.003		0.002		0.1		0.007		0.0008		0.0006		0.003	
Tolerance		0.0015		0.006		0.0022		0.009		0.006		0.4		0.021		0.0024		0.0018		0.009	

Analysis	*	O	*	P	*	S	*	Sb	*	Si	*	Sn	*	Ti	*	V						
1	2	0.006583	11	0.0056	1	0.00556667	11	0.0002	4	0.329	12	0.00080	12	0.00032	4	0.017						
2	2	0.006767	4	0.00613333	12	0.00586667	12	0.0004033	17	0.329667	5	0.00123333	4	0.0006667	5	0.019167						
3	2	0.0072	5	0.00636	1	0.00593333	5	0.00042	3	0.33	4	0.0013	4	0.0008333	3	0.020						
4	2	0.007367	4	0.0069	10	0.006	5	0.0004667	3	0.334	5	0.00137333	5	0.0008933	3	0.02						
5	2	0.0075	12	0.00716667	1	0.006	5	0.0005	4	0.33575	5	0.0014	14	0.0009	4	0.020033						
6	2	0.007587	7	0.00746667	1	0.00606667	4	0.0007	4	0.336333	5	0.00143333	3	0.0011	4	0.0202						
7	2	0.007767	3	0.0075	1	0.00626667	9	0.0008	11	0.337	3	0.0016	5	0.0011133	3	0.0203						
8	2	0.008575	10	0.00753333	1	0.00627	10	0.338667	3	0.0016	4	0.001667	4	0.0011667	4	0.0203						
9	2	0.009167	5	0.0076	1	0.00636667	4	0.339	9	0.00173333	4	0.0013	3	0.0205								
10	2	0.0092	3	0.0081	3	0.0064	4	0.339567	10	0.002	3	0.0013	10	0.020633								
11	2	0.010127	14	0.00813333	11	0.0064	6	0.34	4	0.00203333	3	0.0017	3	0.020667								
12			10	0.0082	3	0.0065	10	0.34	4	0.00213333	11	0.0018	10	0.0207								
13			4	0.0082	1	0.00653333	14	0.340333	4	0.00233333	4	0.00233333	4	0.021167								
14			4	0.00823333	1	0.00666667	6	0.340477	3	0.003			14	0.0212								
15			4	0.0083	1	0.006775	4	0.340667					4	0.021433								
16			3	0.0088	3	0.007	4	0.347					11	0.0217								
17			3	0.0089	1	0.00716667	3	0.347					4	0.021733								
18			3	0.00926667	1	0.0073	3	0.349					4	0.0223								
19			4	0.011	1	0.0073	4	0.350333														
Average		0.007985		0.007863		0.00639		0.000609		0.339147		0.001712		0.000967		0.020502						
Std Dev		0.000095		0.000073		0.00019		0.000047		0.000073		0.000085		0.000040		0.000075						
H		0.00098		0.00097		0.00089		0.00036		0.0060		0.00052		0.0004208		0.0015						
U <sub>1</sub>		0.00099		0.00098		0.00091		0.00036		0.0060		0.00053		0.00042		0.0015						
t-statistic		2.23		2.10		2.10		2.45		2.10		2.16		2.20		2.11						
U <sub>2</sub>		0.0022		0.0021		0.0019		0.00088		0.013		0.0011		0.00093		0.0031						
U <sub>3</sub>		0.00066		0.00047		0.00044		0.00033		0.0029		0.00031		0.00027		0.00074						
Certified		<b>0.008</b>		<b>0.008</b>		<b>0.0064</b>		<b>0.0006</b>		<b>0.339</b>		<b>0.0017</b>		<b>0.0010</b>		<b>0.020</b>						
Uncertainty		0.001		0.001		0.0008		0.0003		0.009		0.0005		0.0003		0.001						
Tolerance		0.003		0.003		0.0024		0.0005		0.027		0.0015		0.0009		0.003						

Analysis	*	Al	*	B	*	Ca	*	Mg	*	Nb	*	Pb	*	W	*	Zr
1	4	0.022533	12	0.0000997	12	0.0000117	12	0.000035	12	0.000387	12	0.0000787	12	0.0001433	12	0.000017
2	5	0.0226	3	0.0002	4	0.0001	5	0.0001	3	0.0007	5	0.0001	5	0.0009967	5	0.00017
3	4	0.023	3	0.0002	11	0.0003	3	0.0002	5	0.0011	5	0.00011333	4	0.0010333	3	0.0006
4	4	0.023233	3	0.0002	3	0.0008	3	0.0003	5	0.00112	5	0.00012333	11	0.0072	3	0.0007
5	3	0.024367	4	0.0002	3	0.001	4	0.00042	11	0.0016	9	0.0008	3	0.0083	3	0.0008
6	5	0.025467	4	0.0035					10	0.0019	4	0.00094667	4	0.0084	4	0.0011
7	4	0.026867							4	0.001967	4	0.0010	4	0.008667	4	0.0012
8	3	0.028							4	0.001967	10	0.0012	4	0.0089333	10	0.0014
9	4	0.028467							3	0.0022	3	0.0012	3	0.013	4	0.0018
10	3	0.029							4	0.002433	3	0.0017				
11	4	0.029267														
12	3	0.0293														
13	4	0.029333														
14	3	0.0296														
15	11	0.0297														
Average		0.026716		0.00073		0.00057		0.000239		0.00154		0.00073		0.00630		0.00087
Std Dev		0.000082		0.00013		0.00014		0.000073		0.00010		0.00010		0.00011		0.00011
H		0.0017		0.00038		0.00035		0.00026		0.00050		0.00038		0.00089		0.00040
U <sub>1</sub>		0.0017		0.00040		0.00038		0.00027		0.00051		0.00039		0.00089		0.00042
t-statistic		2.14		2.57		2.78		2.78		2.26		2.26		2.31		2.31
U <sub>2</sub>		0.0036		0.0010		0.0010		0.00074		0.0012		0.00089		0.0021		0.0010
U <sub>3</sub>		0.00093		0.00042		0.00047		0.00033		0.00037		0.00028		0.00069		0.00032
Reference		<b>0.027</b>		<b>0.0002</b>		<b>&lt;0.005</b>		<b>0.0002</b>		<b>0.0015</b>		<b>0.0007</b>		<b>0.006</b>		<b>0.0009</b>
Uncertainty		0.005		0.0001				0.0001		0.0008		0.0006		0.005		0.0005
Tolerance		0.015		0.0001				0.0001		0.0014		0.0006		0.005		0.0008

For each element, in accordance with the requirements of ISO 17034 and Guide 35, an effort must be made to account for the effects on the certified value of the uncertainty estimate from homogeneity testing (H) and the uncertainties of the contributing laboratories. The average (A) is calculated using a weighted mean where the reciprocal of the square of each laboratory's combined uncertainty (C<sub>L</sub>), calculated from its standard deviation (S<sub>L</sub>) and its uncertainty estimate (U<sub>L</sub>), is used as the weight (W<sub>L</sub>) for its mean (M<sub>L</sub>). The standard deviation (S) is calculated as the square root of the reciprocal of the sum of the weights. U<sub>1</sub> is the combined uncertainty from homogeneity and labs. U<sub>2</sub> is U<sub>1</sub> multiplied by the coverage factor (95 % t-statistic). U<sub>3</sub> is U<sub>2</sub> divided by the square root of the number of determinations (n). Thus:

$$C_L = \sqrt{S_L^2 + U_L^2} \quad W_L = \frac{1}{C_L^2} \quad A = \frac{\sum_{i=1}^n W_L M_L}{\sum_{i=1}^n W_L} \quad S = \frac{1}{\sqrt{\sum_{i=1}^n W_L}} \quad U_1 = \sqrt{H^2 + S^2} \quad U_2 = t \times U_1 \quad U_3 = \frac{U_2}{\sqrt{n}}$$

All but the final reported values are taken to two significant figures as determined by each quantity's uncertainty estimate. The final reported Uncertainty is U<sub>3</sub> rounded to one significant figure and represents the half width of the 95 % confidence interval for the **Certified** value. The final reported **Certified** value is A rounded to the same decimal place as the Uncertainty. The Uncertainty is a measure of the quality of the **Certified** value.

The Tolerance is a measure of the expected performance of an analysis. This involves further expanding the sample uncertainty to include instrument and operator uncertainty, for those without access to such calculations.

For further information regarding the confidence interval for the certified value see ISO Guide 35:2006 section 6.

**BS XCAS**

\* Code for analytical method

Trace analysis listed as mg/kg (ppm)

Analysis	*	Be	*	Bi	*	Cl	*	Ga	*	Ge	*	Li	*	Se	*	Ta	*	Zn
1	12	0.005	12	0.07	12	0.02	12	21	12	3.8	12	0.005	12	3.4	12	1.4	5	1.1
2	12	0.005	12	0.09			12	21	12	3.8	12	0.005	12	3.4	12	1.5	5	1.1
3			12	0.09			12	22	12	3.9	12	0.005	12	3.5	12	1.5	5	4.0
4															4	50	12	4.2
5															4	50	12	4.2
6															4	60	12	4.3
7																	5	4.6
8																	5	5.0
9																	5	5.1
10																	4	27
11																	4	27
12																	4	27
13																	4	55
14																	4	55
15																	4	56

**Analytical Method Codes:**

- |   |                         |    |                         |    |                        |
|---|-------------------------|----|-------------------------|----|------------------------|
| 1 | Combustion (ASTM E1019) | 7  | Photometric             | 13 | Titrimetric            |
| 2 | Fusion (ASTM E1019)     | 8  | Flame Atomic Absorption | 14 | DCP Atomic Emission    |
| 3 | Spark Atomic Emission   | 9  | GF Atomic Absorption    | 15 | HG Atomic Fluorescence |
| 4 | ICP Atomic Emission     | 10 | X-Ray Fluorescence      | 16 | Difference             |
| 5 | ICP Mass Spectrometry   | 11 | GD Atomic Emission      | 17 | Wet                    |
| 6 | Gravimetric             | 12 | GD Mass Spectrometry    |    |                        |

ICP = Inductively Coupled Plasma      GF = Graphite Furnace      GD = Glow Discharge  
 DCP = Direct Current Plasma      HG = Hydride Generation

Lab Name	Location	Registrar	Accreditation
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, 17034
NSL Analytical	Cleveland, OH	ANAB	17025
LECO Corporation	St. Joseph, MI	A2LA	17025
Elemental Analysis, Inc.	Lexington, KY	A2LA	17025
Dirats Laboratories	Westfield, MA	ANAB	17025
Vitkovice Testing Center	Ostrava, Czech	Czech Accreditation Institute	17025
Element Materials Technology	Glendale Heights, IL	A2LA	17025
TUV Rheinland Pvt Ltd	Bangalore, India	NABL	17025
Luvak Inc.	Boylston, MA	PRI	17025
Laboratory Testing, Inc.	Hatfield, PA	PRI	17025
Eurofins EAG Materials Science, LLC	Liverpool, NY	A2LA	17025
National Analysis Center For Iron And Steel	Beijing, China	CNAS	17025
Institut Metalurgii Zelaza	Gliwice, Poland	PCA	17025
Shiva Analyticals	Hoskote, Bangalore	NABL	17025

A2LA = American Association for Laboratory Accreditation  
 ANAB = ANSI-ASQ National Accreditation Board  
 CNAS = China National Accreditation Service  
 NABL = National Accreditation Board for Testing and Calibration Laboratories  
 PCA = Polish Center For Accreditation  
 PRI = Performance Review Institute

**Analysis:** Chemical analyses were made on solid pieces and chips prepared by an end mill from representative samples for the certified portion of the lot in accordance with ASTM Standard Practice E1806. The laboratories participating in the testing followed the requirements of ISO Standard 17025.

**Traceability:** The following Certified Reference Materials were used to validate the analytical data: 12X40CDV12A, 12XLA90, 23X80030; AR 512, 614A, 644, 645, 654, 657, 662, 668, 673, 869, 870, 881, 882, 886, 889, 892, 911A, 1650, 1652; BAS 111, 149/3, 161/3, 224, 251/1, 257/1, 273, 407, 431, 434, 464/1; BS CCS-2, CSN-2, CSN-2D, H13, XAAS, XCCS, XCCS-1, 46B, 50E, 56G, 56H, 73C, 1009, 1018, 1045, 2931A, 8620A; CKD 170A, 187A, 188A; ECRM 082-1; IARM 28K, 30C; IMZ 53/1, 110, 112, 114A, 135, 137, 172, 173; IPT 5/2; JK 21; JSS 168-7, 169-5, 170-7; LECO 501-644, 501-677, 501-991, 502-328, 502-414, 502-704, 502-712, 502-873, 502-893, 502-904, 502-916, 502-928, 502-935, 502-977, 502-990, 503-508; NCS NS21006; SPL 187A, 188A; SRM 13F, 16F, 160B, 361, 363, 1099, 1138A, 1167, 1228, 1755, 1766, 2166, 3167A.

**Homogeneity:** This Certified Reference Material (CRM) was tested for homogeneity using ASTM Standard Method E826 and found acceptable. It was also examined by spark atomic emission spectrometry and found to be compatible with the following Reference Materials: BAS 111; BS CCS-2, CCS-2D, XAAS, XCCS, 50E, 56G; SRM 1138A.

**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 XCAS is valid indefinitely. The certification is nullified if this CRM is damaged, contaminated, or otherwise modified.

**Storage:** This CRM must be stored in a cool, dry, non-corrosive environment.

**Source:** The cast stock for this CRM was produced by SPL-LABMAT s.r.o.

**Form:** This CRM is machined in the form of a disc, approximately 36mm in diameter and 30mm thick by Brammer Standard Company, Inc.

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

**Certified Area:** The certified area of each disc is the portion extending several mm inward from each surface.

**Sample Preparation:** For best analytical results, use the same method for preparing the analytical surface on all reference materials as used for production specimens. Avoid overheating the sample during surface preparation.

Caution: CRM contains significant insoluble soft metal inclusions. Surface smearing may occur. Spark atomic emission spectrometers may require extended preburns to compensate.

**Certificate Number:** The unique identification number for this certificate of analysis is XCAS-091021. You may obtain information on revisions of certificates from the internet at [www.brammerstandard.com](http://www.brammerstandard.com).

**Safety Notice:** A Safety Data Sheet (SDS) 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

Web: [www.brammerstandard.com](http://www.brammerstandard.com)

Fax: (281) 440-4432

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

Brammer Standard Company, Inc., is accredited by the American Association For Laboratory Accreditation (A2LA) to ISO Standard 17034 as a Reference Material Producer for the production of Certified Reference Materials and Reference Materials (Certificate Number 656.02)

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

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

The scopes of accreditation are listed on the website: [www.brammerstandard.com](http://www.brammerstandard.com)

## **References:**

Versions used were those available at the time of testing and characterization

- E826 Standard Practice for Testing Homogeneity of a Metal Lot or Batch in Solid Form by Spark Atomic Emission Spectrometry
- E1019 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques
- E1806 Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition

ISO Standard 17025:2017 General requirements for the competence of testing and calibration laboratories

ISO Standard 9001:2015 Quality Management Systems - Requirements

ISO Guide 30:2015 Terms and definitions used in connection with reference materials + 2008 amendment

ISO Guide 31:2015 Reference materials - Contents of certificates and labels

ISO Guide 33:2015 Uses of certified reference materials

ISO Standard 17034:2016 General requirements for the competence of reference material producers

ISO Guide 35:2017 Reference Materials - General and statistical principles for certification

*ASTM documents available from ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428.*

*ISO Guides and Standards available from Global Engineering - [www.global.ihs.com](http://www.global.ihs.com)*

*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

Certified by: \_\_\_\_\_ on September 10, 2021.

Beau R. Brammer

President