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ANALYTICAL LTD

ISO Certified · 9001:2015 · 17025:2017 · 17043:2010 · 17034:2016

Certificate of Analysis

IARM NiS-18

Nickel Alloy S / N06635

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	**0.388** ± 0.009	**B**	**0.0061** ± 0.0006	**C**	**0.012** ± 0.001	**Co**	**0.416** ± 0.006
Cr	**15.62** ± 0.09	**Fe**	**0.81** ± 0.02	**La**	**0.031** ± 0.006	**Mg**	**0.0021** ± 0.0003
Mn	**0.65** ± 0.01	**Mo**	**15.4** ± 0.2	**Ni**	**65.6** ± 0.3	**P**	**0.006** ± 0.001
Si	**0.49** ± 0.02	**Ti**	**0.0023** ± 0.0008	**V**	**0.0027** ± 0.0009	**W**	**0.36** ± 0.01

Indicative Values listed in ppm

H (20)	Hf (<200)	N (120)	Nb (30)	O (7)	S (<10)	Ta (20)

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	Fe	H	Hf	La	Mg	Mn	Mo	N	Nb	Ni	O
1	0.3730	0.0053	0.0097	0.3950	15.41	0.7590	0.0002	0.0022	0.0210	0.0013	0.6140	14.60	0.0114	0.0005	65.05	0.0003
2	0.3740	0.0054	0.0105	0.4000	15.47	0.7883		0.0200	0.0211	0.0019	0.6150	14.80	0.0116	0.0006	65.10	0.0008
3	0.3774	0.0058	0.0108	0.4150	15.50	0.7900			0.0335	0.0020	0.6400	15.04	0.0121	0.0006	65.58	0.0010
4	0.3800	0.0060	0.0110	0.4160	15.54	0.7980			0.0348	0.0020	0.6410	15.19	0.0130	0.0010	65.60	
5	0.3800	0.0061	0.0116	0.4160	15.55	0.8008			0.0350	0.0020	0.6460	15.27		0.0040	65.70	
6	0.3810	0.0067	0.0120	0.4169	15.57	0.8016			0.0360	0.0020	0.6493	15.37		0.0040	65.71	
7	0.3814	0.0068	0.0124	0.4170	15.61	0.8110			0.0366	0.0021	0.6500	15.45		0.0083	65.90	
8	0.3880	0.0071	0.0140	0.4190	15.63	0.8120				0.0022	0.6547	15.47		<0.005	66.07	
9	0.3930			0.4197	15.68	0.8160				0.0024	0.6553	15.50		<0.01	66.10	
10	0.4040			0.4200	15.76	0.8252				0.0029	0.6580	15.50		≤0.005		
11	0.4100			0.4200	15.81	0.8610					0.6686	15.72		≤0.005		
12	0.4100			0.4332	15.86	0.8613					0.6750	15.89		≤0.005		
13						0.8700					0.6956	15.90				
14																
15																
Mean	0.3877	0.0061	0.0115	0.4156	15.62	0.8149	0.0002	0.0111	0.0311	0.0021	0.6510	15.36	0.0120	0.0027	65.65	0.0007
STDV.	0.0135	0.0007	0.0013	0.0098	0.139	0.0323		0.0126	0.0070	0.0004	0.0221	0.386	0.0007	0.0029	0.374	0.0004
Certified	**0.388**	**0.0061**	**0.012**	**0.416**	**15.62**	**0.81**	**(0.0002)**	**(<0.02)**	**0.031**	**0.0021**	**0.65**	**15.4**	**(0.012)**	**(0.003)**	**65.6**	**0.0**
U_{CRM}	0.009	0.0006	0.001	0.006	0.09	0.02			0.006	0.0003	0.01	0.2		0.004	0.3	
Methods	I,IM,X,O	I,IM	C,O	I,X,O	I,X,O	I,X,O	F	I,X	I,IM	I,IM,X	I,X,O	I,X,O	F	I,IM,X,O	I,X,O	F

	P	S	Si	Ta	Ti	V	W
1	0.0034	0.0001	0.4570	0.0002	0.0013	0.0015	0.3293
2	0.0050	<0.0005	0.4590	0.0019	0.0013	0.0015	0.3300
3	0.0056	<0.0005	0.4599	0.0022	0.0014	0.0019	0.3404
4	0.0059	<0.001	0.4600	0.0025	0.0019	0.0029	0.3450
5	0.0060	<0.001	0.4780	<0.00005	0.0020	0.0030	0.3480
6	0.0060	≤0.005	0.4875	<0.0001	0.0020	0.0031	0.3530
7	0.0060	≤0.005	0.4900	<0.0005	0.0022	0.0036	0.3545
8	0.0061		0.4990	<0.005	0.0027	0.0044	0.3582
9	0.0067		0.5020	≤0.005	0.0031	≤0.002	0.3801
10	0.0068		0.5080		0.0050	≤0.002	0.3850
11	0.0068		0.5159		<0.001	≤0.005	0.3860
12	0.0093		0.5209		≤0.005		0.3900
13	0.0106		0.5300				0.4010
14							
15							
Mean	0.0065	0.0001	0.4898	0.0017	0.0023	0.0027	0.3616
STDV.	0.0018		0.0255	0.0010	0.0011	0.0010	0.0240
Certified	**0.006**	**(<0.001)**	**0.49**	**(0.002)**	**0.0023**	**0.0027**	**0.36**
U_{CRM}	0.001		0.02		0.0008	0.0009	0.01
Methods	IM,I,X,O	C,O	I,W,X,O	I,IM,X	I,IM,X,O	IM,I,X,O	I,X,O

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

Sheffield Analytical Services	Sheffield, UK	Laboratory Testing, Inc.	Hatfield, PA
Massachusetts Materials Research	West Boylston, MA	Connecticut Metallurgical, Inc.	East Hartford, CT
Dirats Laboratories	Westfield, MA	IMR Test Labs	Lansing, NY
NSL Analytical Services	Cleveland, OH	LGC Standards	Manchester, NH
Scrooby's Laboratory Service	Rynfield, South Africa	EAG Laboratories	Liverpool, NY

Much of the analytical work performed to assess this material has been carried out by laboratories with proven competence, as indicated by their accreditation to ISO 17025. It is an implicit requirement for this accreditation that analytical work should be performed with due traceability, via an unbroken chain of comparisons, each with stated uncertainty, to primary standards such as the mole, or to nationally- or internationally-recognised reference materials. Of the individual results herein, some have traceability (to the mole) via primary analytical methods. Some are traceable to substances of known stoichiometry. Most have traceability via commercial solutions. Furthermore, some results have additional traceability to NIST standards, as part of the analytical calibration or process control.

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 calculated 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.

Kimberly Halkiotis, Global Product Manager

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ACCREDITED

ISO 17034 Accredited: Reference Materials Producer, Certificate # 2848.02

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