

Certificate of Analysis

IARM CoElgiloy-18

Cobalt Elgiloy / UNS R30003

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	0.011 ± 0.009	B	0.002 ± 0.001	C	0.008 ± 0.001	Co	40.4 ± 0.2
Cr	20.4 ± 0.1	Cu	0.005 ± 0.003	Fe	12.6 ± 0.1	Mn	2.36 ± 0.03
Mo	8.6 ± 0.3	N	0.0034 ± 0.0003	Nb	0.006 ± 0.004	Ni	15.9 ± 0.2
O	0.009 ± 0.001	P	0.0019 ± 0.0009	S	0.0018 ± 0.0006	Si	0.05 ± 0.01
Ti	0.004 ± 0.002	V	0.009 ± 0.007	W	0.008 ± 0.005		

Indicative Values listed in ppm

Ag (<1)	As (<220)	Be (<1)	Ca (15)	Hf (<200)	La (<1)	Mg (<20)
Pb (<120)	Re (<1)	Sb (<1)	Sn (<1)	Ta (100)	Y (<1)	Zr (<10)

Description and Intended Use

This CRM may come in the form of a solid disk, chips, or powder. The intended use of this CRM may include, but is not limited to, the calibration of instruments and the validation of analytical methods.

Instructions for Use

1. The test surface is on the opposite side of the labeled surface, which includes the material identification. The entire thickness of the unit is certified. However, the user is cautioned not to measure disks less than 2 mm thick when using X-ray fluorescence spectrometry. Each packaged disk has been prepared by finishing the test surface using a lathe. The user must determine the correct surface preparation procedure for each analytical technique. The user is cautioned to use care when either resurfacing the disk or performing additional polishing, as these processes may contaminate the surface.
2. The minimum sample size for chips should be individually evaluated based on the analytical technique used; this would typically be greater than 0.1 grams.
3. The material should be stored in a cool, dry location when not in use.
4. Chips are not certified for Oxygen analysis.

The following data represents all pertinent information reported as it applies to the chemical characterization of this material.

	Ag	Al	As	B	Be	C	Ca	Co	Cr	Cu	Fe	Hf	La	Mg	Mn	Mo
1	<0.000005	0.001	0.022	0.000036	<0.000005	0.004	0.001	39.9989	20.11	0.001	12.32	0.0133	<0.000001	0.0002	2.26	7.7968
2		0.0011	<0.00002	0.0007	<0.00005	0.0069	0.0016	40.2202	20.229	0.0013	12.346	<0.000001		0.0003	2.329	7.878
3		0.0017		0.0009		0.0072	0.0016	40.24	20.34	0.0015	12.41			0.005	2.34	8.36
4		0.0052		0.001		0.0074	0.0017	40.26	20.372	0.005	12.469			<0.0005	2.3477	8.652
5		0.006		0.0015		0.00752		40.31	20.3958	0.0057	12.50				2.349	8.70
6		0.0086		0.002		0.0079		40.54	20.40	0.00667	12.5211				2.354	8.7262
7		0.0097		0.0046		0.00803		40.5977	20.467	0.007	12.613				2.3587	8.745
8		0.015				0.0086		40.60	20.568	0.0094	12.627				2.373	8.771
9		0.029				0.0093		40.722	20.58		12.82				2.37333	8.79
10		0.0365				0.01036			20.729		12.9461				2.40	8.8467
11															2.45	9.21
12																
13																
14																
15																
Mean		0.011		0.002		0.008	0.0015	40.4	20.4	0.005	12.6			0.002	2.36	8.6
STDV.		0.01		0.001		0.002	0.0003	0.2	0.2	0.003	0.2			0.003	0.05	0.4
Certified	<0.0001	0.011	<0.022	0.002	<0.0001	0.008	(0.0015)	40.4	20.4	0.005	12.6	<0.02	<0.0001	(0.002)	2.36	8.6
U _{CRM}		0.009		0.001		0.001		0.2	0.1	0.003	0.1			0.03	0.03	0.3
Methods	G	X,O,IM,I,G	IM,G	O,IM,I,G	IM,I,G	C	IM,G	X,O,I,G	X,W,O,I,G	X,O,IM,I,G	X,O,I,G	X,G	G	IM,G	X,O,I,G	X,O,I,G

	N	Nb	Ni	O	P	Pb	Re	S	Sb	Si	Sn	Ta	Ti	V	W	Zr
1	0.003	0.00079	15.5596	0.0078	0.00015	0.000049	0.000003	0.0007	0.000011	0.0269	0.000035	0.001	0.000076	0.001	0.00098	0.000063
2	0.0031	0.004	15.60	0.0079	0.001	0.00006		0.001	<0.00005	0.034	0.00007	0.006	0.0005	0.0012	0.0013	0.004
3	0.0032	0.005	15.65	0.00884	0.0012	0.012		0.0014		0.045	0.00061	0.0069	0.0025	0.0013	0.004	0.004
4	0.00335	0.008	15.849	0.0089	0.0013			0.0014		0.047	0.0013	0.011	0.0022	0.003	0.00333	0.0042
5	0.0034	0.01	15.869	0.0096	0.002			0.0014		0.05	0.0128	0.003	0.0043	0.004	<0.00005	<0.00005
6	0.0035	0.01	15.9253	0.0098	0.0021			0.0015		0.056	0.028	0.004	0.0045	0.0051	0.01	<0.001
7	0.0036		15.94	0.0108	0.0023			0.0017		0.057	0.0397	0.004	0.0084	0.01		
8			16.05		0.0028			0.0019		0.061		0.0068	0.01	0.011		
9	0.004		16.054		0.004333			0.002		0.0615		0.0073	0.014	0.0159		
10			16.3033					0.00259		0.068		0.01	0.0234	0.023		
11								0.0039		0.081			0.031			
12																
13																
14																
15																
Mean	0.0034	0.006	15.9	0.009	0.0019			0.0018		0.05	0.0001	0.01	0.004	0.009	0.008	0.003
STDV.	0.0003	0.004	0.2	0.001	0.001			0.0009		0.02	0.00002	0.01	0.003	0.01	0.007	0.002
Certified	0.0034	0.006	15.9	0.009	0.0019	<0.012	<0.0001	0.0018	<0.0001	0.05	<0.0001	(0.01)	0.004	0.009	0.008	<0.001
U _{CRM}	0.0003	0.004	0.2	0.001	0.0009			0.0006		0.01		0.002	0.007	0.005		
Methods	F	X,O,IM,I,G	X,O,I,G	F	X,O,IM,I,G	O,IM,G	G	X,G,C	IM,G	X,O,IM,I,G	IM,G	X,O,IM,I,G	X,O,IM,I,G	X,O,IM,I,G	X,O,IM,I,G	X,IM,I,G

Legend: W = Classical, C = Combustion, F = Fusion, A = AA or GFAA, I = ICP or DCP, IM=ICP-MS, D = DC Arc, O = AES, X = XRF, G = GDAES or GDMS, H = Hollow Cathode AES

Certification Laboratories

Huntington Alloys Corporation	Huntington, WV	LECO Corporation	St. Joseph, MI
Kennametal Stellite, Inc.	Bellefonte, ON	Chicago Spectro Service Laboratory	Chicago, IL
ATI Specialty Materials, Monroe	Monroe, NC	ATI Specialty Materials, Lockport	Lockport, NY
Anderson Laboratories, Inc.	Greendale, WI	EAG Laboratories, Inc.	Liverpool, NY
Latrobe Specialty Metals, A Carpenter Co.	Latrobe, PA	Cronimet Specialty Metals USA, Inc.	Wheatland, PA
VHG Labs	Manchester, NH	Laboratory Testing, Inc.	Hatfield, PA
Haynes International, Inc.	Kokomo, IN		

Certification laboratories have demonstrated performance and traceability by utilizing test methods under the scope of ISO 17025 or have shown competence through a proficiency testing program. Some of the specific CRMs and SRMs used in the analysis of the material covered by this certificate are:

NIST 361 NIST 362 NIST 364 NIST 349a NIST 121C IARM 55B IARM 96D IARM 97C IARM 100B IARM 256A IARM 64A

Homogeneity and Uncertainty

"Uncertainty" values, as reported adjacent to certified concentration values, are based on a 95% Confidence Interval. These estimated uncertainties include the combined effects of method imprecision, material inhomogeneity, and any bias between methods. Homogeneity data from experimental XRF results are reflected in both the overall statistics and certified data. Homogeneity samples are selected by a systematic sampling procedure. The number of samples may be determined by equation 1, where N_{prod} is the number of units produced and N_{min} is the number of samples used for homogeneity testing. These samples are arranged in a simple randomized design such that each sample is analyzed multiple times by XRF. Homogeneity may also be determined within sample using an applied version of ASTM E826. A single factor ANOVA is used to calculate uncertainty due to inhomogeneity (U_{hom}). Uncertainty of the material is calculated by equation 2, where $H=U_{hom}$, S = Standard deviation, t = t-value at 95% CI, and n = number of observations.

$$1. N_{min} = \max(10, \sqrt[3]{N_{prod}})$$

$$2. U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$$

Expiration

The certification of this material is valid indefinitely, within the uncertainty specified, provided the material is handled and stored in accordance with the instructions stated on this certificate. The certification is nullified if the material is damaged, contaminated, otherwise modified, or used in a manner for which it was not intended.



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