276 Abby Road, Manchester, NH 03103 USA
Tel: +1 603 622 7660
Email: lgcusa@lgcgroup.com | Online: lgcstandards.com

Certified Reference Material — Certificate of Analysis

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

Product ID: IARM-NIB2-23

Revision No.: 000
Revision Date: 04/17/2023

Product Description: Nickel Hastelloy B-2 / UNS N10665

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	**0.13**	±0.02	**Cr**	**0.579**	±0.009	**Mo**	**27.1**	±0.2	**Ti**	**0.021**	±0.001
B	**0.0018**	±0.0002	**Fe**	**1.36**	±0.02	**N**	**0.0007**	±0.0002	**W**	**0.0042**	±0.0007
C	**0.0030**	±0.0003	**Mg**	**0.0012**	±0.0004	**Ni**	**70.2**	±0.2			
Co	**0.116**	±0.006	**Mn**	**0.504**	±0.009	**S**	**0.0007**	±0.0004			

Indicative Values listed in ppm

Cu	38	H	2	Nb	14	O	13	P	36	Si	667	Sn	9	Ta	25	V	50	Zr	15		

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.

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

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.

- Anderson Laboratories, Inc. - Greendale, WI
- Applied Technical Services - Marietta, GA
- Dirats Laboratories - Westfield, MA
- EAG Laboratories - Liverpool, NY
- Elemental Analysis Inc. - Lexington, KY
- IMR Test Labs - Lansing, NY
- Laboratory Testing, Inc. - Hatfield, PA
- LGC Standards - Manchester, NH
- New Hampshire Materials Laboratory Inc - Somersworth, NH
- NSL Analytical Services - Cleveland, OH
- Scrooby's Laboratory Service Pty Ltd - Benoni, South Africa
- SGS MSi - Melrose Park, IL
- Sheffield Assay Office - Sheffield, England
- TEC Eurolab - Campogalliano, Italy

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.

Chuck Goudreau, Certifying Officer

April 17, 2023
Certification Date

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

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	H	Mg	Mn	Mo	N	Nb
1	0.0750	0.0014	0.0020	0.0960	0.5460	0.0026	1.2700	0.0002	0.0005	0.4600	26.4400	0.0003	0.0003
2	0.0812	0.0015	0.0024	0.1093	0.5640	0.0028	1.3060		0.0010	0.4810	26.5440	0.0004	0.0005
3	0.0905	0.0016	0.0025	0.1101	0.5650	0.0031	1.3170		0.0012	0.4870	26.8780	0.0006	0.0014
4	0.0958	0.0016	0.0026	0.1140	0.5654	0.0032	1.3210		0.0012	0.4899	26.9000	0.0006	0.0020
5	0.1210	0.0017	0.0029	0.1170	0.5667	0.0033	1.3260		0.0013	0.4900	26.9067	0.0007	0.0030
6	0.1240	0.0018	0.0029	0.1180	0.5670	0.0034	1.3290		0.0015	0.4900	26.9520	0.0008	<0.0005
7	0.1300	0.0020	0.0029	0.1187	0.5700	0.0035	1.3626		0.0019	0.4900	26.9890	0.0008	<0.0020
8	0.1300	0.0020	0.0030	0.1197	0.5710	0.0035	1.3660		<0.0005	0.4919	27.1400	0.0008	<0.005
9	0.1540	0.0020	0.0031	0.1230	0.5726	0.0050	1.3730		<0.005	0.5030	27.1600	0.0010	<0.005
10	0.1543	0.0021	0.0032	0.1240	0.5780	0.0050	1.3810		<0.005	0.5030	27.1920	0.0012	<0.01
11	0.1569	0.0022	0.0033	0.1243	0.5800	0.0051	1.3831		<0.005	0.5040	27.2200	<0.0010	
12	0.1587	<0.005	0.0035		0.5838	0.0053	1.3860		<0.005	0.5070	27.2800		
13	0.1600	<0.005	0.0043		0.5842	<0.005	1.3870		<0.01	0.5127	27.3300		
14	0.1630	<0.01			0.5900	<0.01	1.3980		<0.01	0.5129	27.4000		
15	0.1740	<0.01			0.5934		1.4037			0.5150	27.4830		
16					0.5960		1.4510			0.5150	27.5000		
17					0.5990					0.5179	27.5112		
18					0.6290					0.5240			
19										0.5300			
20										0.5460			
Mean	0.1312	0.0018	0.0030	0.1158	0.5789	0.0038	1.3600	0.0002	0.0012	0.5035	27.1074	0.0007	0.0014
STDV	0.0326	0.0003	0.0006	0.0083	0.0184	0.0010	0.0453		0.0004	0.0194	0.3146	0.0003	0.0011
Certified	0.13	0.0018	0.0030	0.116	0.579	(0.0038)	1.36	(0.0002)	0.0012	0.504	27.1	0.0007	(0.0014)
U_{CRM}	0.02	0.0002	0.0003	0.006	0.009		0.02		0.0004	0.009	0.2	0.0002	
Methods	IM,I,G,O,X	IM,I,O	C,G	IM,I,O,X	I,O,X	IM,I,O	I,G,O,X	F	IM,I,O,X	I,G,O,X	I,O,X	F	IM,O,I

	Ni	O	P	S	Si	Sn	Ta	Ti	V	W	Zr
1	69.5200	0.0006	0.0005	0.0002	0.0062	0.0003	0.0001	0.0170	0.0002	0.0031	0.0002
2	69.6500	0.0010	0.0011	0.0003	0.0094	0.0004	0.0018	0.0190	0.0002	0.0034	0.0002
3	69.8500	0.0023	0.0030	0.0005	0.0130	0.0006	0.0021	0.0190	0.0002	0.0035	0.0003
4	69.8730		0.0036	0.0006	0.0144	0.0022	0.0031	0.0197	0.0008	0.0037	0.0003
5	69.9320		0.0047	0.0010	0.0175	<0.00005	0.0052	0.0199	0.0021	0.0038	0.0005
6	69.9773		0.0049	0.0011	0.0190	<0.0001	<0.0005	0.0200	0.0047	0.0046	0.0012
7	70.0060		0.0052	0.0011	0.0232	<0.0010	<0.0010	0.0201	0.0066	0.0050	0.0035
8	70.3000		0.0060	<0.0002	0.0948	<0.002	<0.002	0.0203	0.0083	0.0053	0.0035
9	70.3100		<0.0050	<0.001	0.0981	<0.002	<0.002	0.0204	0.0106	0.0055	0.0042
10	70.3400		<0.0050	<0.001	0.1000	<0.002	<0.002	0.0210	0.0163	<0.0005	<.005
11	70.4000		<0.01	<0.001	0.1000	<0.005	<0.005	0.0210	<0.005	<0.005	<.005
12	70.4033			<0.0010	0.1012	<0.005	<0.005	0.0218	<0.005	<0.01	<.005
13	70.4100				0.1100	<0.01	<0.01	0.0218	<0.01	<0.01	<0.0005
14	70.6000				0.1284	<0.01	<0.01	0.0226	<0.01		<0.005
15	70.7700				0.1660			0.0240	<0.01		<0.005
16					<0.01			0.0250			
17					<0.01			<0.01			
18					<0.05			<0.01			
19											
20											
Mean	70.1561	0.0013	0.0036	0.0007	0.0667	0.0009	0.0025	0.0208	0.0050	0.0042	0.0015
STDV	0.3562	0.0009	0.0020	0.0004	0.0534	0.0009	0.0019	0.0020	0.0054	0.0009	0.0017
Certified	70.2	(0.0013)	(0.0036)	0.0007	(0.0667)	(0.0009)	(0.0025)	0.021	(0.0050)	0.0042	(0.0015)
U_{CRM}	0.2			0.0004				0.001		0.0007	
Methods	I,G,O,X	F	O,I,IM,X	C,G	IM,I,O,X	I,IM,O,X	I,IM,O,X	IM,I,X,O	IM,I,X	IM,I	IM,I,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