

Brammer Standard Company, Inc.

Certificate of Analysis

BS 173A

Certified Reference Material for Cobalt Alloy CCM - UNS Number R30075

	Certified Value ¹	Estimate of Uncertainty ²	Certified Values³	Certified Value ¹	Estimate of Uncertainty ²	
C	0.047	0.005		N	0.169	0.008
Co	64.5	0.5		Nb	0.0026	0.0006
Cr	27.8	0.5		P	0.0024	0.0007
Fe	0.43	0.04		S	0.0005	0.0003
H	0.0002	0.0001		Si	0.64	0.06
Mn	0.78	0.01		W	0.0097	0.0007
Mo	5.49	0.08				

	Reference Value ¹	Estimate of Uncertainty ²	Reference Values^{3,4}	Reference Value ¹	Estimate of Uncertainty ²	
Al	0.06	0.03		O	0.0017	0.0007
B	0.0006	0.0004		Ti	0.012	0.009
Cu	0.014	0.008		V	0.008	0.003
Ni	0.09	0.02				

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 As, Be, Ca, Ce, Ga, Ge, Ir, La, Mg, Nd, Os, Pb, Pr, Re, Sb, Sn, Ta, U, 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	*	C	*	Co	*	Cr	*	Fe	*	H	*	Mn	*	Mo	*	N	*	Nb	*	P
1	1	0.0339333	16	[63.96]	4	27.353333	4	0.386133	2	0.000128	11	0.77	11	5.37	2	0.161333	12	0.001933	12	0.000723
2	1	0.042	14	64.166667	4	27.416167	4	0.39	2	0.000138	8	0.773	4	5.446	2	0.163667	10	0.002	5	0.001323
3	1	0.0430667	16	[64.2]	10	27.55	10	0.41	2	0.00014	7	0.774	4	5.4492	2	0.165	5	0.002023	4	0.0020
4	1	0.0432333	13	64.302	4	27.566667	4	0.41625	2	0.000153	4	0.774667	4	5.453333	2	0.166333	3	0.0021	3	0.0022
5	1	0.04525	4	64.336067	4	27.5975	4	0.417	2	0.0002	4	0.77475	3	5.46	2	0.167	5	0.0021	11	0.0027
6	1	0.0456543	16	[64.3947]	13	27.723667	4	0.4174	2	0.000213	4	0.775	10	5.48	2	0.168	5	0.0022	4	0.0028
7	1	0.0462667	16	[64.4667]	10	27.763333	10	0.423333	2	0.000267	4	0.778833	4	5.496667	2	0.168	4	0.002767	10	0.003
8	1	0.0470333	16	[64.69]	11	27.78	4	0.423333	2	0.0003	4	0.779433	4	5.499267	2	0.168667	4	0.002933	4	0.003
9	1	0.0486333	16	[64.911679]	4	27.872333	4	0.430033	4	0.780033	4	5.499667	2	0.170333	4	0.003033	4	0.003033	4	0.003067
10	1	0.049	4	64.9725	4	27.8989	4	0.4302			14	0.781	4	5.51575	2	0.1726	4	0.003333	4	0.003367
11	1	0.050	4	64.973333	4	27.902633	3	0.431			3	0.789	4	5.527333	2	0.177667	11	0.0047		
12	1	0.0516667			13	27.9092	14	0.432			10	0.79	4	5.530667	2	0.18				
13	1	0.0568			14	27.933333	11	0.437			10	0.79	10	5.543333						
14	11	0.0604			4	28.065333	4	0.441333			4	0.794	4	5.562033						
15					3	28.34	4	0.492667					14	5.566667						
Average		0.047353		64.488510		27.778160		0.425179		0.000188		0.780265		5.493328		0.1692		0.002648		0.00242
Std Dev		0.000085		0.000095		0.000082		0.000082		0.000016		0.000085		0.000082		0.0044		0.000095		0.00010
H		0.0022		0.14		0.082		0.0067		0.00024		0.0094		0.029		0.0042		0.00062		0.00060
U ₁		0.0022		0.14		0.082		0.0067		0.00024		0.0094		0.029		0.0060		0.00063		0.00061
t-statistic		2.16		2.23		2.14		2.14		2.36		2.16		2.14		2.20		2.23		2.26
U ₂		0.0048		0.32		0.18		0.014		0.00056		0.020		0.063		0.013		0.0014		0.0014
U ₃		0.0013		0.10		0.045		0.0037		0.00020		0.0054		0.016		0.0038		0.00042		0.00043
Certified		0.047		64.5		27.8		0.43		0.0002		0.78		5.49		0.169		0.0026		0.0024
Uncertainty		0.005		0.5		0.5		0.04		0.0001		0.01		0.08		0.008		0.0006		0.0007
Tolerance		0.015		1.5		1.5		0.12		0.0001		0.03		0.24		0.024		0.0018		0.0021

Analysis	*	S	*	Si	*	W															
1	1	0.0002	4	0.5887	3	0.002															
2	12	0.0002333	11	0.617	14	0.0054667															
3	1	0.0003	10	0.62	5	0.0091267															
4	1	0.00034	4	0.6243333	4	0.0093333															
5	1	0.0004	4	0.6325333	5	0.0093667															
6	1	0.0004733	4	0.63325	5	0.0099667															
7	1	0.0005667	4	0.6343333	12	0.0100															
8	3	0.0007	4	0.6423333	4	0.0108333															
9	1	0.0011	4	0.6497	4	0.0110															
10	1	0.0011533	4	0.6500333	4	0.0113															
11			14	0.6513333	4	0.0183															
12			10	0.6633333																	
13			4	0.6956667																	
14			3	0.698																	
Average		0.00055		0.642896		0.009699															
Std Dev		0.00010		0.000085		0.000095															
H		0.00034		0.0085		0.0011															
U ₁		0.00036		0.0085		0.0011															
t-statistic		2.26		2.16		2.23															
U ₂		0.00081		0.018		0.0024															
U ₃		0.00026		0.0049		0.00072															
Certified		0.0005		0.64		0.0097															
Uncertainty		0.0003		0.06		0.0007															
Tolerance		0.0004		0.18		0.0024															

Analysis	*	Al	*	B	*	Cu	*	Ni	*	O	*	Ti	*	V
1	12	0.0383333	12	0.00011	8	0.00588	4	0.076	2	0.001	12	0.003333	11	0.0054
2	4	0.0393333	7	0.0003367	5	0.0066767	10	0.082	2	0.001013	14	0.004233	12	0.0062
3	4	0.0532	4	0.0005667	12	0.0067333	12	0.083333	2	0.00107	4	0.005333	4	0.006833
4	4	0.0581	4	0.0008333	5	0.0080333	4	0.0877	2	0.001167	5	0.0064	10	0.007
5	3	0.0636	14	0.0008333	5	0.0082667	5	0.089367	2	0.0012	5	0.00650	4	0.007033
6	10	0.0673333	11	0.0009	4	0.011	3	0.09	2	0.0013	5	0.0079	4	0.007533
7	4	0.0692667			10	0.014	4	0.091	2	0.00145	4	0.0082	4	0.007667
8	10	0.07			14	0.015	4	0.0954	2	0.001613	4	0.013033	10	0.007733
9	4	0.0700333			10	0.017	4	0.098933	2	0.002125	10	0.014	3	0.0088
10	14	0.0708667			4	0.0196667	4	0.102067	2	0.003133	4	0.016533	5	0.00913
11	5	0.0719333			4	0.0203	10	0.103333	2	0.0032	4	0.02	4	0.009467
12	4	0.0722333			4	0.0240333	4	0.109567			4	0.020233	5	0.010133
13	4	0.0753333			11	0.0271	4	0.109967			3	0.0257	4	0.011233
14	11	0.0766												
Average		0.064012		0.000578		0.014130		0.093744		0.001661		0.011646		0.008013
Std Dev		0.000085		0.000098		0.000088		0.000088		0.000095		0.000088		0.000088
H		0.0026		0.00035		0.0013		0.0031		0.00052		0.0012		0.00098
U ₁		0.0026		0.00036		0.0013		0.0031		0.00053		0.0012		0.00099
t-statistic		2.16		2.57		2.18		2.18		2.23		2.18		2.18
U ₂		0.0055		0.00093		0.0028		0.0067		0.0012		0.0025		0.0022
U ₃		0.0015		0.00038		0.00076		0.0019		0.00035		0.00070		0.00060
Reference		0.06		0.0006		0.014		0.09		0.0017		0.012		0.008
Uncertainty		0.03		0.0004		0.008		0.02		0.0007		0.009		0.003
Tolerance		0.05		0.0005		0.024		0.06		0.0016		0.011		0.007

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:

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

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_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.

Analysis	*	As	*	Be	*	Ca	*	Ce	*	Ga	*	Ge	*	Ir	*	La	*	Mg	*	Nd
1	12	1.2	12	60	12	0.4	12	15	12	15	12	0.1	12	0.01	12	7.7	12	1.1	12	5.5
2	12	1.2			12	0.47	12	18	12	15					12	9	12	1.2	12	6.5
3	12	1.3			12	0.48	12	20	12	16					12	9.9	12	1.2	12	7.2
4	15	1.5																		
5	15	1.6																		
6	15	1.7																		
Analysis	*	Os	*	Pb	*	Pr	*	Re	*	Sb	*	Sn	*	Ta	*	U	*	Zn		
1	12	0.01	5	0.18	12	1.6	12	0.4	12	0.68	12	2.1	12	20	12	0.008	12	0.4		
2	12	0.01	5	0.19	12	1.9	12	0.42	5	0.71	5	2.1	12	20	12	0.009	12	0.41		
3			5	0.20	12	2.1	12	0.44	12	0.74	12	2.2	5	20.8	12	0.009	12	0.43		
4			12	0.26					12	0.74	5	2.2	5	21.0						
5			12	0.27					5	0.77	12	2.3	12	21						
6			12	0.27					5	0.77	5	2.4	5	21.2						

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
Dirats Laboratories	Westfield, MA	ANAB	17025
NSL Analytical	Cleveland, OH	ANAB	17025
Elemental Analysis, Inc.	Lexington, KY	A2LA	17025
Eurofins EAG Materials Science, LLC	Liverpool, NY	A2LA	17025
Element Materials Technology	Glendale Heights, IL	A2LA	17025
Shiva Analyticals Private Limited	Hoskote, Bangalore	NABL	17025
Luvak Inc.	Boylston, MA	PRI	17025
Laboratory Testing, Inc.	Hatfield, PA	A2LA	17025
National Analysis Center For Iron And Steel	Beijing, China	CNAS	17025
APL, Inc	Milwaukee, WI	A2LA	17025
Instytut Metalurgii Zelaza	Gliwice, Poland	PCA	17025
TUV Rheinland Pvt Ltd	Bangalore, India	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: 111X12671J, 112X14943H; AR 148, 215A, 546, 555, 631, 644, 645, 646, 647, 662, 668, 870, 871, 881, 892, 920K, 945, 1647, 1653; BAM 328/1; BS 170, 170A, 170B, 172, 172B, 173; DSZU CA01a; ECRM 096-1, 299-1, 378-1D; IARM 64A, 64C, 97B, 98B, 207A, 208B, 229; IMZ 1-N4, 165; JSS GS-1D; KMS LCSON-001; LECO 501-502, 502-416, 502-855, 502-856, 502-870, 505-887, 502-890, 502-903, 503-913, 503-514; SRM 168, 343A, 348A, 862, 1200, 3163.

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: 111X12671J, 112X14943H; BS 170, 170A, 170B; ECRM 378-1D.

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 173A 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 Carpenter Technology Corporation; Reading, PA.

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 173A-010623. 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 05, 2023.

Beau R. Brammer
President