



ARMI

ISO Certified · 9001 · 17025 · 17043 · 17034

Certificate of Analysis

IARM Ni909-18

Nickel Alloy 909 / UNS N19909

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	0.009 ± 0.002	B	0.0013 ± 0.0005	C	0.006 ± 0.001	Co	13.1 ± 0.1
Cr	0.010 ± 0.004	Cu	0.007 ± 0.004	Fe	42.4 ± 0.3	Mg	0.00012 ± 0.00007
Mn	0.030 ± 0.003	N	0.0026 ± 0.0003	Nb	4.6 ± 0.1	Ni	37.7 ± 0.2
O	0.004 ± 0.001	P	0.002 ± 0.001	S	0.0018 ± 0.0004	Si	0.42 ± 0.01
Ta	0.006 ± 0.003	Ti	1.62 ± 0.03	W	0.009 ± 0.007		

Indicative Values listed in ppm

Ag (<5)	As (<50)	Au (<1)	Ba (<1)	Be (<1)	Bi (<10)	Br (<1)
Ca (<50)	Cd (<10)	Ce (<1)	Cl (<1)	Cs (<1)	Dy (<1)	Er (<1)
Eu (<1)	F (<1)	Ga (<3)	Gd (<1)	Ge (<2)	H (<2)	Hf (<250)
Hg (<1)	Ho (<1)	I (<1)	In (<1)	Ir (<1)	K (<1)	La (<1)
Li (<1)	Lu (<1)	Mo (<400)	Na (<1)	Nd (<1)	Os (<1)	Pb (<10)
Pd (<10)	Pr (<1)	Pt (<1)	Rb (<1)	Re (<1)	Rh (<1)	Ru (<1)
Sb (<10)	Sc (<1)	Se (<50)	Sm (<1)	Sn (<120)	Sr (<5)	Tb (<1)
Te (<1)	Th (<1)	Tl (<1)	Tm (<1)	U (<1)	V (<1)	Y (<11)
Yb (<1)	Zn (<11)	Zr (<30)				

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	N	Nb	Ni	O	P	S	Si
1	0.0028	0.00047	0.0033	12.832	0.0007	0.0019	42.0216	0.00024	0.021	0.002	4.416	37.163	0.0027	0.0004	0.001	0.38
2	0.0045	0.0006	0.0053	12.85	0.001	0.0021	42.054	0.00007	0.02333	0.0023	4.4233	37.223	0.0028	0.00083	0.0013	0.396
3	0.0061	0.00081	0.00531	13.01	0.0039	0.003	42.10	0.0001	0.027	0.00246	4.487	37.4693	0.0029	0.0009	0.0014	0.403
4	0.007	0.0009	0.0059	13.06	0.005	0.0032	42.23	0.0001	0.027	0.0025	4.5271	37.54	0.0035	0.002	0.0015	0.41
5	0.0092	0.001	0.0059	13.07	0.006	0.0035	42.2632	0.0002	0.03	0.0027	4.699	37.756	0.00429	0.002	0.00159	0.4115
6	0.01	0.0012	0.006	13.10	0.0064	0.0072	42.275	0.0002	0.0302	0.0028	4.7236	37.8054	0.0044	0.002	0.0018	0.425
7	0.01	0.0012	0.0063	13.1022	0.0096	0.0087	42.30		0.0314	0.003	4.725	37.8139	0.007	0.0028	0.0019	0.425
8	0.011	0.0016	0.0064	13.1371	0.01	0.01	42.568		0.0328	0.003	4.727	37.88		0.003	0.0019	0.4306
9	0.013	0.0022	0.008	13.169	0.0141	0.0131	42.71		0.033		4.73	37.901		0.004	0.002	0.432
10	0.0135	0.0026	0.0099	13.3724	0.0165	0.016	42.8205		0.0341		4.73	38.04		0.0047	0.002	0.44
11	0.014				0.02		43.24		0.0345		4.8448	38.17			0.0032	0.4443
12					0.0212				0.035							
13																
14																
Mean	0.009	0.0013	0.006	13.1	0.01	0.007	42.4	0.00012	0.03	0.0026	4.6	37.7	0.004	0.002	0.0018	0.42
STDV.	0.004	0.0007	0.002	0.2	0.007	0.005	0.4	0.00007	0.005	0.0003	0.1	0.3	0.002	0.001	0.0006	0.02
Certified	0.009	0.0013	0.006	13.1	0.010	0.007	42.4	0.00012	0.030	0.0026	4.6	37.7	0.004	0.002	0.0018	0.42
U _{CRM}	0.002	0.0005	0.001	0.1	0.004	0.004	0.3	0.00007	0.003	0.0003	0.1	0.2	0.001	0.001	0.0004	0.01
Methods	O,X,I,IM,G	O,I,IM,G	C	O,X,I,IM	O,X,I,IM,G	O,X,I,IM,G	O,X,I	O,I,IM,G	O,I,X,IM,G	F	O,X,I	O,X,I	F	O,I,X,IM,G	O,C	O,I,X

	Ta	Ti	W	Ag	As	Au	Ba	Be	Bi	Br	Ca	Cd	Ce	Cl	Cs	Dy
1	0.0037	1.51	0.000026	0.0000072	0.00043	<0.00001	<0.000005	<0.0000005	<0.000005	<0.000005	0.0028	<0.0005	<0.000005	0.00004	<0.000001	<0.000001
2	0.004	1.58	0.002	<0.0005	<0.005						0.004	<0.001				
3	0.005	1.60	0.0106								0.005					
4	0.0057	1.6104	0.013								0.0052					
5	0.006	1.6192	0.0133								0.0054					
6	0.008	1.622	0.016								<0.005					
7	0.013	1.624														
8		1.6262														
9		1.63														
10		1.632														
11		1.713														
12																
Mean	0.006	1.62	0.009								0.004					
STDV.	0.003	0.05	0.007								0.001					
Certified	0.006	1.62	0.009	(<0.0005)	(<0.005)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.001)	(<0.0001)	(<0.005)	(<0.001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
U _{CRM}	0.003	0.03	0.007													
Methods	O,X,IM,I,G	O,X,I	O,X,I,IM	G	IM,G	G	G	G	IM,G	G	O,I,IM,G	IM,G	G	G	G	G

	Er	Eu	F	Ga	Gd	Ge	H	Hf	Hg	Ho	I	In	Ir	K	La	Li
1	<0.000001	<0.000001	<0.00001	0.00029	<0.000001	0.00014	0.0002	0.01	<0.00001	<0.000001	<0.000001	<0.000001	<0.000005	0.000035	<0.000001	<0.000005
2								0.0246								
3								<0.000001								
4								<0.001								
5																
Mean																
STDV.																
Certified	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0003)	(<0.0001)	(<0.0002)	(<0.0002)	(<0.025)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
Methods	G	G	G	G	G	G	F	O,X,IM,G	G	G	G	G	G	G	G	G

	Lu	Mo	Na	Nd	Os	Pb	Pd	Pr	Pt	Rb	Re	Rh	Ru	Sb	Sc	Se
1	<0.000001	0.00029	0.00008	<0.000001	<0.000005	0.000046	<0.00001	<0.000001	<0.00001	<0.0001	<0.000001	<0.000001	<0.00001	0.00022	<0.000005	<0.0002
2		0.00041				0.001	<0.001							0.00039		<0.005
3		0.0006				0.0077								<0.001		
4		0.0029				<0.000005										
5		0.004				<0.001										
6		0.0067														
7		0.0198														
8		0.037														
9		<0.001														
10																
Mean																
STDV.																
Certified	(<0.0001)	(<0.04)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.001)	(<0.001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.001)	(<0.0001)	(<0.005)
Methods	G	O,X,IM,G	G	G	G	O,G,IM	IM,G	G	G	G	G	G	G	IM,G	G	IM,G

	Sm	Sn	Sr	Tb	Te	Th	Tl	Tm	U	V	Y	Yb	Zn	Zr
1	<0.000001	0.000044	<0.0005	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	0.000062	0.00001	<0.000001	0.000032	0.000039
2		0.00007								0.0007	<0.0005		<0.001	0.00018
3		0.003								0.0009	<0.001			0.0006
4		0.0113								0.002				0.002
5		<0.001								0.0025				0.002
6										0.004				0.0023
7										0.0046				<0.001
8										<0.001				<0.001
9														
10														
Mean		0.004								0.002				0.001
STDV.		0.005								0.002				0.001
Certified	(<0.0001)	(<0.012)	(<0.0005)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.001)	(<0.0001)	(<0.001)	(<0.003)
Methods	G	O,IM,G	G	G	G	G	G	G	G	O,X,IM,G	G,X,IM	G	IM,G	O,X,IM,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.
ATI Specialty Materials, Monroe
Anderson Laboratories, Inc.
LGC Standards
EAG Laboratories, Inc.

Uedem, Germany
Hatfield, PA
Monroe, NC
Greendale, WI
Manchester, NH
Liverpool, NY

Alcoa Howmet, Dover Alloy
Carpenter Technology Corporation
Huntington Alloys Corporation
Carpenter Technology - Athens Operations
NSL Analytical, Inc.

Dover, NJ
Reading, PA
Huntington, WV
Tanner, AL
Cleveland, OH

Certification laboratories have demonstrated performance and traceability by utilizing a variety of test methods all under the scope of ISO 17025. Some of the specific CRMs and SRMs used in the analysis of the material covered by this certificate are:

IARM 202A IARM 203A IARM 52B NIST 3101A NIST 3107 NIST 3161A NIST 73C NIST 864 NIST 865 NIST 867 NIST 868

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

