

# Brammer Standard Company, Inc.

## Certificate of Analysis

### BS 187B

Certified Reference Material for Alloy 20 - UNS Number N08020

	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>Al</b>	<b>0.0033</b>	0.0003	<b>O</b>	<b>0.0019</b>	0.0006
<b>B</b>	<b>0.0013</b>	0.0003	<b>P</b>	<b>0.021</b>	0.002
<b>C</b>	<b>0.013</b>	0.001	<b>Pb</b>	<b>0.0005</b>	0.0002
<b>Co</b>	<b>0.191</b>	0.009	<b>S</b>	<b>0.0021</b>	0.0006
<b>Cr</b>	<b>19.8</b>	0.2	<b>Sb</b>	<b>0.0009</b>	0.0004
<b>Cu</b>	<b>3.13</b>	0.05	<b>Si</b>	<b>0.63</b>	0.03
<b>Fe</b>	<b>39.2</b>	0.2	<b>Sn</b>	<b>0.0042</b>	0.0008
<b>Mn</b>	<b>0.77</b>	0.02	<b>Ta</b>	<b>0.0008</b>	0.0003
<b>Mo</b>	<b>2.07</b>	0.05	<b>Ti</b>	<b>0.0028</b>	0.0006
<b>N</b>	<b>0.0185</b>	0.0009	<b>V</b>	<b>0.086</b>	0.004
<b>Nb</b>	<b>0.335</b>	0.008	<b>W</b>	<b>0.047</b>	0.004
<b>Ni</b>	<b>33.8</b>	0.2	<b>Zr</b>	<b>0.0015</b>	0.0003
	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>As</b>	<b>0.0041</b>	0.0011	<b>Mg</b>	<b>&lt;0.002</b>	
<b>Ca</b>	<b>0.0003</b>	0.0002			

<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 5 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 5 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 Ag, Au, Bi, Ce, Ga, Ge, Ir, La, Na, Nd, Os, Pr, Pt, Re, U, and Zn are shown on page 5.

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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Analysis	*	Al	*	B	*	C	*	Co	*	Cr	*	Cu	*	Fe	*	Mn	*	Mo	*	N
1	4	0.029767	5	0.000873	1	0.010	4	0.175333	4	19.4511667	3	3.0425	4	38.932	4	0.733333	4	1.986667	2	0.0174333
2	5	0.029867	4	0.000933	1	0.01078	3	0.182	4	19.54	3	3.08	16	[38.97]	4	0.736667	3	2.01	2	0.0176333
3	17	0.0299	5	0.0010	1	0.01183333	11	0.18375	13	19.5655	17	3.09	16	[39.05467]	4	0.74625	18	2.023	2	0.0177
4	3	0.03	3	0.001048	1	0.012	3	0.184	3	19.6	4	3.091	4	39.111433	3	0.74975	4	2.027333	2	0.018
5	3	0.0312	7	0.00105	1	0.01206667	4	0.1847	18	19.605	4	3.10	16	[39.1167]	3	0.754	17	2.03	2	0.0180
6	14	0.0319	7	0.00106	1	0.0121	10	0.186	10	19.62	11	3.1175	14	39.133333	3	0.755	3	2.0325	2	0.0180667
7	8	0.032	4	0.0011	1	0.01213333	4	0.186	4	19.624	4	3.1185	4	39.143333	10	0.763	18	2.04	2	0.0181333
8	4	0.032133	3	0.0012	1	0.0123	14	0.186333	3	19.63	10	3.12	16	[39.16]	4	0.7645	4	2.06	2	0.0183
9	4	0.032467	3	0.00128	1	0.01233333	4	0.186533	13	19.645	16	3.12	10	39.17	3	0.766	4	2.064	2	0.0183333
10	4	0.032567	3	0.0014	1	0.0127	8	0.187	13	19.6625	3	3.12	16	[39.3025]	11	0.767	3	2.067	2	0.0183333
11	4	0.032633	4	0.001433	1	0.01282	3	0.1875	4	19.6796667	3	3.122	4	39.32	14	0.768667	3	2.0675	2	0.0186
12	3	0.03275	7	0.0015	3	0.0129	4	0.188	3	19.69	4	3.1256	16	[39.3675]	4	0.769833	4	2.074	2	0.0186
13	3	0.0331	7	0.001567	17	0.013	4	0.188367	4	19.6966667	4	3.1297	1	39.383333	8	0.770	4	2.075067	2	0.0186667
14	3	0.03325	4	0.0016	1	0.013	4	0.188767	13	19.70	7	3.13	16	[39.42613]	4	0.77	4	2.078667	2	0.0188
15	4	0.033433	14	0.0016	1	0.013	4	0.189	4	19.7333333	4	3.13			3	0.772	4	2.079367	2	0.0188333
16	5	0.033467	3	0.001625	1	0.0131	17	0.190333	11	19.7375	14	3.133333			4	0.772667	3	2.08	2	0.0188667
17	3	0.034	3	0.0018	1	0.0136	4	0.19075	18	19.77	4	3.134533			4	0.7739	4	2.080667	2	0.0192
18	11	0.0347	11	0.002175	1	0.0137	3	0.193	14	19.8	3	3.1425			4	0.775	4	2.081567	2	0.0193
19	3	0.035			4	0.014	3	0.194	4	19.8399667	4	3.148333			4	0.777	11	2.0825	2	0.020075
20	4	0.038			3	0.01445	3	0.20	4	19.8503667	17	3.15			4	0.778033	14	2.083333	2	0.021
21					1	0.015	3	0.21	4	19.8554	4	3.156			3	0.78	3	2.095		
22					1	0.015633	5	0.226667	18	19.86	3	3.16			3	0.781	4	2.095167		
23					1	0.016	4	0.226667	3	19.87	8	3.16			19	0.7815	10	2.1		
24					11	0.0162			3	19.872	4	3.1625			3	0.79	3	2.12		
25					3	0.017			3	19.885	3	3.17			19	0.791667	17	2.12		
26					3	0.017			3	19.94	4	3.212333					19	2.139333		
27					1	0.0195			3	19.98							3	2.16		
28									3	20.0125										
29									17	20.04										
Average		0.032607		0.001347		0.01314		0.1909		19.4620		3.1312		39.185064		0.767471		2.072321		0.01851
Std Dev		0.000071		0.000075		0.00045		0.0028		0.0037		0.0064		0.000085		0.000063		0.000061		0.00063
H		0.0013		0.00036		0.00083		0.0034		0.11		0.024		0.21		0.0085		0.017		0.0010
U <sub>1</sub>		0.0013		0.00036		0.00095		0.0044		0.11		0.025		0.21		0.0085		0.017		0.0012
t-statistic		2.09		2.11		2.06		2.07		2.05		2.06		2.16		2.06		2.06		2.09
U <sub>2</sub>		0.0027		0.00077		0.0019		0.0091		0.23		0.051		0.46		0.017		0.036		0.0024
U <sub>3</sub>		0.00060		0.00018		0.00037		0.0019		0.043		0.010		0.12		0.0035		0.0069		0.00054
Certified		<b>0.033</b>		<b>0.0013</b>		<b>0.013</b>		<b>0.191</b>		<b>19.8</b>		<b>3.13</b>		<b>39.2</b>		<b>0.77</b>		<b>2.07</b>		<b>0.0185</b>
Uncertainty		0.003		0.0003		0.001		0.009		0.2		0.05		0.2		0.02		0.05		0.0009
Tolerance		0.009		0.0009		0.003		0.027		0.6		0.15		0.6		0.06		0.15		0.0027

Analysis	*	Nb	*	Ni	*	O	*	P	*	Pb	*	S	*	Sb	*	Si	*	Sn	*	Ta
1	4	0.306333	3	33.4075	2	0.0011	18	0.018	8	0.0002	1	0.001115	8	0.0003	3	0.59	5	0.0033	5	0.0003667
2	3	0.32	3	33.455	2	0.00142333	5	0.019	3	0.0002595	1	0.0012	4	0.0005	3	0.596	11	0.003325	11	0.0004
3	1	0.320333	4	33.55	2	0.0016	3	0.01925	11	0.0003	1	0.001215	5	0.0005733	3	0.60	12	0.0035	5	0.00047
4	18	0.322	18	33.673	2	0.0016	3	0.0200	5	0.00048333	1	0.0014	5	0.0008667	4	0.602667	3	0.0037	4	0.0008133
5	3	0.32775	7	33.72	2	0.00166667	18	0.020	5	0.00049	3	0.00155	5	0.00088	6	0.607	17	0.003785	3	0.00085
6	16	0.33	11	33.7225	2	0.0017	5	0.020367	5	0.00053333	1	0.001597	12	0.0008933	10	0.61	3	0.0039	3	0.001
7	3	0.331	13	33.74	2	0.00173333	7	0.02095	5	0.0006	1	0.0016	4	0.0012333	3	0.62	9	0.0039	3	0.001
8	3	0.331	18	33.76	2	0.0019	3	0.021	3	0.00065	1	0.0018	11	0.0013	4	0.627667	5	0.003967	5	0.0010667
9	4	0.332667	4	33.76667	2	0.0019	3	0.0210	12	0.00069333	1	0.0019	3	0.001525	3	0.628	3	0.004	12	0.0014
10	9	0.3351	18	33.78	2	0.00194667	4	0.021067			1	0.002			3	0.6305	4	0.0041		
11	16	0.335667	4	33.78077	2	0.0021	4	0.021433			1	0.0020			7	0.631233	3	0.0042		
12	3	0.33675	4	33.7835	2	0.0021	4	0.0215			1	0.00207			4	0.631533	4	0.004267		
13	18	0.339	6	33.785	2	0.0021	4	0.021667			1	0.0021			14	0.632667	3	0.004475		
14	4	0.34	4	33.80667	2	0.002195	4	0.0218			3	0.0021			3	0.636	5	0.004733		
15	3	0.34	4	33.81667	2	0.00225	11	0.022125			1	0.0021			4	0.640667	5	0.004767		
16	17	0.341	4	33.8224	2	0.00236667	4	0.022233			1	0.0021			4	0.641667	3	0.005		
17	17	0.3418	10	33.83	2	0.00288	3	0.0224			1	0.002167			17	0.641933	12	0.0051		
18	1	0.342333	3	33.85			3	0.022875			11	0.0022			11	0.642	3	0.005267		
19	4	0.342667	4	33.8502			4	0.023			1	0.0024			4	0.6475	9	0.0053		
20	18	0.347	6	33.90			4	0.023			1	0.0024			6	0.65				
21	18	0.35225	4	33.93667							1	0.0024			19	0.656				
22	18	0.35275	4	33.94367							1	0.002433			4	0.656667				
23			17	33.98							1	0.002667			4	0.662333				
24			3	33.995							1	0.0027			3	0.67625				
25			17	34.02							3	0.003			4	0.682				
26			4	34.0675																
27			3	34.08																
28			3	34.105																
29			3	34.175																
30			3	34.1875																
Average		0.3350		33.7873		0.001915		0.021133		0.000480		0.002122		0.000896		0.6289		0.004241		0.000817
Std Dev		0.0036		0.0035		0.000077		0.000071		0.000049		0.000063		0.000042		0.0041		0.000073		0.000024
H		0.0048		0.19		0.00040		0.0010		0.00027		0.00041		0.00032		0.0074		0.00052		0.00031
U <sub>1</sub>		0.0061		0.19		0.00040		0.0010		0.00027		0.00042		0.00032		0.0084		0.00053		0.00031
t-statistic		2.08		2.05		2.12		2.09		2.31		2.06		2.31		2.06		2.10		2.31
U <sub>2</sub>		0.013		0.38		0.00086		0.0022		0.00063		0.00086		0.00074		0.017		0.0011		0.00071
U <sub>3</sub>		0.0027		0.069		0.00021		0.00048		0.00021		0.00017		0.00025		0.0035		0.00025		0.00024
Certified		<b>0.335</b>		<b>33.8</b>		<b>0.0019</b>		<b>0.021</b>		<b>0.0005</b>		<b>0.0021</b>		<b>0.0009</b>		<b>0.63</b>		<b>0.0042</b>		<b>0.0008</b>
Uncertainty		0.008		0.2		0.0006		0.002		0.0002		0.0006		0.0004		0.03		0.0008		0.0003
Tolerance		0.024		0.6		0.0018		0.006		0.0004		0.0018		0.0008		0.09		0.0024		0.0007

**BS 187B** \* Code for method Certified values listed as weight percent

Analysis	*	Ti	*	V	*	W	*	Zr
1	4	0.001667	4	0.0705	12	0.0340	4	0.0013
2	17	0.002033	4	0.078	3	0.0401	3	0.00145
3	4	0.0022	4	0.079333	12	0.0420	3	0.0015
4	4	0.002233	4	0.081567	4	0.042	4	0.001533
5	4	0.002233	17	0.0820	3	0.04335	12	0.0016
6	10	0.0023	3	0.0830	10	0.046	3	0.001625
7	16	0.0023	3	0.08325	4	0.04653333	11	0.001975
8	3	0.002875	3	0.084	4	0.04686667		
9	3	0.0029	3	0.08425	3	0.0470		
10	5	0.002933	4	0.085433	14	0.047		
11	14	0.002967	4	0.085733	4	0.0477		
12	4	0.003	10	0.086	4	0.04776667		
13	3	0.003	4	0.086067	4	0.04776667		
14	5	0.003037	14	0.086267	4	0.04846667		
15	5	0.0032	11	0.0864	11	0.050225		
16	12	0.003633	3	0.087	3	0.05125		
17	11	0.004	4	0.087033	4	0.05233333		
18	3	0.00415	4	0.088633	5	0.05796667		
19			4	0.0892	3	0.059		
20			3	0.08945				
21			3	0.092				
22			3	0.0934				
23			5	0.100367				
Average		0.002815		0.0857		0.0467		0.001528
Std Dev		0.000075		0.0018		0.0015		0.000067
H		0.00045		0.0021		0.0015		0.00037
U <sub>1</sub>		0.00046		0.0028		0.0021		0.00038
t-statistic		2.11		2.07		2.10		2.45
U <sub>2</sub>		0.0010		0.0058		0.0044		0.00092
U <sub>3</sub>		0.00023		0.0012		0.0010		0.00035
Certified		<b>0.0028</b>		<b>0.086</b>		<b>0.047</b>		<b>0.0015</b>
Uncertainty		0.0006		0.004		0.004		0.0003
Tolerance		0.0018		0.012		0.012		0.0009

**BS 187B** \* Code for method Reference values listed as weight percent

Analysis	*	As	*	Ca	*	Mg
1	3	0.003025	4	0.000107	5	0.0000743
2	9	0.003067	9	0.00012	5	0.0001
3	4	0.003167	12	0.00013	4	0.00010667
4	3	0.004	5	0.000153	3	0.000165
5	5	0.0042	4	0.0002	3	0.00053
6	5	0.004285	18	0.0002	3	0.0008
7	15	0.004323	3	0.000255	14	0.00116667
8	5	0.005233	3	0.000285		
9	5	0.005933	3	0.0004		
10			11	0.0004		
11			4	0.0009		
12						
13						
14						
15						
16						
17						
18						
19						
20						
Average		0.00414		0.00029		0.00042
Std Dev		0.00011		0.00012		0.00052
H		0.00052		0.00024		0.00026
U <sub>1</sub>		0.00053		0.00027		0.00059
t-statistic		2.31		2.23		2.45
U <sub>2</sub>		0.0012		0.00060		0.0014
U <sub>3</sub>		0.00041		0.00018		0.00054
Reference		<b>0.0041</b>		<b>0.0003</b>		<b>&lt;0.002</b>
Uncertainty		0.0011		0.0002		
Tolerance		0.0033		0.0002		

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 187B

\* Code for analytical method

Trace analysis listed as mg/kg (ppm)

Analysis	*	Ag	*	Au	*	Bi	*	Ce	*	Ga	*	Ge	*	Ir	*	La	*	Na	*	Nd
1	12	2.8	12	0.21	12	0.16	12	0.59	12	24	12	4.8	12	0.07	12	0.45	12	0.03	12	0.20
2	12	2.9	12	0.23	12	0.18	12	0.67	12	25	12	4.8	12	0.07	12	0.45			12	0.21
3	12	2.9	12	0.23	12	0.19	12	0.69	12	25	12	5.0	12	0.07	4	0.46			12	0.23
4							12	1.0							12	0.49				
5							4	20							12	2				
6							4	20							4	3.2				
7							4	180							4	3.2				
8															4	4				
Analysis	*	Os	*	Pr	*	Pt	*	Re	*	U	*	Zn								
1	12	0.09	12	0.10	12	0.13	12	0.82	12	0.002	12	35								
2	12	0.09	12	0.11	12	0.13	12	0.87	12	0.002	12	35								
3	12	0.10	12	0.12	12	0.14	12	0.89	12	0.002	12	35								

## Analytical Method Codes:

- |   |                         |    |                         |    |                        |
|---|-------------------------|----|-------------------------|----|------------------------|
| 1 | Combustion (ASTM E1019) | 8  | Flame Atomic Absorption | 15 | HG Atomic Fluorescence |
| 2 | Fusion (ASTM E1019)     | 9  | GF Atomic Absorption    | 16 | Difference             |
| 3 | Spark Atomic Emission   | 10 | X-Ray Fluorescence      | 17 | Wet                    |
| 4 | ICP Atomic Emission     | 11 | GD Atomic Emission      | 18 | Volumetric             |
| 5 | ICP Mass Spectrometry   | 12 | GD Mass Spectrometry    | 19 | AAS                    |
| 6 | Gravimetric             | 13 | Titrimetric             |    |                        |
| 7 | Photometric             | 14 | DCP Atomic Emission     |    |                        |

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

Lab Name	Location	Registrar	Accreditation
Brammer Standard Company, Inc.	Houston, TX	A2LA	17025, Guide 34
Spectrochemical Laboratories, Inc.	Pittsburgh, PA		
Advanced Analytical Services and Reference	Czech Republic		
Crucible Specialty Metals	Syracuse, NY		
Jeffrey A. Nunes Laboratories, Inc.	Washington, PA		
Ledoux & Company	Teaneck, NJ		
Andrew S. McCreath & Son, Inc.	Harrisburg, PA	A2LA	17025
LECO Corporation	St. Joseph, MI	A2LA	17025
Analytical Associates	Detroit, MI		
Coleman Testing Laboratories Corp	Houston, TX		
Shiva Technologies	Cicero, NY	PRI/Nadcap	17025
VHG Labs, Inc.	Manchester, NH		
NSL Analytical	Cleveland, OH	ANAB	17025
Elemental Analysis, Inc.	Lexington, KY	A2LA	17025
Dirats Laboratories	Westfield, MA	ANAB	17025
National Analysis Center For Iron And Steel	Beijing, China	CNAS	17025
Evans Analytical Group	Liverpool, NY	A2LA	17025
Vitkovice Testing Center	Ostrava, Czech Republic	Czech Accreditation Institute	17025
Luvak Inc.	Boylston, MA	PRI	17025
Institut Metalurgii Zelaza	Gliwice, Poland	PCA	17025
Laboratory Testing, Inc.	Hatfield, PA	PRI	17025
TUV Rheinland Pvt Ltd	Bangalore, India	NABL	17025
Shiva Analyticals Private Limited	Hoskote, Bangalore	NABL	17025
Element Materials Technology	Glendale Heights, IL	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: 12X3490, 12X3500, 13X31400A, 23X80030; 501-501, 501-503, 501-504, 501-505, 501-506, 501-510, 501-553, 501-644, 501-645, 501-676, 502-016, 502-328, 502-414, 502-414, 502-704, 502-712, 502-855, 502-843, 502-893, 502-916, 502-918, 502-928, 502-946, 502-963, 502-977; AR 512, 512B, 644, 654, 657, 668, 673, 869, 870, 882, 886, 889, 892, 911A, 1650, 1652, 1653; BAS 4-94, 334, 342, 345, 346, 434, 464/1, 466/1, 475; BS CSN-4, H1C, H230, H230A, HH5157A, HH5179A, HH5196A, HON T, 11B, 17-4PHA, 86D, 86E, 86F, 160A, 179B, 179C, 180B, 183C, 187, 187A, 187C, 187D, 188B, 192, 273, 625C, 625D, 625E, 800, 800A, 825F, 925A, 1016, 1045, 1762, 4340, 4340A; CKD 186A; DSZU CA01A, CA013; ECRM 084-1, 085-1, 088-1, 087-1, 096-1, 097-1, 284-1, 289-1, 292-1, 299-1, 481-1; IARM 5C, 25B, 25C, 54A, 56H, 62E, 68A; IMZ 52/1, 112, 162, 187, 206; IPT 12A, 17, 75A, 97; JK 21, 37; JSS 169-5, 174-5, 175-7; NCS NS11043, NS11078; SRM C1288, 16F, 32E, 73C, 101G, 121D, 123C, 125B, 126C, 133B, 160B, 316D, 339, 344, 345, 346A, 348A, 361, 362, 363, 365, 868, 1158, 1246, 1247, 1261, 1261A, 1263A, 1265, 1265A, 1288, 1762, 2165, 2166, 2171.

**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: BAM 230-1; BAS 4-94, 342, 475; BS CSN-4, HON T, 86D, 86E, 86F, 187, 187A, 187D, 800; DSZU CA01A; ECRM 088-1, 292-1, 299-1, 481-1; JK 37, LECO 501-676, 502-873; NCS NS 11043, NS 11078; SRM C1288, 32E, 73C, 101G, 121D, 125B, 126C, 133B, 160B, 339, 344, 345, 348A, 363, 868, 1246, 1247, 2165, 2171.

**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 187B 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 U.S Alloys; Houston, Texas.

**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 187B-081221. 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 August 12, 2021.

Beau R. Brammer

President