



ARMI

ISO Certified · 9001 · 17025 · 17043 · 17034

Certificate of Analysis

IARM FeE9310-18

Low Alloy Steel AISI E9310 / UNS G93106

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	0.036 ± 0.003	C	0.121 ± 0.003	Co	0.009 ± 0.001	Cr	1.09 ± 0.02
Cu	0.158 ± 0.003	Fe	94.6 ± 0.2	Mn	0.62 ± 0.01	Mo	0.086 ± 0.002
N	0.0070 ± 0.0006	Ni	3.07 ± 0.03	O	0.0017 ± 0.0006	P	0.009 ± 0.001
S	0.0128 ± 0.0008	Si	0.256 ± 0.006	Sn	0.0072 ± 0.0006	V	0.0030 ± 0.0005

Indicative Values listed in ppm

As (40)	B (<50)	Bi (<50)	Ca (<50)	Cd (<50)	H (<10)	Hf (<10)
La (<10)	Mg (<200)	Nb (20)	Pb (1)	Pd (<10)	Sb (20)	Se (<50)
Ta (<50)	Ti (10)	W (30)	Y (<10)	Zn (10)	Zr (20)	

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** certified laboratories. 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 recommended for gas analysis.

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

	Al	C	Co	Cr	Cu	Fe	Mn	Mo	N	Ni	O	P	S	Si	Sn	V
1	0.0309	0.1168	0.007	1.005	0.147667	94.40	0.577	0.08143	0.00583	2.9767	0.00087	0.006	0.01008	0.245	0.006	0.0016
2	0.031	0.117	0.00728	1.052	0.150	94.50	0.602	0.08203	0.006	3.022	0.0012	0.00637	0.012	0.247	0.006	0.002
3	0.031	0.1184	0.00757	1.0767	0.15	94.527	0.60985	0.0822	0.007	3.03	0.001267	0.00678	0.0123	0.248	0.00693	0.00273
4	0.032	0.12	0.0077	1.088	0.1556	94.56	0.6106	0.0834	0.00718	3.032	0.00179	0.0068	0.012433	0.248	0.007	0.003
5	0.0327	0.12	0.009	1.099	0.158	94.652	0.612	0.084	0.0074	3.037	0.002	0.007	0.0128	0.248	0.0071	0.003
6	0.0341	0.123	0.009	1.10	0.158	94.88	0.6133	0.085	0.0075	3.05408	0.002	0.009	0.0128	0.25	0.00728	0.0032
7	0.0349	0.123	0.0092	1.10	0.158		0.616	0.0855	0.0075	3.056	0.0027	0.00907	0.013	0.252	0.0073	0.0032
8	0.038	0.1237	0.01	1.105	0.158		0.61633	0.086	0.0078	3.06		0.0092	0.0132	0.256	0.0075	0.00375
9	0.0386	0.124	0.0102	1.11	0.1583		0.618	0.086		3.07		0.0098	0.014	0.25867	0.00843	0.0038
10	0.0399	0.128	0.01098	1.1133	0.16		0.62	0.087		3.08		0.00983	0.0141	0.259	0.0085	0.004
11	0.041		0.012	1.1161	0.163		0.628	0.088		3.099		0.01	0.0143	0.266		
12	0.04303			1.12	0.163		0.634	0.08805		3.126		0.0104		0.269		
13				1.125	0.1647		0.678	0.094		3.207		0.011		0.2757		
14																
Mean	0.036	0.121	0.009	1.09	0.158	94.6	0.62	0.086	0.0070	3.07	0.0017	0.009	0.0128	0.256	0.0072	0.0030
STDV.	0.004	0.004	0.002	0.03	0.005	0.2	0.02	0.003	0.0007	0.06	0.0006	0.002	0.001	0.010	0.0008	0.0008
Certified	0.036	0.121	0.009	1.09	0.158	94.6	0.62	0.086	0.0070	3.07	0.0017	0.009	0.0128	0.256	0.0072	0.0030
U _{CRM}	0.003	0.003	0.001	0.02	0.003	0.2	0.01	0.002	0.0006	0.03	0.0006	0.001	0.0008	0.006	0.0006	0.0005
Methods	I,IM,O,X	C	I,IM,O,X	I,O,X	I,IM,O,X	I,X,O	I,O,X	I,IM,O,X	F	I,IM,O,X	F	I,IM,O,X	C,I,O,X	I,IM,O,X	I,IM,O,X	I,IM,O,X

	As	B	Bi	Ca	Cd	H	Hf	La	Mg	Nb	Pb	Pd	Sb	Se	Ta	Ti
1	0.00337	0.0001	<0.00005	0.0003	0.000373	0.00015	<0.001	<0.001	0.018	0.00007	0.00011	<0.001	0.001	0.00013	<0.00005	0.00032
2	0.0043	<0.00005	<0.001	<0.0005	<0.0005	0.0002			<0.00005	0.00013	0.00013		0.0013	<0.001	<0.001	0.00058
3	0.0046	<0.001	<0.001	<0.001	<0.001	<0.001			<0.001	0.0016	<0.001		0.0015	<0.001	<0.001	0.0008
4	0.005	<0.001	<0.005	<0.005	<0.001	<0.001			<0.001	0.003	<0.001		0.00455	<0.005	<0.001	0.002
5	<0.001	<0.005		<0.005	<0.001	<0.001			<0.001	0.0033	<0.001		<0.0002	<0.005	<0.001	0.003
6	<0.005			<0.005	<0.001	<0.001			<0.005	<0.0002	<0.002		<0.001	<0.005	<0.001	<0.001
7	<0.005				<0.005					<0.001	<0.005		<0.001		<0.001	<0.001
8										<0.001						<0.005
Mean	0.0040								0.002	0.0001	0.0001		0.002			0.001
STDV.	0.0007								0.002	0.00001	0.00001		0.002			0.001
	(0.004)	(<0.005)	(<0.005)	(<0.005)	(<0.005)	(<0.001)	(<0.001)	(<0.001)	(0.002)	(0.0001)	(0.0001)	(<0.001)	(0.002)	(<0.005)	(<0.005)	(0.001)
Methods	I,IM,O	I,IM,O	I,IM	I,IM,O	I,IM	F	IM	O	I,IM,O	I,IM,O,X	I,IM,O	IM	I,IM,O	I,IM	I,IM	I,IM,O

	W	Y	Zn	Zr												
1	0.0008	<0.001	0.00016	0.00006												
2	0.00091		0.00055	0.00015												
3	0.0011		0.0015	0.0014												
4	0.0011		<0.001	0.0036												
5	0.003		<0.001	0.006												
6	0.0045		<0.001	<0.001												
7	0.0088		<0.005	<0.005												
Mean	0.003		0.001	0.002												
STDV.	0.003		0.0007	0.003												
	(0.003)	(<0.001)	(0.001)	(0.002)												
Methods	I,IM,O,X	IM	I,IM,O	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

Certification Laboratories

Applied Technical Services, Inc. Dirats Laboratories Element Materials Technology Massachusetts Materials Research, Inc. SGS MSI	Marietta, GA Westfield, MA Gary, IN West Boylston, MA Melrose Park, IL	Connecticut Metallurgical, Inc. EAG Laboratories, Inc. IMR Test Labs NSL Analytical Services, Inc. LGC Standards	East Hartford, CT Liverpool, NY Lansing, NY Cleveland, OH Manchester, NH
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Certification laboratories have demonstrated performance and traceability by utilizing a variety of test methods all under the scope of ISO 17025. Some of the specific CRMs and SRMs used in the analysis of the material covered by this certificate are:

NBS 139B NBS 184 NBS 37e NBS 856 IARM 111A IARM 155A IARM 156A IARM 35E IARM 56A IARM 98B IARM 6D IARM 330A

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.

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

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

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.



David Coler, General Manager
Analytical Reference Materials International

