

Certificate of Analysis

IARM NiWasp-18

Nickel Waspaloy / UNS N07001

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	1.36 ± 0.02	B	0.0061 ± 0.0005	C	0.038 ± 0.003	Co	13.13 ± 0.09
Cr	19.7 ± 0.1	Cu	0.009 ± 0.001	Fe	0.69 ± 0.02	Mg	0.0018 ± 0.0006
Mn	0.022 ± 0.003	Mo	4.28 ± 0.03	N	0.0046 ± 0.0004	Nb	0.033 ± 0.004
Ni	57.8 ± 0.4	O	0.0009 ± 0.0007	P	0.0032 ± 0.0008	Si	0.028 ± 0.006
Ta	0.005 ± 0.003	Ti	3.01 ± 0.04	V	0.023 ± 0.009	W	0.030 ± 0.006
Zr	0.058 ± 0.004						

Indicative Values listed in ppm

Ag (<4)	As (<50)	Au (<1)	Ba (<1)	Be (<1)	Bi (<10)	Br (<1)
Ca (<50)	Cd (<50)	Ce (<1)	Cl (<1)	Cs (<1)	Dy (<1)	Er (<1)
Eu (<1)	F (<1)	Ga (<30)	Gd (<1)	Ge (<1)	H (<2)	Hf (<20)
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 (<20)	Pd (<10)
Pr (<1)	Pt (<1)	Rb (<5)	Re (<1)	Rh (<1)	Ru (<1)	S (4)
Sb (0.8)	Sc (<1)	Se (<50)	Sm (<1)	Sn (5)	Sr (<20)	Tb (<1)
Te (<1)	Th (<1)	Tl (<1)	Tm (<1)	U (<1)	Y (<20)	Yb (<1)
Zn (<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.

	Al	B	C	Co	Cr	Cu	Fe	Mg	Mn	Mo	N	Nb	Ni	O	P	Si
1	1.312	0.0046	0.0288	12.87	19.252	0.006	0.62	0.0011	0.016	4.230	0.00351	0.0207	57.226	0.0004	0.0013	0.0148
2	1.32	0.0051	0.0352	13.03	19.42	0.0065	0.657	0.00137	0.0194	4.233	0.00378	0.026	57.42	0.000433	0.00178	0.018
3	1.325	0.00579	0.037	13.0468	19.643	0.00766	0.67	0.0014	0.0196	4.245	0.0043	0.031567	57.48	0.0005	0.0026	0.0199
4	1.327	0.006	0.0373	13.0633	19.651	0.008	0.674	0.0015	0.02	4.254	0.0047	0.032	57.572	0.00051	0.0032	0.02
5	1.348	0.006	0.03769	13.1398	19.67	0.009	0.688	0.0018	0.02	4.26	0.0047	0.0329	57.62	0.00139	0.0032	0.025
6	1.3523	0.006	0.0397	13.17	19.7267	0.0092	0.69	0.00186	0.02	4.2685	0.004733	0.033	57.6835	0.00189	0.0035	0.026
7	1.36	0.0061	0.04	13.191	19.727	0.009267	0.692	0.002	0.0207	4.28	0.00477	0.0342	57.71667		0.0038	0.03
8	1.364	0.00637	0.04167	13.238	19.7409	0.0093	0.6924	0.0035	0.021	4.2814	0.0048	0.035	57.90		0.004	0.031
9	1.3667	0.0064	0.043	13.25	19.757	0.01	0.6938		0.022	4.2867	0.005167	0.0369	58.52	0.004367	0.00328	0.0313
10	1.38	0.00657	0.04336	13.273	19.76	0.01025	0.713		0.0228	4.29	0.0052	0.0391	58.774	0.00463	0.03147	0.0328
11	1.389	0.0073			19.8982	0.0107	0.715		0.022967	4.368		0.04			0.0328	0.0328
12	1.3979	0.00743				0.0121	0.748		0.024	4.368					0.0328	0.0328
13	1.4067						0.75		0.027						0.0503	0.0503
14									0.0363							
15																
Mean	1.36	0.0061	0.038	13.13	19.7	0.009	0.69	0.0018	0.022	4.28	0.0046	0.033	57.8	0.0009	0.0032	0.028
STDV.	0.03	0.0008	0.004	0.1	0.2	0.002	0.04	0.0008	0.005	0.04	0.0006	0.006	0.5	0.0006	0.001	0.009
Certified	1.36	0.0061	0.038	13.13	19.7	0.009	0.69	0.0018	0.022	4.28	0.0046	0.033	57.8	0.0009	0.0032	0.028
U _{CRM}	0.02	0.0005	0.003	0.09	0.1	0.001	0.02	0.0006	0.003	0.03	0.0004	0.004	0.4	0.0007	0.0008	0.006
Methods	I,X,O	I,IM,O,G	C,O	I,X,O	I,X,O	I,IM,X,O,G	I,X,O,G	I,IM,O,G	I,IM,X,O,G	I,X,O	F,C,O	I,IM,X,O,G	I,X,O,G	F,C	I,IM,O,X,G	I,X,IM,O,G

	Ta	Ti	V	W	Zr	Ag	As	Au	Ba	Be	Bi	Br	Ca	Cd	Ce	Cl
1	0.0014	2.917	0.014	0.014	0.045	0.00047	0.00024	<0.00001	<0.000005	<0.000005	0.000001	<0.000005	0.000034	<0.00002	0.000014	0.000001
2	0.0019	2.93	0.015	0.02154	0.0497	0.00031	0.00027	<0.00005	<0.00003	<0.00001	<0.000005	<0.000005	0.000043	<0.001	<0.000005	<0.000001
3	0.002	2.932	0.01757	0.0275	0.0555	<0.00005	0.000713				<0.0001	<0.000005	<0.001	<0.0010		<0.000001
4	0.00237	2.9767	0.018	0.029	0.0559		0.00278				<0.001	<0.000005	<0.005	<0.005		
5	0.0024	2.983	0.0185	0.03	0.0565		0.00474				<0.001	<0.000005	<0.005	<0.005		
6	0.006	3.02	0.0199	0.0305	0.058		<0.005									
7	0.0098	3.0249	0.022	0.0328	0.0587											
8	0.0107	3.036	0.03	0.034	0.0587											
9		3.041	0.0515	0.0357	0.059											
10		3.0413		0.042	0.059											
11		3.061			0.06											
12		3.07			0.067											
13		3.105			0.067											
14																
15																
Mean	0.005	3.01	0.023	0.03	0.058											
STDV.	0.004	0.06	0.01	0.008	0.006											
Certified	0.005	3.01	0.023	0.030	0.058	<0.0004	<0.0005	<0.0001	<0.0001	<0.0001	<0.001	<0.0001	<0.005	<0.005	<0.0001	<0.0001
U _{CRM}	0.003	0.04	0.009	0.006	0.004											
Methods	I,IM,O,X,G	I,X,O	I,IM,O,X,G	I,IM,O,X,G	I,IM,X,O,G	IM,G	I,IM,G	G	G	G	IM,G	G	I,IM,G	I,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	0.0019	<0.000001	<0.00001	0.0001	0.000413	<0.00001	<0.000001	<0.000001	<0.00001	0.000011	0.0000036
2	<0.000001	<0.000005	<0.000005	<0.000005	<0.00001	0.0021	<0.000005	<0.00005	0.000133	0.000476	<0.00005	<0.000005	<0.000001	<0.00001	0.000023	0.0000005
3										0.00053						
4										0.00058						
5										<0.001						
6										<0.005						
7																
8																
9																
10																
Mean										0.00050						
STDV.										0.00007						
Certified	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.0003	<0.0001	<0.0001	<0.0002	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
95% C.I.																
Methods	G	G	G	G	G	G	G	G	F,C	IM,I,G,X	G	G		G	G	G

	La	Li	Lu	Na	Nd	Os	Pb	Pd	Pr	Pt	Rb	Re	Rh	Ru	S	Sb
1	0.000012	<0.000005	<0.000001	0.000007	<0.000001	0.000014	0.0000023	<0.00001	<0.000001	<0.00001	<0.0001	0.000087	<0.00001	<0.00001	0.000063	0.000074
2	<0.000001	<0.000001	<0.000005	<0.000001	<0.000005	<0.00001	0.0000567	<0.00005	<0.000005	<0.00001	<0.0005	0.000088	<0.00001	<0.0001	0.000088	0.000079
3							0.00185	<0.001				0.00009			0.00026	0.0000833
4							<0.000005								0.00075	0.000098
5							<0.0001								0.001	<0.0001
6							<0.001								<0.0005	<0.001
7															<0.0005	<0.001
8															<0.001	<0.001
9															<0.001	<0.001
10															<0.001	<0.001
Mean												0.000088			0.0004	0.00008
STDV.												0.000002			0.0004	0.00001
Certified	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.0001	<0.002	<0.001	<0.0001	<0.0001	<0.0005	<0.0001	<0.0001	<0.0001	0.0004	0.00008
95% C.I.																
Methods	G	G	G	G	G	G	I,IM,G	IM,G	G	G	G	IM,I,G,X	G	G	C,I,O,G,X	I,IM,G

	Sc	Se	Sm	Sn	Sr	Tb	Te	Th	Tl	Tm	U	Y	Yb	Zn
1	<0.000005	<0.00005	<0.000001	0.000388	<0.0005	<0.000001	0.000002	<0.000001	<0.000001	<0.000001	0.0000024	<0.0005	<0.000001	0.000035
2	<0.000001	<0.00002	<0.000005	0.000423	<0.0020	<0.000005	<0.00001	<0.000001	<0.000005	<0.000005	0.0000004	<0.001	<0.000005	<0.00001
3		<0.001		0.00047								<0.0020		<0.001
4		<0.005		0.00058										<0.001
5				<0.001										<0.001
6				<0.01										
7														
8														
9														
10														
Mean				0.00050										
STDV.				0.00008										
Certified	<0.00001	<0.0005	<0.00001	0.0005	<0.002	<0.00001	<0.0001	<0.00001	<0.00001	<0.0001	<0.0001	<0.002	<0.00001	<0.001
95% C.I.														
Methods	G	I,IM,G	G	I,IM,G,X	G	G	G	G	G	G	G	IM,G	G	I,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

Connecticut Metallurgical, Inc.
Dirats Laboratories
IMR Test Labs
NSL Analytical Services, Inc.
ATI Specialty Materials, Monroe
VHG Labs

East Hartford, CT
Westfield, MA
Lansing, NY
Cleveland, OH
Monroe, NC
Manchester, NH

Massachusetts Materials Research, Inc.
EAG Laboratories, Inc.
Haynes International, Inc.
Kennametal Stellite, Inc.
Northern Analytical Laboratory, Inc.

West Boylston, MA
Liverpool, NY
Kokomo, IN
Belleville, ON
Londonderry, NH

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 349A NIST 361 NIST 362 NIST 363 NIST 364 NIST 1207-1 NIST 1207-2 NIST 1243 IARM 207A IARM 53A IARM 55B IARM 62A

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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