Brammer Standard Company, Inc.

Certificate of Analysis

BS M250

Certified Reference Material for Maraging 250 - UNS Number K92890

Certified Values[3]

	Certified Value[1]	Estimate of Uncertainty[2]		Certified Value[1]	Estimate of Uncertainty[2]
Al	**0.098**	0.008	**Mo**	**4.93**	0.06
B	**0.0029**	0.0004	**Ni**	**18.7**	0.3
C	**0.0021**	0.0006	**O**	**0.0005**	0.0003
Co	**7.9**	0.2	**P**	**0.0031**	0.0006
Fe	**67.8**	0.1	**Ti**	**0.422**	0.008
Mn	**0.024**	0.002	**Zr**	**0.0048**	0.0009

Reference Values[3,4]

	Reference Value[1]	Estimate of Uncertainty[2]		Reference Value[1]	Estimate of Uncertainty[2]
Ca	**0.003**	0.002	**S**	**0.0005**	0.0004
Cr	**0.004**	0.002	**Sb**	**<0.0005**	
Cu	**0.003**	0.002	**Si**	**0.003**	0.002
H	**<0.0005**		**Sn**	**<0.005**	
Mg	**<0.005**		**Ta**	**<0.005**	
N	**<0.005**		**V**	**<0.05**	
Nb	**<0.005**		**W**	**0.007**	0.005

[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 4 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 4 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.

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

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BS M250 * Code for method Certified values listed as weight percent

Analysis	*	Al	*	B	*	C	*	Co	*	Fe	*	Mn	*	Mo	*	Ni	*	O	*	P
1	14	0.0901333	7	0.00234	1	0.0010	4	7.7243333	4	67.65	14	0.0198667	4	4.782	3	18.45	2	0.000333333	14	0.002767
2	5	0.0924333	5	0.0026667	1	0.00121	3	7.77	16	[67.7]	4	0.0211333	3	4.8233333	4	18.46	2	0.000386667	4	0.0028
3	3	0.093	4	0.0027	1	0.0015333	4	7.8046667	16	[67.72233]	4	0.0213667	11	4.89	10	18.52	2	0.000393333	4	0.002833
4	4	0.0930333	4	0.0027	1	0.0016667	4	7.822	16	[67.725667]	4	0.0218333	3	4.9	3	18.58	2	0.000416667	6	0.002933
5	4	0.0931333	14	0.0028	1	0.0018333	3	7.92	16	[67.8]	3	0.0219	4	4.9134	13	18.619667	2	0.000433333	4	0.003167
6	4	0.0936033	5	0.00282	1	0.002	14	7.9233333	16	[67.8]	5	0.0225	14	4.92	4	18.6374	2	0.00058	11	0.0035
7	3	0.0945	4	0.0028667	1	0.002	4	7.926	16	[67.8529334]	4	0.0228	4	4.9205333	4	18.654667	2	0.000633333	3	0.0039
8	10	0.095	3	0.0028667	1	0.0020667	3	7.93	4	67.9002667	8	0.0232667	4	4.9211667	4	18.680477	2	0.00072		
9	5	0.0951667	11	0.003	1	0.0020667	4	7.9304333	16	[67.9084]	11	0.0233	4	4.9243333	4	18.696667	2	0.0008		
10	11	0.0958	3	0.0030	11	0.0022	4	7.9318333	13	67.9263333	4	0.0243333	4	4.9254333	4	18.699				
11	4	0.0987667	4	0.003	1	0.0027	4	7.9372667	16	[68.03]	4	0.0249333	4	4.9268	4	18.722667				
12	7	0.0993333	3	0.0032	1	0.0027333	11	7.94			4	0.0249667	4	4.979	4	18.736667				
13	3	0.10	4	0.0035	1	0.0030333	10	7.99			4	0.0250333	10	4.98	4	18.778333				
14	4	0.1053333			3	0.0035	4	7.9954667			10	0.026	3	4.98	14	18.8				
15	4	0.1061333					4	8.0133667			3	0.026	4	4.9853333	11	18.89				
16	4	0.1073333					4	8.1966667			4	0.027	4	5.12	3	18.893333				
17	4	0.1103333									3	0.027								
Average		0.097826		0.002924		0.002102		7.922210		67.803		0.023720		4.930708		18.6805		0.000470		0.00313
Std Dev		0.000077		0.000081		0.000078		0.000079		0.057		0.000077		0.000079		0.0033		0.000038		0.00012
H		0.0031		0.0006459		0.00057		0.037		0.15		0.0016		0.028		0.063		0.00032		0.00066
U_1		0.0031		0.00065		0.00057		0.037		0.16		0.0016		0.028		0.063		0.00033		0.00067
t-statistic		2.12		2.18		2.16		2.13		2.23		2.12		2.13		2.13		2.31		2.45
U_2		0.0067		0.0014		0.0012		0.078		0.35		0.0034		0.059		0.14		0.00075		0.0017
U_3		0.0016		0.00039		0.00033		0.020		0.11		0.00082		0.015		0.034		0.00025		0.00062
Certified		**0.098**		**0.0029**		**0.0021**		**7.9**		**67.8**		**0.024**		**4.93**		**18.7**		**0.0005**		**0.0031**
Uncertainty		0.008		0.0004		0.0006		0.2		0.1		0.002		0.06		0.3		0.0003		0.0006
Tolerance		0.024		0.0012		0.0018		0.6		0.4		0.006		0.18		0.9		0.0004		0.0018

Analysis	*	Ti	*	Zr
1	4	0.4158667	3	0.0035
2	3	0.4166667	4	0.0039333
3	4	0.4176667	14	0.0042
4	14	0.418	4	0.005
5	11	0.418	4	0.005
6	10	0.42	11	0.0057
7	4	0.4201	4	0.0059333
8	4	0.4201333		
9	3	0.421		
10	4	0.4217667		
11	4	0.4248267		
12	4	0.428		
13	5	0.4283333		
14	3	0.43		
15	4	0.434		
Average		0.4220		0.00485
Std Dev		0.0045		0.00028
H		0.0067		0.0009128
U_1		0.0081		0.00095
t-statistic		2.14		2.4469119
U_2		0.017		0.0023
U_3		0.0045		0.00088
Certified		**0.422**		**0.0048**
Uncertainty		0.008		0.0009
Tolerance		0.024		0.0023

BS M250 * Code for method Reference values listed as weight percent

Analysis	*	Ca	*	Cr	*	Cu	*	H	*	Mg	*	N	*	Nb	*	S	*	Sb	*	Si
1	4	0.00057	4	0.0012667	4	0.0002	2	0.000053	4	0.00026	2	0.00002	5	0.0012467	1	0.0001333	5	0.0000167	4	0.0018
2	11	0.0016	4	0.0018267	14	0.0021					2	0.0001033			1	0.00015			11	0.0018
3	4	0.0016667	4	0.0031667	11	0.0031					2	0.000139			1	0.000247			4	0.0026
4	4	0.0038333	14	0.0033	4	0.0034					2	0.00023			1	0.0002867			6	0.0031
5	4	0.0050667	4	0.0033333	4	0.0036					2	0.0002333			1	0.0003			4	0.0044
6			3	0.0036	4	0.0040					2	0.0004			1	0.0003			3	0.0044
7			3	0.004	3	0.0041					2	0.00055			1	0.0003333			4	0.0050
8			4	0.0044333	4	0.0041									14	0.0006				
9			4	0.0049667	4	0.0043									1	0.0008				
10			4	0.0050333	10	0.0050									1	0.0009333				
11			11	0.0064											1	0.0009467				
12			4	0.0064667																
Average		0.00255		0.003983		0.00340		0.000053		0.00026		0.0000209		0.00125		0.000457		0.00001670		0.00329
Std Dev		0.00014		0.000091		0.00010		0.000023		0.00010		0.0000038		0.00030		0.000095		0.00000090		0.00012
H		0.00061		0.00073		0.00069		0.00016		0.00026		0.00012		0.00046		0.0003208		0.00012		0.00068
U_1		0.00063		0.00074		0.00069		0.00016		0.00028		0.00012		0.00055		0.00033		0.00012		0.00069
t-statistic		2.78		2.20		2.26		12.71		12.71		2.45		12.71		2.23		12.71		2.45
U_2		0.0017		0.0016		0.0016		0.0021		0.0036		0.00030		0.0070		0.00075		0.0015		0.0017
U_3		0.00078		0.00047		0.00050		0.0021		0.0036		0.00011		0.0070		0.00022		0.0015		0.00064
Reference		**0.003**		**0.004**		**0.003**		**<0.0005**		**<0.005**		**<0.005**		**<0.005**		**0.0005**		**<0.0005**		**0.003**
Uncertainty		0.002		0.002		0.002										0.0004				0.002
Tolerance		0.002		0.003		0.002										0.0004				0.002

Analysis	*	Sn	*	Ta	*	V	*	W	*		*		*		*		*		*	
1	5	0.000058	5	0.000102	3	0.000086	5	0.00068												
2	3	0.0016333			4	0.00009	4	0.0024333												
3					11	0.0001	4	0.0077667												
4					4	0.0085	4	0.008												
5							4	0.0080333												
6							14	0.0081667												
7							11	0.0082												
8							4	0.0106667												
Average		0.000064		0.00010		0.00011		0.00674												
Std Dev		0.000030		0.00010		0.00011		0.00011												
H		0.00017		0.00019		0.00020		0.00091												
U_1		0.00017		0.00022		0.00023		0.00092												
t-statistic		12.71		12.71		3.18		2.36												
U_2		0.0022		0.0028		0.00072		0.0022												
U_3		0.0015		0.0028		0.00036		0.00077												
Reference		**<0.005**		**<0.005**		**<0.05**		**0.007**												
Uncertainty								0.005												
Tolerance								0.006												

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. U_1 is the combined uncertainty from homogeneity and labs. U_2 is U_1 multiplied by the coverage factor (95 % t-statistic). U_3 is U_2 divided by the square root of the number of determinations (n). Thus:

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

*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_3 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.

Analytical Method Codes:

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

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
Elemental Analysis, Inc.	Lexington, KY	A2LA	17025
TUV Rheinland Pvt Ltd	Bangalore, India	NABL	17025
Shiva Analyticals Private Limited	Hoskote, Bangalore	NABL	17025
Dirats Laboratories	Westfield,MA	ANAB	17025
Luvak Inc.	Boylston, MA	PRI	17025
Laboratory Testing, Inc.	Hatfield, PA	A2LA	17025
Raghavendra Spectro Metallurgical Laboratory	Karnataka, India	NABL	17025
Instytut Metalurgii Zelaza	Gliwice, Poland	PCA	17025
National Analysis Center For Iron And Steel	Beijing, China	CNAS	17025
APL, Inc	Milwaukee, WI	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: 12X1521X, 12X15266U, 13X14934, 13X14935; AR 115C, 147, 148, 250, 546, 645, 659, 662, 668, 673, 870, 882, 892, 920K, 945, 1653, 1658; BAS 312, 464/1; BS 161, 161A, 161B, 2507, 9841; CT 250; DSZU Ca01a; ECRM 285-2; IARM Fe514OH-18, 20A, 27A, 28D, 49D, 99A, 308A; IMZ 195; KMS LCSON-001E; LECO 501-644, 502-704, 502-712, 502-856, 502-903; NCS NS 20035b; SRM 100B, 131E, 153A, 160B, 361, 363, 364, 1156.

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: BS 161, 161A; CT 250; SRM 1156.

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 M250 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 Universal Stainless; Dunkirk Specialty Steel; Dunkirk, NY.

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 M250-080123. 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:

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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 August 1, 2023.

Beau R. Brammer

President