

Certificate of Analysis

IARM FeM2-18

Tool Steel AISI M-2 / T11302

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	0.014 ± 0.002	As	0.008 ± 0.003	C	0.853 ± 0.006	Co	0.28 ± 0.02
Cr	4.23 ± 0.07	Cu	0.098 ± 0.003	Fe	81.4 ± 0.5	Mn	0.337 ± 0.005
Mo	4.92 ± 0.05	N	0.0148 ± 0.0008	Nb	0.021 ± 0.005	Ni	0.182 ± 0.009
O	0.0016 ± 0.0006	P	0.025 ± 0.002	S	0.0010 ± 0.0008	Si	0.26 ± 0.03
Sn	0.007 ± 0.002	Ti	0.0016 ± 0.0007	V	1.90 ± 0.02	W	5.81 ± 0.06

Indicative Values listed in ppm

B (4)	Bi (<50)	Ca (<50)	Cd (<2)	H (<1)	Mg (<10)	Pb (10)
Sb (140)	Se (<50)	Ta (23)	Zn (5)	Zr (35)		

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 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.

Instructions for Use

1. The test surface for disks 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	As	C	Co	Cr	Cu	Fe	Mn	Mo	N	Nb	Ni	O	P	S	Si
1	0.0110	0.0033	0.8460	0.228	3.982	0.0879	80.81	0.3260	4.760	0.0133	0.0086	0.1690	0.0010	0.0210	0.0001	0.1970
2	0.0114	0.0056	0.8470	0.237	4.177	0.0920	81.13	0.3277	4.841	0.0134	0.0094	0.1710	0.0010	0.0211	0.0003	0.2200
3	0.0117	0.0069	0.8477	0.276	4.188	0.0958	81.27	0.3300	4.863	0.0140	0.0153	0.1752	0.0011	0.0232	0.0007	0.2244
4	0.0120	0.0080	0.8490	0.288	4.205	0.0959	81.45	0.3301	4.870	0.0148	0.0156	0.1760	0.0011	0.0240	0.0010	0.2280
5	0.0130	0.0082	0.8495	0.290	4.208	0.0962	81.76	0.3310	4.873	0.0150	0.0184	0.1799	0.0014	0.0246	0.0017	0.2310
6	0.0130	0.0123	0.8497	0.290	4.211	0.0962	82.19	0.3340	4.920	0.0150	0.0203	0.1834	0.0020	0.0250	0.0021	0.2471
7	0.0137	0.0130	0.8580	0.290	4.214	0.0990		0.3340	4.920	0.0157	0.0216	0.1910	0.0020	0.0251		0.2480
8	0.0150		0.8658	0.294	4.215	0.0990		0.3373	4.941	0.0159	0.0250	0.1932	0.0029	0.0260		0.2483
9	0.0150		0.8660	0.294	4.241	0.0993		0.3407	4.984	0.0160	0.0257	0.2030		0.0270		0.2535
10	0.0176			0.301	4.304	0.1020		0.3420	4.990		0.0270			0.0296		0.2673
11	0.0180			0.302	4.340	0.1020		0.3469	5.004		0.0281			0.0321		0.3110
12				0.308	4.470	0.1040		0.3480	5.006		0.0360					0.3493
13						0.1080		0.3480	5.030							0.3570
14																
15																
Mean	0.0138	0.0082	0.8532	0.283	4.230	0.098	81.434	0.3366	4.923	0.0148	0.0209	0.1824	0.0016	0.025	0.0010	0.260
STDV.	0.0024	0.0035	0.0080	0.025	0.114	0.005	0.487	0.0078	0.079	0.0010	0.0080	0.0113	0.0007	0.003	0.0008	0.049
Certified	0.014	0.008	0.853	0.28	4.23	0.098	81.4	0.337	4.92	0.0148	0.021	0.182	0.0016	0.025	0.0010	0.26
U _{CRM}	0.002	0.003	0.006	0.02	0.07	0.003	0.5	0.005	0.05	0.0008	0.005	0.009	0.0006	0.002	0.0008	0.03
Methods	I,IM,O	I,IM,A	C,O	I,IM,O,X	I,O,X	I,IM,O,X	I,O,X	I,IM,O,X	I,IM,O,X	F	I,IM,O,X	I,IM,O	F	I,IM,O	C,F,O	I,IM,O,X

	Sn	Ti	V	W	B	Bi	Ca	Cd	H	Mg	Pb	Sb	Se	Ta	Zn	Zr
1	0.0031	0.0005	1.850	5.620	0.0001	<0.001	<0.005	0.0011	0.0001	0.0020	0.0002	0.0006	<0.001	0.0002	0.0002	0.0024
2	0.0058	0.0009	1.850	5.682	0.0001	<0.0010		<0.001	0.0001	<0.001	0.0003	0.0009	<0.005	0.0002	0.0002	0.0032
3	0.0060	0.0010	1.866	5.700	0.0006	<0.005			<0.001	<0.001	0.0005	0.0011		0.0003	0.0003	0.0050
4	0.0060	0.0015	1.873	5.764	0.0006						0.0032	0.0012		0.0031	0.0007	<0.00005
5	0.0068	0.0015	1.876	5.767	<0.0001						<0.0001	0.0045		0.0050	0.0009	<0.0001
6	0.0068	0.0016	1.879	5.788	<0.0005						<0.0005	0.0260		0.0051	<0.0005	<0.001
7	0.0078	0.0029	1.886	5.830	<0.0005						<0.001	0.0630		<0.0001	<0.001	<0.001
8	0.0080	0.0029	1.890	5.835	<0.001						<0.001	<0.002		<0.001	<0.005	<0.002
9	0.0100		1.919	5.843	<0.005						<0.005	<0.005		<0.005	<0.01	<0.005
10	0.0119		1.930	5.857	<0.005						<0.005	<0.01		<0.005		<0.005
11			1.935	5.866												
12			1.968	5.930												
13			1.970	6.020												
14																
15																
Mean	0.0072	0.0016	1.899	5.808	0.0004						0.0010	0.0139		0.0023	0.0005	0.0035
STDV.	0.0024	0.0009	0.041	0.106	0.0003						0.0014	0.0235		0.0024	0.0003	0.0013
Certified	0.007	0.0016	1.90	5.81	(0.0004)	(<0.005)	(<0.005)	(<0.002)	(<0.0001)	(<0.001)	(0.001)	(0.014)	(<0.005)	(0.0023)	(0.0005)	(0.0035)
U _{CRM}	0.002	0.0007	0.02	0.06												
Methods	I,IM,O,A	I,IM,O	I,O,X	I,O	I,IM	IM	IM	IM	F	IM	I,IM,A	I,IM,A	IM	I,IM	I,IM	I,IM

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

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

NIST 361 NIST 363 NIST 132 NIST 856 NIST 184 IARM 6D IARM 56B

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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