

Certified Reference Material

Certificate of Analysis

Product ID: IARM-FE904L-22

ISO
17034:2016

ISO/IEC
17025:2017

ISO
9001:2015

Product Description: Nickel Chromium, Alloy 904L/N08904

Revision No.: 000
Revision Date: 03/7/2023

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	0.036 ±0.004	Cr	19.3 ±0.1	N	0.045 ±0.001	Sb	0.0018 ± 0.0008
As	0.0044 ±0.0009	Cu	1.30 ±0.02	Nb	0.017 ±0.001	Si	0.654 ± 0.009
B	0.0005 ±0.0004	Fe	49.0 ±0.2	Ni	24.0 ±0.1	Sn	0.0051 ± 0.0008
C	0.0133 ±0.0009	Mg	0.0009 ±0.0002	O	0.0018 ±0.0005	Ti	0.0020 ± 0.0006
Ca	0.0041 ±0.0003	Mn	1.14 ±0.01	P	0.020 ±0.001	V	0.064 ± 0.005
Co	0.126 ±0.006	Mo	4.03 ±0.04	S	0.0007 ±0.0003	W	0.024 ± 0.002

Indicative Values listed in ppm

Pb 4 Ta 31 Zr 24

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.

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

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
- Dirats Laboratories - Westfield, MA
- Eurofins EAG Laboratory - Liverpool, NY
- 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

Chuck Goudreau, Certifying Officer

March 7, 2023
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.

	Al	As	B	C	Ca	Co	Cr	Cu	Fe	Mg	Mn	Mo	N	Nb
1	0.0235	0.0031	0.0002	0.0101	0.0038	0.0960	19.00	1.1760	48.26	0.0007	1.0710	3.9360	0.0418	0.0100
2	0.0240	0.0035	0.0002	0.0111	0.0038	0.1110	19.04	1.2653	48.61	0.0008	1.1020	3.9420	0.0431	0.0128
3	0.0280	0.0036	0.0002	0.0121	0.0039	0.1112	19.13	1.2775	48.70	0.0008	1.1100	3.9580	0.0431	0.0148
4	0.0283	0.0039	0.0003	0.0124	0.0039	0.1120	19.17	1.2800	48.96	0.0009	1.1130	3.9600	0.0435	0.0150
5	0.0288	0.0039	0.0004	0.0130	0.0040	0.1200	19.18	1.2900	49.00	0.0010	1.1180	3.9620	0.0441	0.0151
6	0.0291	0.0043	0.0006	0.0132	0.0043	0.1200	19.20	1.2900	49.07	0.0011	1.1200	3.9672	0.0442	0.0152
7	0.0297	0.0050	0.0011	0.0137	0.0045	0.1243	19.22	1.2930	49.11	<0.0005	1.1207	3.9710	0.0445	0.0160
8	0.0313	0.0060	0.0012	0.0139	0.0047	0.1265	19.27	1.3020	49.17	<0.001	1.1230	3.9764	0.0449	0.0171
9	0.0319	0.0067	<0.0005	0.0140	<0.005	0.1290	19.29	1.3090	49.20	<0.005	1.1259	4.0170	0.0453	0.0174
10	0.0362	<0.005	<0.005	0.0143	<0.005	0.1300	19.33	1.3110	49.28	<0.005	1.1414	4.0200	0.0470	0.0174
11	0.0383	<0.01	<0.005	0.0146	<0.005	0.1300	19.35	1.3140	49.45	<0.005	1.1423	4.0250	0.0491	0.0179
12	0.0410	<0.01	<0.01	0.0150	<0.005	0.1303	19.35	1.3210	49.66	<0.01	1.1500	4.0250		0.0180
13	0.0444		<0.01	0.0150		0.1319	19.42	1.3270		<0.01	1.1510	4.0454		0.0190
14	0.0460					0.1319	19.49	1.3300			1.1540	4.0500		0.0190
15	0.0470					0.1320	19.50	1.3500			1.1540	4.0720		0.0200
16	0.0480					0.1330	19.56	1.3600			1.1550	4.0920		0.0200
17	0.0480					0.1330	19.63	1.3660			1.1590	4.1210		0.0200
18						0.1340	19.70				1.1600	4.1500		0.0225
19						0.1440					1.1650	4.2700		<0.005
20						0.1472					1.1900			
Mean	0.0355	0.0044	0.0005	0.0133	0.0041	0.1264	19.32	1.3036	49.04	0.0009	1.1363	4.0295	0.0446	0.0171
STDV	0.0087	0.0012	0.0004	0.0015	0.0004	0.0119	0.196	0.0436	0.379	0.0001	0.0272	0.0845	0.0020	0.0030
Certified	0.036	0.0044	0.0005	0.0133	0.0041	0.126	19.3	1.30	49.0	0.0009	1.14	4.03	0.045	0.017
U _{CRM}	0.004	0.0009	0.0004	0.0009	0.0003	0.006	0.1	0.02	0.2	0.0002	0.01	0.04	0.001	0.001
Methods	I,IM,G,O,X	I,IM,G	I,IM,G	C	I,IM,X	I,IM,G,O,X	I,G,O,X	I,G,O,X	I,G,O,X	I,IM,G,O,X	I,G,O,X	I,G,O,X	F	I,IM,G,O,X

	Ni	O	P	Pb	S	Sb	Si	Sn	Ta	Ti	V	W	Zr
1	23.40	0.0011	0.0150	0.0003	0.0003	0.0005	0.6300	0.0036	0.0001	0.0006	0.0420	0.0130	0.0002
2	23.55	0.0011	0.0170	0.0005	0.0004	0.0010	0.6308	0.0044	0.0002	0.0010	0.0579	0.0192	0.0006
3	23.76	0.0012	0.0190		0.0005	0.0011	0.6359	0.0045	0.0013	0.0015	0.0590	0.0194	0.0020
4	23.87	0.0013	0.0190		0.0005	0.0011	0.6410	0.0048	0.0043	0.0017	0.0601	0.0208	0.0021
5	23.89	0.0015	0.0190		0.0007	0.0022	0.6440	0.0048	0.0044	0.0018	0.0610	0.0208	0.0027
6	23.90	0.0018	0.0190		0.0008	0.0025	0.6458	0.0049	0.0053	0.0018	0.0621	0.0220	0.0034
7	23.92	0.0021	0.0191		0.0013	0.0028	0.6470	0.0049	0.0059	0.0018	0.0626	0.0220	0.0058
8	23.95	0.0021	0.0196		<0.0005	0.0030	0.6480	0.0057	<0.0005	0.0021	0.0634	0.0229	<0.0005
9	23.96	0.0021	0.0198		<0.0005	<0.002	0.6515	0.0063	<0.0010	0.0029	0.0637	0.0240	<0.0005
10	23.98	0.0027	0.0198		<0.0010	<0.002	0.6600	0.0075	<0.005	0.0033	0.0642	0.0241	<0.0010
11	24.00	0.0033	0.0200		<0.002	<0.002	0.6630	<0.005	<0.005	0.0037	0.0650	0.0249	<0.005
12	24.00		0.0204		<0.002	<0.005	0.6660	<0.01	<0.01	<0.002	0.0660	0.0260	<0.005
13	24.01		0.0210		<0.002	<0.005	0.6720	<0.01	<0.01	<0.002	0.0660	0.0260	
14	24.04		0.0211				0.6760			<0.002	0.0660	0.0261	
15	24.09		0.0215				0.6770			<0.005	0.0662	0.0270	
16	24.17		0.0237				0.6820			<0.005	0.0715	0.0271	
17	24.18		0.0245							<0.01	0.0949	0.0280	
18	24.65		0.0247									0.0331	
19	24.70												
20													
Mean	24.00	0.0018	0.0202	0.0004	0.0007	0.0018	0.6544	0.0051	0.0031	0.0020	0.0642	0.0237	0.0024
STDV	0.303	0.0007	0.0024	0.0001	0.0003	0.0010	0.0168	0.0011	0.0025	0.0009	0.0100	0.0044	0.0019
Certified	24.0	0.0018	0.020	(0.0004)	0.0007	0.0018	0.654	0.0051	(0.0031)	0.0020	0.064	0.024	(0.0024)
U _{CRM}	0.1	0.0005	0.001		0.0003	0.0008	0.009	0.0008		0.0006	0.005	0.002	
Methods	I,G,O,X	F,I	I,IM,G,O,X	O,I	C,O,I,X	I,IM,O,X	I,G,O,X	I,IM,G	I,IM,G,O	I,IM,O,X	I,IM,G,O,X	I,IM,O,X	I,IM,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