

## Certified Reference Material

## Certificate of Analysis

**Product ID:** IARM-FE304L-22

ISO  
17034:2016

ISO/IEC  
17025:2017

ISO  
9001:2015

**Product Description:** Stainless Steel, Austenitic, AISI 304L / S30403

Revision No.: 000  
 Revision Date: 01/23/2023

**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

<b>Al</b>	<b>0.0020</b>	$\pm 0.0006$	<b>Cr</b>	<b>18.21</b>	$\pm 0.09$	<b>Ni</b>	<b>8.65</b>	$\pm 0.09$	<b>Sn</b>	<b>0.0101</b>	$\pm 0.0006$
<b>As</b>	<b>0.0054</b>	$\pm 0.0007$	<b>Cu</b>	<b>0.443</b>	$\pm 0.009$	<b>O</b>	<b>0.005</b>	$\pm 0.001$	<b>Ti</b>	<b>0.0021</b>	$\pm 0.0007$
<b>B</b>	<b>0.0010</b>	$\pm 0.0003$	<b>Mn</b>	<b>1.46</b>	$\pm 0.01$	<b>P</b>	<b>0.031</b>	$\pm 0.001$	<b>V</b>	<b>0.081</b>	$\pm 0.002$
<b>C</b>	<b>0.013</b>	$\pm 0.001$	<b>Mo</b>	<b>0.362</b>	$\pm 0.004$	<b>S</b>	<b>0.0324</b>	$\pm 0.0009$	<b>W</b>	<b>0.066</b>	$\pm 0.003$
<b>Ca</b>	<b>0.0005</b>	$\pm 0.0002$	<b>N</b>	<b>0.083</b>	$\pm 0.001$	<b>Sb</b>	<b>0.0025</b>	$\pm 0.0006$			
<b>Co</b>	<b>0.331</b>	$\pm 0.009$	<b>Nb</b>	<b>0.015</b>	$\pm 0.002$	<b>Si</b>	<b>0.287</b>	$\pm 0.008$			

### Indicative Values listed in ppm

Fe Balance Zr 12

**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.

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

**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.

- Applied Technical Services - Marietta, GA
- Avon Specialty Metals Ltd - Gloucester, England
- EAG Laboratories - Liverpool, NY
- IMR Test Labs - Lansing, NY
- Laboratory Testing, Inc. - Hatfield, PA
- LGC Standards - Manchester, NH
- Lithea S.R.O. - Brno, Czech Republic
- Lucid Laboratories Pvt Ltd - Hyderabad, India
- New Hampshire Materials Laboratory Inc - Somersworth, NH
- NSL Analytical Services - Cleveland, OH
- Raghavendra Spectro Metallurgical Laboratory - Bengaluru, India
- Scrooby's Laboratory Service Pty Ltd - Benoni, South Africa
- SGS MSI - Melrose Park, IL
- Sheffield Assay Office - Sheffield, England

**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

23 January 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	Mn	Mo	N	Nb
1	0.0001	0.0026	0.0002	0.0094	0.0002	0.2919	17.91	0.3990	69.7000	1.401	0.3400	0.0804	0.0095
2	0.0009	0.0033	0.0005	0.0100	0.0003	0.2930	17.93	0.4098	69.8067	1.419	0.3473	0.0816	0.0125
3	0.0010	0.0046	0.0005	0.0105	0.0004	0.3032	18.00	0.4170	69.8900	1.420	0.3490	0.0820	0.0135
4	0.0010	0.0046	0.0005	0.0107	0.0005	0.3051	18.03	0.4243	70.1600	1.425	0.3570	0.0825	0.0139
5	0.0015	0.0048	0.0008	0.0110	0.0005	0.3190	18.04	0.4271	70.2000	1.427	0.3580	0.0827	0.0140
6	0.0018	0.0050	0.0009	0.0110	0.0007	0.3200	18.06	0.4300		1.441	0.3580	0.0830	0.0150
7	0.0018	0.0050	0.0010	0.0115	0.0007	0.3230	18.09	0.4317		1.441	0.3590	0.0833	0.0156
8	0.0019	0.0050	0.0010	0.0116	0.0008	0.3310	18.10	0.4327		1.447	0.3594	0.0839	0.0160
9	0.0020	0.0051	0.0010	0.0118	<0.0005	0.3331	18.12	0.4440		1.449	0.3600	0.0866	0.0164
10	0.0020	0.0054	0.0010	0.0120	<0.001	0.3350	18.14	0.4450		1.451	0.3627	0.0871	0.0166
11	0.0022	0.0054	0.0014	0.0134	<0.0010	0.3368	18.16	0.4470		1.457	0.3648		0.0170
12	0.0022	0.0056	0.0014	0.0143	<0.002	0.3370	18.16	0.4470		1.459	0.3650		0.0175
13	0.0022	0.0057	0.0017	0.0146	<0.002	0.3387	18.17	0.4473		1.463	0.3652		0.0179
14	0.0029	0.0060	0.0023	0.0147	<0.002	0.3387	18.20	0.4474		1.467	0.3680		0.0205
15	0.0040	0.0061	<0.0005	0.0160	<0.005	0.3410	18.20	0.4482		1.470	0.3698		
16	0.0040	0.0065	<0.0010	0.0163	<0.0050	0.3419	18.24	0.4557		1.473	0.3700		
17	<0.0005	0.0080	<0.005	0.0170		0.3430	18.33	0.4559		1.478	0.3700		
18	<0.0010	0.0086	<0.005	0.0170		0.3455	18.36	0.4590		1.484	0.3702		
19	<0.005	<0.005	<0.01			0.3480	18.37	0.4638		1.500	0.3754		
20	<0.005	<0.0050	<0.01			0.3600	18.47	0.4680		1.510			
21		<0.01				0.3710	18.54	0.4700		1.521			
22		<0.01					18.55	0.4710		1.524			
23							18.63						
Mean	0.0020	0.0054	0.0010	0.0129	0.0005	0.3312	18.21	0.4428	69.9513	1.460	0.3615	0.0833	0.0154
STDV	0.0010	0.0014	0.0005	0.0025	0.0002	0.0203	0.20	0.0195	0.2198	0.033	0.0089	0.0021	0.0027
Certified	0.002	0.0054	0.001	0.013	0.0005	0.331	18.21	0.443	(69.95)	1.46	0.362	0.083	0.015
U <sub>CRM</sub>	0.0006	0.0007	0.0003	0.001	0.0002	0.009	0.09	0.009		0.01	0.004	0.001	0.002
Methods	IM,I,G,O,X	IM,I,G,O,X	IM,I,G,O	C,G,O	IM,I,O,X	IM,I,G,O,X	I,G,O,X	IM,I,G,O,X	O,I,X	I,G,O,X	IM,I,O,X	F,O	IM,I,O,X

	Ni	O	P	S	Sb	Si	Sn	Ti	V	W	Zr
1	8.272	0.0036	0.0245	0.0290	0.0015	0.2590	0.0070	0.0002	0.0750	0.0530	0.0001
2	8.338	0.0039	0.0270	0.0290	0.0016	0.2610	0.0073	0.0007	0.0750	0.0580	0.0002
3	8.401	0.0042	0.0281	0.0297	0.0017	0.2623	0.0090	0.0010	0.0752	0.0590	0.0013
4	8.425	0.0044	0.0287	0.0312	0.0020	0.2675	0.0090	0.0012	0.0766	0.0600	0.0015
5	8.541	0.0047	0.0298	0.0315	0.0020	0.2683	0.0095	0.0013	0.0785	0.0612	0.0019
6	8.565	0.0051	0.0300	0.0320	0.0024	0.2720	0.0099	0.0016	0.0802	0.0615	0.0020
7	8.571	0.0061	0.0300	0.0320	0.0027	0.2730	0.0099	0.0018	0.0806	0.0620	<0.00005
8	8.596	0.0073	0.0300	0.0325	0.0030	0.2810	0.0100	0.0019	0.0810	0.0630	<0.0005
9	8.601	0.0075	0.0303	0.0326	0.0039	0.2820	0.0100	0.0023	0.0815	0.0640	<0.0010
10	8.618	0.0079	0.0304	0.0327	0.0040	0.2834	0.0101	0.0029	0.0818	0.0645	<0.002
11	8.620		0.0306	0.0327	<0.002	0.2890	0.0102	0.0031	0.0820	0.0650	<0.002
12	8.620		0.0310	0.0329	<0.002	0.2891	0.0103	0.0038	0.0820	0.0679	<0.002
13	8.639		0.0313	0.0329	<0.002	0.2900	0.0104	0.0040	0.0825	0.0684	<0.0020
14	8.681		0.0320	0.0332	<0.0020	0.2905	0.0105	0.0043	0.0825	0.0687	<0.005
15	8.691		0.0321	0.0333	<0.01	0.2924	0.0105	<0.0005	0.0830	0.0690	<0.005
16	8.710		0.0330	0.0340	<0.01	0.2973	0.0110	<0.0010	0.0830	0.0692	<0.01
17	8.715		0.0330	0.0354		0.3000	0.0110	<0.002	0.0835	0.0694	<0.01
18	8.844		0.0330	0.0361		0.3013	0.0110	<0.002	0.0840	0.0710	
19	8.930		0.0330			0.3040	0.0110	<0.002	0.0840	0.0720	
20	8.980		0.0333			0.3090	0.0119	<0.005	0.0843	0.0730	
21	8.993		0.0345			0.3102	0.0120	<0.005	0.0890	0.0731	
22	9.008		0.0350			0.3220				0.0782	
23			0.0360								
Mean	8.653	0.0055	0.0312	0.0324	0.0025	0.2866	0.0101	0.0021	0.0812	0.0660	0.0012
STDV	0.203	0.0016	0.0026	0.0019	0.0009	0.0174	0.0012	0.0013	0.0035	0.0060	0.0008
Certified	8.65	0.005	0.031	0.0324	0.0025	0.287	0.0101	0.0021	0.081	0.066	(0.0012)
U <sub>CRM</sub>	0.09	0.001	0.001	0.0009	0.0006	0.008	0.0006	0.0007	0.002	0.003	
Methods	I,G,O,X	F,I	IM,I,G,O,X	C,G,O,I	IM,I,G,O,X	IM,I,G,O,X	IM,I,G,O,X	IM,I,G,O,X	IM,I,G,O,X	IM,I,G,O,X	IM,I,G,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