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ANALYTICAL LTD

Certified Reference Material | Certificate of Analysis

ISO 17034:2016 **ISO/IEC 17025:2017** **ISO 9001:2015**

Product ID: IARM-Ni686-20

Product Description: Nickel Alloy, Alloy 686 / N06686

Revision No.: 000
Revision Date: 03/09/2022

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

Certified Values listed in wt.% with associated uncertainties

Al	0.34 ± 0.02	C	0.0087 ± 0.0009	Co	0.017 ± 0.003	Cr	20.4 ± 0.1
Cu	0.039 ± 0.005	Fe	0.44 ± 0.01	Mg	0.009 ± 0.002	Mn	0.270 ± 0.008
Mo	16.1 ± 0.2	N	0.0097 ± 0.0007	Nb	0.13 ± 0.01	Ni	58.6 ± 0.3
O	0.0006 ± 0.0002	P	0.003 ± 0.001	S	0.0005 ± 0.0002	Si	0.037 ± 0.007
Ti	0.058 ± 0.003	V	0.009 ± 0.001	W	3.59 ± 0.06	Zr	0.0013 ± 0.0006

Indicative Values listed in ppm

Ag (<10)	As (10)	B (20)	Bi (<20)	Ca (20)	Cd (<30)	Hf (<100)
La (7)	Nd (<10)	Pb (<10)	Re (<3)	Sb (<20)	Sn (6)	Ta (100)
Y (<10)	Zn (<100)					

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.

$$1. \; N_{MIN} = \max\left(10, \sqrt[3]{N_{PROD}}\right) \qquad\qquad 2. \; U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$$

Certification Laboratories: 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.

- LGC Standards - Manchester, NH
- Connecticut Metallurgical, Inc. - East Hartford, CT
- Dirats Laboratories - Westfield, MA
- IMR Test Labs - Lansing, NY
- Applied Technical Services - Marietta, GA
- TEC Eurolab - Campogalliano MO, Italy

- Laboratory Testing, Inc. - Hatfield, PA
- Instytut Metalurgii Żelaza - Gliwice, Poland
- NSL Analytical Services - Cleveland, OH
- SGS MSi - Melrose Park, IL
- EAG Laboratories - Liverpool, NY

- Lucid Laboratories - Telangana, India
- New Hampshire Materials Laboratory - Somersworth, NH
- Scrooby's Laboratory Service - Benoni, South Africa
- Sheffield Analytical Services - Sheffield, UK
- TCR Engineering Services - Maharashtra, India

Instructions for Use: 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. 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. The material should be stored in a cool, dry location when not in use.

Chips are not recommended for gas analysis.

Period of Validity: 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

March 9, 2022
Certification Date

Conditions of Sale and Supply: All CRMs & RMs sold are subject to applicable LGC Standard Terms and Conditions of Sale.

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

	Ag	Al	As	B	Bi	C	Ca	Cd	Co	Cr	Cu	Fe	Hf
1	0.0010	0.2600	0.0002	0.0001	0.0010	0.0073	0.0002	0.0030	0.0060	19.958	0.0240	0.3980	0.0012
2	0.0013	0.2920	0.0003	0.0006	<0.00005	0.0074	0.0002	0.0035	0.0062	20.105	0.0267	0.4000	0.0032
3	<0.00005	0.2963	0.0013	0.0020	<0.0001	0.0076	0.0007	<0.0001	0.0105	20.120	0.0300	0.4060	0.0110
4	<0.0002	0.3140	0.0017	0.0020	<0.0005	0.0077	0.0010	<0.0002	0.0132	20.130	0.0314	0.4174	<0.00005
5	<0.0005	0.3200	0.0020	0.0028	<0.001	0.0080	0.0020	<0.0005	0.0141	20.150	0.0320	0.4180	<0.0001
6	<0.001	0.3233	0.0027	0.0033	<0.0010	0.0080	0.0080	<0.001	0.0151	20.160	0.0328	0.4240	<0.0005
7	<0.0010	0.3237	<0.0005	<0.0005	<0.002	0.0082	<0.0005	<0.001	0.0151	20.176	0.0333	0.4296	<0.001
8	<0.002	0.3240	<0.0010	<0.001	<0.002	0.0083	<0.001	<0.0010	0.0160	20.242	0.0340	0.4300	<0.0010
9	<0.002	0.3310	<0.002	<0.0010	<0.002	0.0085	<0.002	<0.0010	0.0160	20.300	0.0341	0.4300	<0.0010
10	<0.005	0.3410	<0.002	<0.0010	<0.0020	0.0086	<0.002	<0.002	0.0163	20.300	0.0344	0.4320	<0.005
11		0.3439	<0.005	<0.002		0.0088	<0.005	<0.002	0.0177	20.338	0.0381	0.4322	
12		0.3520	<0.0050	<0.002		0.0105	<0.0050	<0.010	0.0180	20.400	0.0400	0.4400	
13		0.3524		<0.005		0.0111			0.0183	20.440	0.0451	0.4463	
14		0.3610				0.0122			0.0201	20.517	0.0469	0.4490	
15		0.3630				<0.005			0.0210	20.579	0.0491	0.4500	
16		0.3700				<0.005			0.0213	20.610	0.0500	0.4700	
17		0.3780							0.0218	20.690	0.0580	0.4800	
18		0.3880							0.0254	20.700	0.0582	0.4803	
19									0.0280	20.900		0.4880	
20									<0.01	20.940		0.4910	
21										21.100			
Mean	0.0012	0.3352	0.0014	0.0018	0.0010	0.0087	0.0020	0.0033	0.0168	20.422	0.0388	0.4406	0.0051
STDV	0.0002	0.0326	0.0010	0.0012		0.0015	0.0030	0.0004	0.0056	0.3114	0.0102	0.0285	0.0052
Certified	**(<0.001)**	**0.34**	**(0.001)**	**(0.002)**	**(<0.002)**	**0.0087**	**(0.002)**	**(<0.003)**	**0.017**	**20.4**	**0.039**	**0.44**	**(<0.01)**
U$_{CRM}$		0.02				0.0009			0.003	0.1	0.005	0.01	
Methods	IM,I,X,A	I,O,X,G,IM	IM,I,X	I,IM,O	IM,I,X	C,O,X,I,G	I,IM,X,A	I,IM,X,O,A	I,IM,O,X,A	I,O,X,W,G	I,IM,O,X,A	I,O,X,G,IM,A	IM,I,X

	La	Mg	Mn	Mo	N	Nb	Nd	Ni	O	P	Pb	Re	S
1	0.0005	0.0021	0.2322	15.585	0.0081	0.0940	0.0003	57.900	0.0003	0.0006	0.0001	0.0001	0.0002
2	0.0006	0.0057	0.2450	15.724	0.0086	0.0970	0.0011	58.380	0.0004	0.0006	0.0001	0.0002	0.0002
3	0.0008	0.0068	0.2482	15.840	0.0089	0.1117	<0.0005	58.400	0.0005	0.0020	0.0025	0.0005	0.0003
4	0.0010	0.0070	0.2500	15.976	0.0090	0.1120	<0.001	58.528	0.0007	0.0030	<0.0001	<0.0005	0.0004
5	<0.0001	0.0072	0.2600	15.990	0.0095	0.1150	<0.002	58.630	0.0007	0.0034	<0.0005	<0.001	0.0004
6	<0.0002	0.0074	0.2629	16.030	0.0102	0.1200	<0.005	58.660	0.0008	0.0038	<0.001	<0.0010	0.0005
7	<0.0005	0.0076	0.2630	16.040	0.0103	0.1240	<0.010	58.771	0.0010	0.0039	<0.0010	<0.003	0.0005
8	<0.0005	0.0078	0.2650	16.120	0.0105	0.1270		59.346	<0.0001	0.0039	<0.0010	<0.005	0.0009
9	<0.001	0.0083	0.2694	16.135	0.0110	0.1270			<0.0010	0.0042	<0.002		0.0010
10	<0.001	0.0100	0.2700	16.200	0.0110	0.1274				0.0047	<0.002		0.0010
11	<0.0010	0.0100	0.2720	16.260		0.1280				0.0055	<0.002		<0.0003
12	<0.005	0.0114	0.2730	16.270		0.1300				0.0057	<0.005		<0.0005
13		0.0142	0.2750	16.433		0.1309				<0.0010			<0.0005
14		0.0180	0.2762	16.540		0.1322				<0.005			<0.001
15		<0.01	0.2763	16.704		0.1450				<0.005			<0.001
16			0.2800			0.1540				<0.005			<0.0010
17			0.2850			0.1590				<0.0050			<0.0010
18			0.2900			0.1600				<0.01			<0.002
19			0.3000			0.1600							<0.002
20			0.3070			0.1620							<0.002
21						0.1621							
Mean	0.0007	0.0088	0.2700	16.123	0.0097	0.1323	0.0007	58.577	0.0006	0.0034	0.0009	0.0003	0.0005
STDV	0.0002	0.0038	0.0182	0.2974	0.0010	0.0210	0.0006	0.4088	0.0002	0.0017	0.0014	0.0002	0.0003
Certified	**(0.0007)**	**0.009**	**0.270**	**16.1**	**0.0097**	**0.13**	**(<0.001)**	**58.6**	**0.0006**	**0.003**	**(<0.001)**	**(<0.0003)**	**0.0005**
U$_{CRM}$		0.002	0.008	0.2	0.0007	0.01		0.3	0.0002	0.001			0.0002
Methods	I,IM,F	I,IM,O,G	I,O,X,IM,G,A	I,O,X	F,C,O,I	I,O,X,G,IM	I,IM	I,X,O	C,F,O,I	I,IM,O,X	IM,I,X,A	I,IM	C

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

	Sb	Si	Sn	Ta	Ti	V	W	Y	Zn	Zr
1	0.0002	0.0167	0.0001	0.0002	0.0500	0.0050	3.3710	<0.0001	<0.0010	0.0004
2	0.0020	0.0175	0.0001	0.0005	0.0520	0.0060	3.3800	<0.0002	<0.01	0.0006
3	<0.00005	0.0200	0.0008	0.0010	0.0540	0.0060	3.3900	<0.0005		0.0006
4	<0.0005	0.0262	0.0010	0.0042	0.0567	0.0063	3.4000	<0.0005		0.0008
5	<0.001	0.0300	0.0010	0.0054	0.0569	0.0077	3.4029	<0.001		0.0008
6	<0.0010	0.0302	<0.0002	0.0056	0.0570	0.0089	3.4510	<0.0010		0.0010
7	<0.002	0.0310	<0.0006	0.0112	0.0580	0.0090	3.5044	<0.0010		0.0014
8	<0.002	0.0336	<0.001	0.0367	0.0581	0.0095	3.5600			0.0020
9	<0.002	0.0338	<0.0010	<0.00005	0.0590	0.0100	3.5900			0.0021
10	<0.002	0.0358	<0.0010	<0.0010	0.0592	0.0101	3.5970			0.0029
11		0.0393	<0.002	<0.0010	0.0597	0.0104	3.6000			<0.001
12		0.0400	<0.002	<0.002	0.0602	0.0109	3.6000			<0.0010
13		0.0420	<0.002	<0.002	0.0604	0.0112	3.6500			<0.005
14		0.0534	<0.005	<0.002	0.0642	0.0113	3.6530			<0.005
15		0.0546		<0.005	0.0696	0.0120	3.7080			<0.005
16		0.0600		<0.005		0.0120	3.7125			<0.01
17		0.0600				<0.0020	3.7233			
18						<0.01	3.7300			
19							3.7430			
20							3.7720			
21							3.7870			
Mean	0.0011	0.0367	0.0006	0.0081	0.0583	0.0091	3.5869			0.0013
STDV	0.0013	0.0138	0.0005	0.0121	0.0047	0.0023	0.1414			0.0008
Certified	**(<0.002)**	**0.037**	**(0.0006)**	**(0.01)**	**0.058**	**0.009**	**3.59**	**(<0.001)**	**(<0.01)**	**0.0013**
U_{CRM}		0.007			0.003	0.001	0.06			0.0006
Methods	IM,I,O,X,A	I,IM,O,X,G	IM,I,O,X	I,IM,X	I,IM,O,X	IM,I,X,O	I,IM,O,X,G	IM,I	I	I,IM,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