

Brammer Standard Company, Inc.

Certificate of Analysis

BS 54J

Certified Reference Material for Carbon Steel AISI 1080 - UNS Number G10800

	Certified Value ¹	Estimate of Uncertainty ²	Certified Values³	Certified Value ¹	Estimate of Uncertainty ²	
Al	0.0021	0.0004		N	0.0060	0.0005
As	0.0025	0.0006		Ni	0.037	0.001
C	0.78	0.02		P	0.0090	0.0007
Co	0.0042	0.0006		S	0.0108	0.0009
Cr	0.177	0.008		Si	0.552	0.008
Cu	0.080	0.002		Ti	0.0020	0.0004
Fe	97.6	0.1		V	0.0014	0.0004
Mn	0.77	0.02		W	0.0024	0.0008
Mo	0.0138	0.0008				

	Reference Value ¹	Estimate of Uncertainty ²	Reference Values^{3,4}	Reference Value ¹	Estimate of Uncertainty ²	
B	<0.0005			Sb	0.0006	0.0004
Ca	<0.01			Sn	0.005	0.002
Mg	0.0002	0.0001		Ta	0.0002	0.0001
Nb	0.002	0.001		Zr	0.0021	0.0007
O	0.0011	0.0006				

¹ 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.

² 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.

³ Values are given in weight percent. Values in brackets are reported by difference.

⁴ Reference values are not certified and are provided for information only.

Trace element information values for Pb are shown on page 3.

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

Analysis	*	Al	*	As	*	C	*	Co	*	Cr	*	Cu	*	Fe	*	Mn	*	Mo	*	N
1	4	0.00193333	4	0.0019	1	0.7582667	11	0.0034	3	0.173	14	0.077867	14	97.5333333	4	0.7513333	4	0.010	2	0.00544
2	3	0.002	5	0.0020	1	0.7666667	4	0.0036	10	0.173	3	0.078	16	[97.54]	3	0.76	11	0.0116	2	0.00547
3	4	0.00203333	3	0.0021	1	0.7667667	14	0.0038	4	0.173433	4	0.078	16	[97.54]	4	0.7643333	4	0.013333	2	0.00563
4	5	0.00206	4	0.0023	1	0.7673333	4	0.0040	3	0.174	3	0.0783	4	97.5456	3	0.767	3	0.014	2	0.0057
5	3	0.0021	9	0.00235	11	0.768	4	0.004133	4	0.174	3	0.079	16	[97.5487334]	4	0.7686667	3	0.014	2	0.00573
6	11	0.0021	10	0.0027	1	0.768	4	0.004267	14	0.174333	4	0.0790	16	[97.549334]	14	0.7703333	10	0.014	2	0.0060
7	3	0.0022	15	0.0027833	1	0.769	3	0.0043	8	0.175	11	0.0794	16	[97.55]	4	0.7712667	4	0.014267	2	0.00603
8	4	0.0022	4	0.0028	1	0.7709333	3	0.0045	4	0.175333	5	0.0798	16	[97.55633]	10	0.777	5	0.014433	2	0.00606
9	4	0.00223333	5	0.0028733	3	0.773	4	0.0045	4	0.175333	4	0.0798	16	[97.583667]	8	0.7776667	4	0.014467	2	0.00615
10	14	0.0025	9	0.0029	1	0.7798	5	0.004633	11	0.177	4	0.079923	13	97.585	4	0.77776	14	0.0145	2	0.00617
11					3	0.78	5	0.005543	4	0.178633	8	0.08			4	0.7790667	4	0.0145	2	0.0062
12					1	0.784			3	0.18	4	0.080467			4	0.7793	4	0.0145	2	0.0063
13					1	0.7846667			4	0.184667	10	0.0810			3	0.78	4	0.014933	2	0.00663
14					1	0.790			5	0.187333	4	0.081			8	0.78	3	0.0174		
15					1	0.7933333					4	0.081233			4	0.785				
16					1	0.794					4	0.082533			11	0.786				
17															7	0.7923333				
Average		0.002136		0.00247		0.775860		0.00421		0.176790		0.0796		97.553		0.774533		0.01379		0.00599
Std Dev		0.000074		0.00010		0.000079		0.00017		0.000085		0.0017		0.036		0.000077		0.00053		0.00020
H		0.00057		0.00060		0.0094		0.00075		0.0042		0.0028		0.19		0.0094		0.0012		0.00087
U ₁		0.00057		0.00061		0.0094		0.00077		0.0042		0.0033		0.19		0.0094		0.0014		0.00089
t-statistic		2.26		2.26		2.13		2.23		2.16		2.13		2.26		2.12		2.16		2.18
U ₂		0.0013		0.0014		0.020		0.0017		0.0092		0.0071		0.44		0.020		0.0029		0.0019
U ₃		0.00041		0.00044		0.0050		0.00052		0.0025		0.0018		0.14		0.0048		0.00078		0.00054
Certified		0.0021		0.0025		0.78		0.0042		0.177		0.080		97.6		0.77		0.0138		0.0060
Uncertainty		0.0004		0.0006		0.02		0.0006		0.008		0.002		0.1		0.02		0.0008		0.0005
Tolerance		0.0013		0.0018		0.06		0.0018		0.024		0.007		0.4		0.06		0.0029		0.0019

Analysis	*	Ni	*	P	*	S	*	Si	*	Ti	*	V	*	W							
1	4	0.034	7	0.0087667	1	0.0093333	10	0.542	5	0.0016	5	0.000927	5	0.00113							
2	11	0.0352	3	0.0088	1	0.0097333	4	0.544667	3	0.0017	4	0.0011	4	0.00176667							
3	14	0.0359	3	0.0088	1	0.0100333	6	0.548033	14	0.0018	14	0.0013	4	0.00286667							
4	8	0.036	4	0.0088667	1	0.01005	3	0.55	5	0.001837	3	0.0013	11	0.003							
5	4	0.03626667	10	0.0089	1	0.0103	11	0.55	4	0.002	4	0.0013	3	0.0031							
6	4	0.03633333	4	0.0089333	1	0.0104167	6	0.55	4	0.002023	4	0.001393									
7	4	0.0364	4	0.0090	1	0.0104667	4	0.551733	3	0.0021	11	0.0016									
8	5	0.03673333	4	0.0090167	3	0.0106	14	0.552333	4	0.002133	10	0.0017									
9	3	0.0368	4	0.0091	3	0.011	6	0.553333	11	0.0022	4	0.001967									
10	3	0.037	4	0.0092	10	0.011	4	0.553667	4	0.0027											
11	10	0.037	4	0.0092567	1	0.0110333	4	0.554967													
12	4	0.03736667	11	0.0095	1	0.0110667	6	0.5552													
13	3	0.038	3	0.01	1	0.0112833	4	0.556667													
14	4	0.03966667			1	0.01147	3	0.557													
15	4	0.0400			1	0.0116	3	0.56													
16					1	0.0117333															
17					11	0.0127															
Average		0.0367		0.00902		0.0108		0.551973		0.001974		0.00140		0.00237							
Std Dev		0.0011		0.00036		0.00035		0.000082		0.000068		0.00011		0.00014							
H		0.0020		0.0010		0.001119		0.0078		0.00055		0.00048		0.00059							
U ₁		0.0022		0.0011		0.0012		0.0078		0.00056		0.00050		0.00061							
t-statistic		2.14		2.18		2.12		2.14		2.26		2.31		2.78							
U ₂		0.0048		0.0024		0.0025		0.017		0.0013		0.0011		0.0017							
U ₃		0.0012		0.00066		0.00060		0.0043		0.00040		0.00038		0.00076							
Certified		0.037		0.0090		0.0108		0.552		0.0020		0.0014		0.0024							
Uncertainty		0.001		0.0007		0.0009		0.008		0.0004		0.0004		0.0008							
Tolerance		0.005		0.0024		0.0027		0.024		0.0013		0.0012		0.0023							

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* Code for method

Reference values listed as weight percent

Analysis	*	B	*	Ca	*	Mg	*	Nb	*	O	*	Sb	*	Sn	*	Ta	*	Zr
1	4	0.0000767	3	0.000055	3	0.0002	5	0.001033	2	0.0005	4	0.000243	9	0.00263333	4	0.0001733	3	0.0012
2	11	0.000081	11	0.0001	4	0.0002	3	0.0013	2	0.00065	3	0.0003	5	0.0039	3	0.0002	4	0.001723
3	7	0.00037	4	0.00012	4	0.0002367	4	0.002	2	0.000727	9	0.000467	5	0.0041	4	0.00022	4	0.002
4			4	0.0007067	4	0.0003367	4	0.002267	2	0.000823	5	0.0006	4	0.0043			10	0.0020
5							4	0.0025	2	0.001133	5	0.000793	3	0.0046			11	0.0023
6							11	0.0035	2	0.001183	14	0.000967	5	0.00476667			4	0.002807
7							4	0.00461	2	0.0012			9	0.00496667			4	0.00289
8									2	0.001233			3	0.0054				
9									2	0.0016			4	0.00673333				
10									2	0.001667			3	0.007				
11									2	0.001733			4	0.0070				
12													4	0.00743333				
13													11	0.0076				
Average		0.000079		0.00025		0.0002367		0.00246		0.001137		0.00056		0.005418		0.0001746		0.00213
Std Dev		0.000020		0.00016		0.0000055		0.00012		0.000088		0.00013		0.000088		0.0000099		0.00012
H		0.00018		0.00026		0.00026		0.00060		0.00045		0.00034		0.00083		0.00023		0.00057
U ₁		0.00018		0.00031		0.00026		0.00061		0.00046		0.00037		0.00084		0.00023		0.00058
t-statistic		4.30		3.18		3.18		2.45		2.23		2.57		2.18		4.30		2.45
U ₂		0.00078		0.0010		0.00082		0.0015		0.0010		0.00095		0.0018		0.0010		0.0014
U ₃		0.00045		0.00049		0.00041		0.00057		0.00031		0.00039		0.00051		0.00058		0.00054
Reference		<0.0005		<0.01		0.0002		0.002		0.0011		0.0006		0.005		0.0002		0.0021
Uncertainty						0.0001		0.001		0.0006		0.0004		0.002		0.0001		0.0007
Tolerance						0.0001		0.001		0.0010		0.0005		0.004		0.0001		0.0020

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_L), calculated from its standard deviation (S_L) and its uncertainty estimate (U_L), is used as the weight (W_L) for its mean (M_L). The standard deviation (S) is calculated as the square root of the reciprocal of the sum of the weights. U₁ is the combined uncertainty from homogeneity and labs. U₂ is U₁ multiplied by the coverage factor (95 % t-statistic). U₃ is U₂ 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 U₃ 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.

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* Code for analytical method

Trace analysis listed as mg/kg (ppm)

Analysis	*	Pb																
1	10	5																

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	
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
Element Materials Technology	Glendale Heights, IL	A2LA	17025
Vitkovice Testing Center	Hulvaky, Ostrava	ILAC	17025
Elemental Analysis, Inc.	Lexington, KY	A2LA	17025
LECO Corporation	St. Joseph, MI	A2LA	17025
National Analysis Center For Iron And Steel	Beijing, China	CNAS	17025
Instytut Metalurgii Zelaza	Gliwice, Poland	PCA	17025
Luvak Inc.	Boylston, MA	PRI	17025
Laboratory Testing, Inc.	Hatfield, PA	PRI	17025
Shiva Analyticals Private Limited	Hoskote, Bangalore	NABL	17025
TUV Rheinland Pvt Ltd	Bangalore, India	NABL	17025
Element Materials Technology	Huntington Beach, CA	A2LA	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: 12XLA10, 12XLA90, 13X12534X, 13X12855N, 13X14211R, 22X9030, 24X26310; AR 644, 654, 657, 659, 662, 668, 673, 688, 871, 876, 881, 885, 886, 889, 948, 960, 1647, 1650, 1652, 1653; BAS 312, 346A, 401, 401/1, 431/1, 459/1, 459/2, 464/1; BS CE 26, XCCS-1, 54C, 54D, 54E, 54G, 54H, 56H, 64B, 160A, 203, 204, 1018, 1020, 1026, 1045, 2931A, 8620E, 8740; CKD 164A; DSZU CA01A, Ca013; ECRM 082-1, 85-1, 86-1, 87-1; IARM 30C, 31B, 38A, 98B, 190A, 156A, 189A, 206B, 270A; IMZ 64/1, 65, 112, 130, 139, 198, 199; IPT 12A, 39, 43, 97; JSS 170-7, 171-5; LECO 501-024, 501-504, 501-505, 501-506, 501-644, 501-646, 501-679, 501-991, 502-328, 502-364, 502-712, 502-893, 502-894, 502-916, 502-990, 502-991, 503-501, 503-520; SPL CM-25A, 27-1, 182A; SRM 13F, 14G, 153, 160B, 361, 363, 1224, 1263, 1264, 1765, 1766, 3113, 3169.

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 459/1, 459/2; BS 54C, 54D, 54E, 54G, 56H, 64B, 203, 204; IARM 206B; SRM 1224.

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 54J 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 bar stock for this CRM was produced by Steel Dynamics, Inc.; Columbia City, Indiana.

Form: This CRM is machined in the form of a disc, approximately 38mm in diameter and 19mm 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 entire depth of the CRM may be used.

Caution: As with any bar material, avoid spark atomic emission spectrometric burns in the center of the CRM (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 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 54J-011122. You may obtain information on revisions of certificates from the internet at 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
Fax: (281) 440-4432

Web: www.brammerstandard.com
Email: 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

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

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 January 11, 2022.

Beau R. Brammer
President