

Certified Reference Material

Certificate of Analysis

Product ID: IARM-NiR405-20

ISO
17034:2016

ISO/IEC
17025:2017

ISO
9001:2015

Product Description: Nickel Alloy, Alloy R405 / N04405

Revision No.: 000
Revision Date: 03/22/2022

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	0.043	± 0.002	As	0.0005	± 0.0002	C	0.117	± 0.003	Co	0.040	± 0.001
Cr	0.499	± 0.008	Cu	31.2	± 0.3	Fe	1.71	± 0.03	La	0.006	± 0.002
Mg	0.018	± 0.003	Mn	0.96	± 0.02	Mo	0.102	± 0.003	N	0.0007	± 0.0002
Nb	0.103	± 0.004	Ni	64.8	± 0.3	O	0.0008	± 0.0004	P	0.011	± 0.001
Pb	0.0010	± 0.0003	S	0.040	± 0.002	Si	0.161	± 0.005	Ti	0.0086	± 0.0007
W	0.005	± 0.002	Zr	0.006	± 0.001						

Indicative Values listed in ppm

Ag (4)	B (6)	Bi (<50)	Ca (20)	Cd (<20)	Hf (<100)	Sb (2)
Sn (6)	Ta (4)	V (20)				

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.

$$1. N_{MIN} = \max(10, \sqrt[3]{N_{PROD}})$$

$$2. U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$$

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-recognized 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
- 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
- TEC Eurolab - Campogalliano MO, Italy
- Raghavendra Spectro Metallurgical Laboratory - Bengaluru, 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 Halkotis, Global Product Manager

March 22, 2022
Certification Date



ISO 17034 Accredited: Reference Materials
Producer, Certificate # 2848.02
ISO/IEC 17025 Accredited: Chemical
Testing, Certificate # 2848.01

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	0.0002	0.0343	0.0003	0.0001	0.0010	0.1050	0.0001	0.0001	0.0348	0.4700	29.437	1.5960	0.0050
2	0.0002	0.0380	0.0003	0.0004	<0.0001	0.1100	0.0010	0.0002	0.0350	0.4770	30.140	1.6300	0.0168
3	0.0003	0.0389	0.0004	0.0006	<0.0001	0.1108	0.0018	0.0010	0.0372	0.4800	30.310	1.6400	<0.0001
4	0.0003	0.0400	0.0004	0.0007	<0.0010	0.1120	0.0050	<0.0001	0.0383	0.4800	30.430	1.6440	<0.0001
5	0.0008	0.0402	0.0005	0.0010	<0.0010	0.1140	<0.0001	<0.0005	0.0386	0.4840	30.680	1.6469	<0.0005
6	<0.0005	0.0410	0.0006	<0.0001	<0.0010	0.1150	<0.0005	<0.0005	0.0390	0.4875	31.120	1.6500	<0.0010
7	<0.0010	0.0414	0.0010	<0.0002	<0.002	0.1160	<0.0005	<0.001	0.0390	0.4893	31.130	1.6502	<0.0010
8	<0.0010	0.0420	<0.0005	<0.0005	<0.002	0.1160	<0.0010	<0.0010	0.0395	0.4900	31.217	1.6600	<0.002
9	<0.0010	0.0431	<0.0010	<0.001	<0.002	0.1160	<0.002	<0.0010	0.0395	0.4904	31.230	1.6690	<0.005
10	<0.002	0.0436	<0.002	<0.0010	<0.005	0.1170	<0.002	<0.002	0.0397	0.4935	31.289	1.6747	
11	<0.002	0.0440	<0.002	<0.0010		0.1172	<0.005	<0.002	0.0398	0.4950	31.300	1.6810	
12		0.0440	<0.005	<0.0010		0.1180	<0.0050		0.0400	0.4980	31.316	1.6900	
13		0.0456	<0.0050	<0.002		0.1200			0.0400	0.5000	31.325	1.6910	
14		0.0458		<0.002		0.1200			0.0406	0.5012	31.340	1.6930	
15		0.0476		<0.005		0.1203			0.0406	0.5027	31.361	1.6950	
16		0.0482				0.1212			0.0421	0.5037	31.400	1.7058	
17		0.0496				0.1250			0.0430	0.5070	31.670	1.7130	
18						0.1257			0.0437	0.5100	31.736	1.7140	
19									0.0440	0.5222	31.830	1.7200	
20									0.0450	0.5270	31.950	1.7321	
21									<0.01	0.5280	32.188	1.7920	
22										0.5415	32.508	1.8400	
23												1.8550	
24												1.9590	
Mean	0.0004	0.0428	0.0005	0.0006	0.0010	0.1166	0.0020	0.0004	0.0400	0.4990	31.223	1.7059	0.0109
STDV	0.0003	0.0040	0.0002	0.0003		0.0052	0.0021	0.0005	0.0027	0.0181	0.6961	0.0819	0.0083
Certified	(0.0004)	0.043	0.0005	(0.0006)	(<0.005)	0.117	(0.002)	(<0.002)	0.040	0.499	31.2	1.71	(<0.01)
U _{CRM}		0.002	0.0002			0.003			0.001	0.008	0.3	0.03	
Methods	IM,I,X,A	I,X,IM,O	IM,I,X	I,O,IM	I,IM,X	C,O,G	I,IM,X,A	I,IM,X,A	I,X,G,IM,O	I,X,IM,O	I,X,O	I,X,O,G,A	I,IM

	La	Mg	Mn	Mo	N	Nb	Ni	O	P	Pb	S	Sb	Si
1	0.0010	0.0112	0.8340	0.0885	0.0002	0.0860	63.739	0.0004	0.0061	0.0005	0.0332	0.00004	0.1480
2	0.0034	0.0112	0.8680	0.0924	0.0004	0.0872	63.950	0.0004	0.0070	0.0010	0.0360	0.0001	0.1500
3	0.0057	0.0146	0.8900	0.0970	0.0006	0.0890	64.203	0.0006	0.0080	0.0011	0.0360	0.0001	0.1507
4	0.0066	0.0157	0.8910	0.1000	0.0007	0.0950	64.300	0.0006	0.0080	0.0011	0.0372	0.0001	0.1510
5	0.0069	0.0160	0.9441	0.1000	0.0007	0.0956	64.344	0.0012	0.0080	0.0011	0.0383	0.0008	0.1520
6	0.0069	0.0165	0.9620	0.1001	0.0008	0.1000	64.350	0.0012	0.0089	0.0013	0.0393	<0.0005	0.1527
7	0.0078	0.0170	0.9628	0.1004	0.0008	0.1010	64.380	0.0015	0.0090	<0.0005	0.0395	<0.0010	0.1560
8	0.0100	0.0193	0.9641	0.1006	0.0010	0.1020	64.590	<0.001	0.0092	<0.0010	0.0397	<0.0010	0.1564
9	<0.0010	0.0197	0.9660	0.1020	0.0010	0.1030	64.710	<0.0010	0.0095	<0.0010	0.0400	<0.002	0.1570
10	<0.005	0.0200	0.9670	0.1020	0.0012	0.1060	64.797		0.0100	<0.0010	0.0405	<0.002	0.1580
11		0.0212	0.9700	0.1029	<0.001	0.1063	64.953		0.0103	<0.002	0.0405	<0.002	0.1600
12		0.0250	0.9700	0.1037	<0.0010	0.1085	65.307		0.0113	<0.002	0.0410	<0.002	0.1613
13		0.0283	0.9707	0.1040		0.1087	65.340		0.0113	<0.002	0.0418		0.1620
14		<0.001	0.9713	0.1040		0.1100	65.397		0.0116	<0.002	0.0460		0.1620
15		<0.0010	0.9758	0.1044		0.1100	65.500		0.0120	<0.005	0.0487		0.1629
16		<0.002	0.9800	0.1050		0.1120	65.600		0.0125				0.1662
17		<0.002	0.9820	0.1079		0.1123	65.900		0.0128				0.1667
18		<0.002	0.9825	0.1081		0.1150			0.0140				0.1730
19		<0.01	0.9840	0.1100					0.0140				0.1771
20			0.9936						0.0144				0.1790
21			1.0000						0.0160				0.1810
22			1.0160						0.0182				
23			1.0320						<0.01				
24									<0.01				
Mean	0.0060	0.0181	0.9599	0.1017	0.0007	0.1026	64.786	0.0008	0.0110	0.0010	0.0398	0.0002	0.1611
STDV	0.0027	0.0049	0.0467	0.0051	0.0003	0.0089	0.6304	0.0004	0.0031	0.0003	0.0038	0.0003	0.0098
Certified	0.006	0.018	0.96	0.102	0.0007	0.103	64.8	0.0008	0.011	0.0010	0.040	(0.0002)	0.161
U _{CRM}	0.002	0.003	0.02	0.003	0.0002	0.004	0.3	0.0004	0.001	0.0003	0.002		0.005
Methods	IM,I	I,O,G,IM,X	I,X,O	I,X,IM,O	F	I,X,IM,G,O	I,X,O,W	F	I,X,O,G,IM,W	IM,I,O,X,A	C,I,O	IM,I,O,X,A	I,X,O,G,IM,W

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

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

	Sn	Ta	Ti	V	W	Zr
1	0.0001	0.0001	0.0060	0.0003	0.0026	0.0030
2	0.0002	0.0002	0.0060	0.0009	0.0030	0.0043
3	0.0002	0.0002	0.0060	0.0010	0.0038	0.0044
4	0.0006	0.0010	0.0079	0.0010	0.0049	0.0047
5	0.0018	<0.0001	0.0081	0.0010	0.0055	0.0050
6	<0.0001	<0.0005	0.0083	0.0012	0.0055	0.0054
7	<0.0002	<0.001	0.0083	0.0015	0.0065	0.0058
8	<0.0006	<0.0010	0.0088	0.0030	0.0067	0.0059
9	<0.0010	<0.0010	0.0089	0.0030	0.0072	0.0059
10	<0.0010	<0.0010	0.0089	0.0035	0.0079	0.0060
11	<0.0010	<0.002	0.0090	<0.0005	<0.005	0.0061
12	<0.002	<0.002	0.0090	<0.0010	<0.01	0.0063
13	<0.002	<0.005	0.0090	<0.0010	<0.01	0.0064
14	<0.002		0.0100	<0.002	<0.01	0.0070
15	<0.005		0.0100	<0.002		0.0080
16			0.0100	<0.002		0.0080
17			0.0100	<0.005		<0.01
18			0.0110	<0.01		
19			<0.01			
20						
21						
22						
23						
24						
Mean	0.0006	0.0004	0.0086	0.0016	0.0054	0.0058
STDV	0.0007	0.0004	0.0014	0.0011	0.0018	0.0013
Certified	(0.0006)	(0.0004)	0.0086	(0.002)	0.005	0.006
U _{CRM}			0.0007		0.002	0.001
Methods	IM,I,X,O	I,IM,X	I,X,G,IM,O	IM,I,G,O,X	I,IM,G	I,IM,O,X

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