



ARMI

ISO Certified · 9001 · 17025 · 17043 · 17034

Certificate of Analysis

IARM FeKovar-18

Stainless Steel Kovar[®] / UNS K94610

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

C	0.024 ± 0.002	Co	17.3 ± 0.2	Cr	0.068 ± 0.003	Cu	0.077 ± 0.005
Fe	53.3 ± 0.3	Mn	0.26 ± 0.01	Mo	0.062 ± 0.007	Ni	29.0 ± 0.3
P	0.004 ± 0.003	S	0.0055 ± 0.0009	Si	0.09 ± 0.01	Sn	0.0021 ± 0.0002
W	0.020 ± 0.006						

Indicative Values listed in ppm

Al (<60)	As (30)	B (<50)	Bi (<50)	Ca (<50)	Cd (<50)	H (<10)
Hf (<10)	Mg (<100)	N (<20)	Nb (<50)	O (<80)	Pb (<50)	Pd (<10)
Sb (<50)	Se (<50)	Ta (<50)	Ti (<50)	V (<50)	Y (<10)	Zn (<50)
Zr (<50)						

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.

	C	Co	Cr	Cu	Fe	Mn	Mo	Ni	P	S	Si	Sn	W	Al	As	B
1	0.0191	16.93	0.063	0.064	52.913	0.211	0.037	28.161	0.001	0.003	0.059	0.002	0.01413	0.00029	0.0028	0.0001
2	0.022	17.06	0.065	0.07	52.97	0.242	0.0506	28.665	0.0011	0.0048	0.081	0.002	0.0143	0.002	0.003	0.0006
3	0.0232	17.11	0.0658	0.073	53.073	0.254	0.0602	28.75	0.0013	0.00519	0.082	0.002	0.0154	0.002	0.0031	<0.00005
4	0.0246	17.117	0.0669	0.0736	53.30	0.25808	0.06047	28.864	0.00217	0.0053	0.08383	0.0021	0.016	0.00213	<0.001	<0.001
5	0.025	17.25	0.06887	0.07497	53.34	0.2637	0.06117	28.93	0.0025	0.00568	0.09028	0.0023	0.0165	0.0051	<0.001	<0.001
6	0.025	17.253	0.069	0.07593	53.401	0.2667	0.062	28.96	0.003	0.006	0.092	0.0024	0.017	<0.001	<0.005	<0.001
7	0.026	17.27	0.0696	0.08	53.61	0.2684	0.06287	28.967	0.006	0.006	0.093		0.017	<0.001	<0.005	<0.005
8	0.02615	17.37	0.0697	0.08	53.734	0.2727	0.06465	29.01	0.012	0.00647	0.0932		0.0248	<0.005	<0.005	<0.005
9	0.0273	17.519	0.07	0.084		0.273	0.066	29.033		0.007	0.097		0.02895	<0.005		
10		17.617	0.077	0.08437		0.277	0.068	29.16			0.1047		0.039			
11		17.99		0.0897		0.28	0.077	29.675			0.11					
12						0.282	0.078	29.69			0.1203					
13																
Mean	0.024	17.3	0.068	0.077	53.3	0.26	0.062	29.0	0.004	0.0055	0.09	0.0021	0.02	0.002	0.0030	
STDV.	0.002	0.3	0.004	0.007	0.3	0.02	0.01	0.4	0.004	0.001	0.02	0.0002	0.008	0.002	0.0002	
Certified	0.024	17.3	0.068	0.077	53.3	0.26	0.062	29.0	0.004	0.0055	0.09	0.0021	0.020	(<0.006)	(0.003)	(<0.005)
U _{CRM}	0.002	0.2	0.003	0.005	0.3	0.01	0.007	0.3	0.003	0.0009	0.01	0.0002	0.006			
Methods	C	I,O,IM,X	I,IM,O,X	I,IM,O,X	I,X,O	I,O,IM,X	I,IM,O,X	I,O,X	I,IM,O,X	C,O,X	I,IM,O,X	I,IM,O,X	I,IM,O,X	I,IM,O	I,IM,O	I,IM,O

	Bi	Ca	Cd	H	Hf	Mg	N	Nb	O	Pb	Pd	Sb	Se	Ta	Ti	V
1	<0.00005	<0.0005	0.000127	0.00011	<0.001	0.00007	0.0006	0.000977	0.00067	<0.00005	<0.001	0.00024	<0.00005	0.000103	0.0005	0.000483
2	<0.001	<0.001	0.00287	<0.0001		0.0007	0.00085	0.0011	0.001	<0.001		0.00039	<0.001	<0.00005	0.00053	0.00056
3	<0.001	<0.001	<0.001	<0.0001		0.007	0.001	<0.001	<0.001	<0.001		0.005	<0.001	<0.001	0.001	0.00115
4	<0.001	<0.005	<0.001	<0.001		0.01	0.001	<0.001	0.001	<0.001		<0.001	<0.005	<0.001	0.003	0.0014
5	<0.005	<0.005	<0.005			<0.001	0.00132	<0.001	0.00293	<0.005		<0.001	<0.001	<0.001	<0.001	0.002
6						<0.001	<0.0005	<0.005	0.007427			<0.005		<0.005	<0.003	0.005
7						<0.001	<0.001	<0.001	<0.0005						<0.005	<0.001
8						<0.001	<0.001	<0.001	<0.001						<0.005	<0.005
Mean						0.004	0.0010	0.00100	0.002			0.002			0.001	0.002
STDV.						0.005	0.0003	0.00009	0.003			0.003			0.001	0.002
	(<0.005)	(<0.005)	(<0.005)	(<0.001)	(<0.001)	(<0.01)	(<0.002)	(<0.005)	(<0.008)	(<0.005)	(<0.001)	(<0.005)	(<0.005)	(<0.005)	(<0.005)	(<0.005)
Methods	I,IM	I,IM	I,IM	F	IM	I,IM,O	I,F	I,IM,O,X	F	I,IM	IM	I,IM	I,IM	I,IM	I,IM,O	I,IM,O,X

	Y	Zn	Zr													
1	0.00076	<0.00005	0.0001													
2	<0.001	<0.001	0.000247													
3		<0.001	0.004													
4		<0.001	<0.00005													
5		<0.005	<0.001													
6			<0.002													
7			<0.005													
Mean			0.001													
STDV.			0.002													
	(<0.001)	(<0.005)	(<0.005)													
Methods	IM	I,IM	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.	Marietta, GA	Connecticut Metallurgical, Inc.	East Hartford, CT
Dirats Laboratories	Westfield, MA	EAG Laboratories, Inc.	Liverpool, NY
Element Materials Technology	Gary, IN	IMR Test Labs	Lansing, NY
Massachusetts Materials Research, Inc.	West Boylston, MA	NSL Analytical Services, Inc.	Cleveland, OH
SGS MSI	Melrose Park, IL	VHG Labs	Manchester, NH

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:

IARM 100B IARM 10C IARM 111A IARM 24B IARM 26B IARM 56A IARM 96C IARM 98B IARM 99B NBS 184 NBS 37e NBS 856

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.



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