



ARMI

ISO Certified · 9001 · 17025 · 17043 · 17034

# Certificate of Analysis

## IARM Ni617-18

Nickel Alloy 617 / UNS N06617

### Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

<b>Al</b>	<b>1.08 ± 0.03</b>	<b>B</b>	<b>0.0023 ± 0.0003</b>	<b>C</b>	<b>0.079 ± 0.002</b>	<b>Co</b>	<b>11.81 ± 0.09</b>
<b>Cr</b>	<b>21.9 ± 0.1</b>	<b>Cu</b>	<b>0.009 ± 0.003</b>	<b>Fe</b>	<b>1.45 ± 0.03</b>	<b>Mg</b>	<b>0.0011 ± 0.0006</b>
<b>Mn</b>	<b>0.24 ± 0.01</b>	<b>Mo</b>	<b>9.33 ± 0.07</b>	<b>N</b>	<b>0.0082 ± 0.0003</b>	<b>Nb</b>	<b>0.197 ± 0.008</b>
<b>Ni</b>	<b>53.3 ± 0.5</b>	<b>O</b>	<b>0.0010 ± 0.0006</b>	<b>P</b>	<b>0.004 ± 0.001</b>	<b>S</b>	<b>0.0007 ± 0.0004</b>
<b>Si</b>	<b>0.21 ± 0.02</b>	<b>Ti</b>	<b>0.32 ± 0.02</b>	<b>V</b>	<b>0.006 ± 0.002</b>	<b>W</b>	<b>0.02 ± 0.01</b>
<b>Zr</b>	<b>0.06 ± 0.01</b>						

Indicative Values listed in ppm

Ag (<5)	As (<50)	Au (<1)	Ba (<1)	Be (<1)	Bi (<10)	Br (<1)
Ca (<50)	Cd (<280)	Ce (<1)	Cl (<1)	Cs (<1)	Dy (<1)	Er (<1)
Eu (<1)	F (<1)	Ga (<20)	Gd (<1)	Ge (<1)	H (<2)	Hf (<100)
Hg (<1)	Ho (<1)	I (<1)	In (<1)	Ir (<1)	K (<1)	La (<1)
Li (<1)	Lu (<1)	Na (<1)	Nd (<1)	Os (<1)	Pb (<10)	Pd (<10)
Pr (<1)	Pt (<1)	Rb (<1)	Re (<200)	Rh (<1)	Ru (<1)	Sb (<10)
Sc (<1)	Se (<50)	Sm (<1)	Sn (<60)	Sr (<5)	Ta (<90)	Tb (<1)
Te (<1)	Th (<1)	Tl (<1)	Tm (<1)	U (<1)	Y (<10)	Yb (<1)
Zn (<10)						

#### Description and Intended Use

This **Certified Reference Material** is covered under the scope of accreditation to **ISO 17034** by LGC Standards - Manchester, NH. As an ISO 17034 certified reference material, appropriate use of this material will fulfill the certified reference material and traceability requirements for use in **ISO 17025** certified laboratories. 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 recommended for gas analysis.

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

	Al	B	C	Co	Cr	Cu	Fe	Mg	Mn	Mo	N	Nb	Ni	O	P	S
1	1.021	0.0016	0.076	11.57	21.55	0.0031	1.379	0.00041	0.218	9.1317	0.0077	0.177	52.4219	0.0004	0.002	0.0002
2	1.042	0.002	0.077	11.70	21.6267	0.0049	1.385	0.00063	0.222	9.178	0.008	0.1893	52.85	0.0006	0.002	0.00035
3	1.05	0.002	0.0773	11.73	21.82	0.005	1.412	0.0007	0.228	9.29	0.008	0.19	52.90	0.00067	0.00278	0.00039
4	1.052	0.0022	0.0775	11.82	21.89	0.006	1.44	0.001	0.2283	9.31667	0.0082	0.191	52.97	0.001	0.00319	0.0004
5	1.06	0.0022	0.0779	11.821	21.91	0.0064	1.455	0.00142	0.23	9.336	0.00823	0.20	53.186	0.00141	0.0035	0.0004
6	1.06	0.00238	0.0787	11.825	21.92	0.008	1.457	0.0018	0.23	9.344	0.0083	0.20	53.30	0.002	0.004	0.00055
7	1.096	0.00243	0.08	11.8267	21.92	0.01	1.465	0.00195	0.23	9.37	0.00835	0.20	53.3733	0.0052	0.006	0.0006
8	1.10	0.0025	0.0806	11.90	21.921	0.011	1.47	0.002	0.231	9.388	0.0088	0.204	53.547	0.007	0.007	0.001
9	1.13	0.003	0.082	11.951	22.01	0.012	1.48	0.002	0.2562	9.40	0.0088	0.208	53.92	0.007	0.007	0.0011
10	1.138	0.0031	0.0833	11.98	22.134	0.013	1.49	0.002	0.26	9.424	0.0088	0.213	54.92	0.007	0.007	0.0019
11	1.1417				22.1356	0.0144	1.538	0.002	0.274	9.467						
12						0.0147										
13																
Mean	1.08	0.0023	0.079	11.81	21.9	0.009	1.45	0.0011	0.24	9.33	0.0082	0.197	53.3	0.001	0.004	0.0007
STDV.	0.04	0.0005	0.002	0.1	0.2	0.004	0.05	0.0006	0.02	0.1	0.0003	0.01	0.7	0.0006	0.002	0.0005
Certified	1.08	0.0023	0.079	11.81	21.9	0.009	1.45	0.0011	0.24	9.33	0.0082	0.197	53.3	0.0010	0.004	0.0007
U <sub>CRM</sub>	0.03	0.0003	0.002	0.09	0.1	0.003	0.03	0.0006	0.01	0.07	0.0003	0.008	0.5	0.0006	0.001	0.0004
Methods	O,X,I,G	O,I,G,IM	C	O,X,I,G	O,X,W,G,I	O,X,I,G,IM	O,X,I,G	O,G,IM	O,X,I,G,IM	O,X,I	F	O,X,G,IM	O,I,X	F	O,G,IM,X	O,C,G,X

	Si	Ti	V	W	Zr	Ag	As	Au	Ba	Be	Bi	Br	Ca	Cd	Ce	Cl
1	0.16	0.2504	0.0023	0.0051	0.026	0.000008	0.00033	<0.00001	<0.000005	<0.000005	0.0000057	<0.000005	0.00001	0.028	<0.000005	<0.000001
2	0.184	0.2635	0.003	0.011	0.0444	<0.0005	<0.005				<0.000005		0.0002	<0.0005		
3	0.19	0.313	0.0038	0.013	0.056						<0.001		<0.005	<0.005		
4	0.192	0.32	0.0044	0.015	0.0596											
5	0.197	0.3239	0.0047	0.015	0.06											
6	0.20	0.33	0.005	0.015	0.06											
7	0.206	0.334	0.005	0.019	0.063											
8	0.2122	0.337	0.007	0.0389	0.068											
9	0.25	0.34	0.0095	0.04	0.0792											
10	0.2715	0.341	0.01	0.041												
11		0.37	0.0104													
12																
Mean	0.21	0.32	0.006	0.02	0.06											
STDV.	0.03	0.03	0.003	0.01	0.01											
Certified	0.21	0.32	0.006	0.02	0.06	<0.0005	<0.005	<0.0001	<0.0001	<0.0001	<0.001	<0.0001	<0.005	<0.028	<0.0001	<0.0001
U <sub>CRM</sub>	0.02	0.02	0.002	0.01	0.01											
Methods	O,X,I,G,IM	O,X,I,G,IM	O,X,G,IM	O,X,G,IM	O,X,G,IM	A,IM,G	IM,G	G	G	G	A,IM,G	G	O,IM,G	IM,G	G	G

	Cs	Dy	Er	Eu	F	Ga	Gd	Ge	H	Hf	Hg	Ho	I	In	Ir	K
1	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001	0.0012	<0.000001	0.000015	0.0002	0.00025	<0.00001	<0.000001	<0.000001	<0.000001	0.000007	<0.000005
2										0.01						
3										<0.001						
4																
5																
Mean																
STDV.																
Certified	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.002	<0.0001	<0.0001	<0.0002	<0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
U <sub>CRM</sub>																
Methods	G	G	G	G	G	G	G	G	F	IM,G,X	G	G	G	G	G	G

	La	Li	Lu	Na	Nd	Os	Pb	Pd	Pr	Pt	Rb	Re	Rh	Ru	Sb	Sc
1	<0.000001	<0.0000005	<0.000001	<0.000001	<0.000001	0.000005	0.000017	<0.00001	<0.000001	<0.00001	<0.0001	0.000022	<0.00001	<0.00001	0.000044	<0.000005
2							0.000028	<0.001				0.01333			0.00005	<0.000005
3							0.001								<0.001	
4							<0.001									
5																
Mean												0.010			0.000050	
STDV.												0.009			0.000004	
Certified	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.001	<0.001	<0.0001	<0.0001	<0.0001	<0.02	<0.0001	<0.0001	<0.001	<0.0001
U <sub>CRM</sub>																
Methods	IM,G	G	G	G	G	G	A,O,IM,G	IM,G	G	G	G	G,X	G	G	IM,G	G

	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tm	U	Y	Yb	Zn
1	0.00075	<0.000001	0.000088	<0.0005	0.000041	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	0.000002	<0.0005	<0.000001	0.00014
2	<0.0002		0.001		0.0015							<0.001		0.0017
3	<0.005		0.0055		0.006									<0.001
4			<0.001		0.00851									
5					<0.001									
6														
Mean														
STDV.														
Certified	<0.005	<0.0001	<0.006	<0.0005	<0.009	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.001	<0.0001	<0.001
U <sub>CRM</sub>														
Methods	IM,G	G	O,IM,G	G	O,X,IM,G	G	G	G	G	G	G	IM,G	G	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

Oxford Instruments Analytical GmbH  
Laboratory Testing, Inc.  
Haynes International, Inc.  
Anderson Laboratories, Inc.  
NSL Analytical Services, Inc.  
LGC Standards

Uedem, Germany  
Hatfield, PA  
Kokomo, IN  
Greendale, WI  
Cleveland, OH  
Manchester, NH

VDM-Metals USA, LLC  
Latrobe Specialty Metals, A Carpenter Co.  
Huntington Alloys Corporation  
LECO Corporation  
EAG Laboratories

Florham Park, NJ  
Latrobe, PA  
Huntington, WV  
St. Joseph, MI  
Liverpool, NY

Certification laboratories have demonstrated performance and traceability by utilizing a variety of test methods. Some of the specific Certified Reference Materials and Standard Reference Materials used in the analysis of the material covered by this certificate are:

IARM 202A IARM 203A IARM 52B IARM 55B IARM 63B NIST 1191 NIST 1192 NIST 339 NIST 348A NIST 349A NIST 361 NIST 865

## 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.



David Coler, General Manager

Analytical Reference Materials International

