



Certificate of Analysis

IARM Fe316L-18

Stainless Steel AISI 316L / UNS S31603

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	0.006 ± 0.005	C	0.021 ± 0.001	Co	0.209 ± 0.008	Cr	16.7 ± 0.1
Cu	0.550 ± 0.006	Mn	1.70 ± 0.03	Mo	2.02 ± 0.02	N	0.067 ± 0.003
Nb	0.027 ± 0.006	Ni	10.12 ± 0.09	O	0.005 ± 0.001	P	0.033 ± 0.003
S	0.029 ± 0.005	Si	0.438 ± 0.006	Sn	0.013 ± 0.003	Ti	0.003 ± 0.002
V	0.067 ± 0.006	W	0.060 ± 0.007				

Indicative Values listed in ppm

As (<230)	B (10)	Ca (20)	Ce (<20)	H (8)	Mg (4)	Pb (<30)
Sb (18)	Se (<40)	Ta (<50)	Zn (<50)	Zr (<50)		

Description and Intended Use

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

Instructions for Use

1. 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.
2. 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.
3. The material should be stored in a cool, dry location when not in use.
4. Chips are not certified for Oxygen analysis.



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

	Al	As	B	C	Ca	Ce	Co	Cr	Cu	Fe	H	Mg	Mn	Mo	N	Nb
1	0.00045	0.00487	0.00036	0.0181	0.0014	<0.002	0.176	16.342	0.523	69.04	0.00033	0.0004	1.606	1.92	0.0622	0.006
2	0.001	0.005	0.0004	0.0189	0.00142		0.194	16.4633	0.538		0.000748	0.000495	1.648	1.9861	0.065	0.013
3	0.001	0.00609	0.0005	0.019	0.0022		0.197	16.523	0.54		0.00129	<0.0005	1.656	2.00	0.06583	0.027
4	0.0027	0.0229	0.0017	0.0205	<0.001		0.20133	16.5333	0.546			<0.001	1.6574	2.00	0.0659	0.0277
5	0.0031	<0.001	0.0027	0.0208	<0.005		0.205	16.542	0.5482				1.683	2.011	0.0661	0.02872
6	0.004		<0.005	0.021			0.20633	16.559	0.55103				1.70333	2.021	0.0664	0.03
7	0.0072			0.021			0.207	16.5936	0.553				1.71	2.0216	0.0675	0.0313
8	0.015			0.022			0.209	16.62	0.554				1.71535	2.022	0.074	0.0315
9	0.018			0.0222			0.214	16.632	0.5543				1.72	2.029		0.032
10				0.0226			0.22078	16.73	0.55467				1.72	2.03		0.03395
11				0.0227			0.22198	16.7541	0.558				1.74	2.061		0.037
12							0.2227	16.81	0.5586				1.7418	2.064		
13							0.226	17.048	0.56				1.754	2.074		
14							0.226	17.147	0.564				1.777	2.0759		
15																
Mean	0.006	0.01	0.001	0.021	0.002		0.209	16.7	0.55		0.0008	0.00040	1.7	2.02	0.067	0.027
STDV.	0.006	0.009	0.001	0.002	0.0005		0.01	0.2	0.01		0.0005	0.00007	0.05	0.04	0.003	0.009
Certified	0.006	(<0.023)	(0.001)	0.021	(0.002)	(<0.002)	0.209	16.7	0.550	(69.04)	(0.0008)	(0.0004)	1.70	2.02	0.067	0.027
U _{CRM}	0.005			0.001			0.008	0.1	0.006				0.03	0.02	0.003	0.006
Methods	I,G,O	IM,A,I	I,O	C,G,O	I	I	I,O,X,G	I,O,X,G	I,O,X,G	X	F	I	I,O,X,G	I,O,X,G	C,F	I,IM,X,G,O

	Ni	O	P	Pb	S	Sb	Se	Si	Sn	Ta	Ti	V	W	Zn	Zr
1	9.91	0.0027	0.025	0.0002	0.018	0.001633	0.0031	0.411	0.0075	0.000193	0.001	0.04583	0.037	0.000174	0.000067
2	9.9922	0.0037	0.02619	<0.001	0.0242	0.00179	<0.0001	0.424	0.009	<0.001	0.0013	0.04927	0.0466	0.000673	0.002
3	10.00	0.004	0.027	<0.0030	0.0277	0.0021	<0.001	0.428	0.0118	<0.0010	0.00186	0.06144	0.047	<0.0005	0.003
4	10.0267	0.0045	0.0298		0.028	<0.001		0.431	0.0121	<0.002	0.0025	0.064	0.056167	<0.001	<0.0010
5	10.048	0.0048	0.032		0.0283	<0.0050		0.43388	0.01287	<0.005	0.003	0.067	0.058	<0.0010	<0.005
6	10.0633	0.00553	0.03223		0.0286			0.43567	0.013		0.0031	0.06793	0.0597	<0.005	
7	10.074	0.00583	0.03277		0.0289			0.44	0.01315		0.0031	0.068	0.0605		
8	10.089	0.00732	0.033		0.029			0.442	0.0142		0.0034	0.0693	0.06092		
9	10.1072		0.0343		0.0293			0.443	0.01667		0.0086	0.0695	0.06153		
10	10.131		0.036		0.02947			0.445	0.0213		<0.005	0.06983	0.063		
11	10.16		0.03672		0.031			0.44567				0.0704	0.064		
12	10.327		0.03687		0.04995			0.4464				0.074	0.067		
13	10.39		0.0376					0.45				0.0756	0.06723		
14	10.391		0.04					0.451				0.087	0.09077		
15															
Mean	10.12	0.005	0.033		0.029	0.0018		0.438	0.013		0.003	0.067	0.06	0.0004	0.002
STDV.	0.1	0.001	0.005		0.007	0.0002		0.01	0.004		0.002	0.01	0.01	0.0004	0.001
Certified	10.12	0.005	0.033	(<0.003)	0.029	(0.0018)	(<0.004)	0.438	0.013	(<0.005)	0.003	0.067	0.060	(<0.005)	(<0.005)
U _{CRM}	0.09	0.001	0.003		0.005			0.006	0.003		0.002	0.006	0.007		
Methods	I,O,X,G	C,F	I,O,X,G	A,I	C,G,X,O	IM,A,I	A,I	I,O,X,G	I,X,A,O	I,G	I,X,G,O	I,O,X,G	I,O,X,G	IM,I	IM,I

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

Certification Laboratories

Connecticut Metallurgical Inc	East Hartford, CT	Dirats Laboratories	Westfield, MA
IMR Test Labs	Lansing, NY	VHG Labs	Manchester, NH
EAG Laboratories	Liverpool, NY	Laboratory Testing, Inc.	Hatfield, PA
Luvak Laboratories Inc.	Boylston, MA	Massachusetts Materials Research Inc.	West Boylston, MA
New Hampshire Materials Lab	Somersworth, NH		

Certification laboratories have demonstrated performance and traceability by utilizing test methods under the scope of ISO 17025 or have shown competence through a proficiency testing program. Some of the specific SRMs used in the analysis of the material covered by this certificate are:

NIST 100C NIST 101G NIST 1155A NIST 152B NIST 157B NIST 160B Nist 3100 Series NIST 363

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. $N_{min} = \max(10, \sqrt[3]{N_{prod}})$

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

Expiration

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.



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