

Certificate of Analysis

IARM Fe418-18

Stainless Steel 418 / Greek Ascoloy / UNS S41800

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	0.004 ± 0.003	C	0.168 ± 0.005	Co	0.029 ± 0.004	Cr	12.4 ± 0.2
Cu	0.222 ± 0.009	Mn	0.429 ± 0.004	Mo	0.104 ± 0.005	N	0.031 ± 0.001
Nb	0.019 ± 0.006	Ni	2.00 ± 0.04	O	0.004 ± 0.002	P	0.016 ± 0.003
Si	0.32 ± 0.02	Sn	0.005 ± 0.001	V	0.046 ± 0.003	W	2.63 ± 0.05

Indicative Values listed in ppm

As (30)	B (<50)	Bi (<50)	Ca (<50)	Cd (<50)	Mg (<50)	Pb (<50)
S (5)	Sb (<500)	Se (<50)	Ta (<50)	Ti (40)	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	Bi	C	Ca	Cd	Co	Cr	Cu	Fe	Mg	Mn	Mo	N	Nb
1	0.00086	0.0013	0.000096	<0.0010	0.1558	<0.001	<0.0010	0.016	12.01	0.19	82.10	<0.001	0.42	0.0917	0.0291	0.0024
2	0.002	0.0031	0.00152	<0.005	0.163	<0.0001	<0.005	0.0215	12.13	0.2005		<0.0001	0.42167	0.0940	0.02937	0.0062
3	0.00203	0.0036	<0.0005		0.165	<0.0005		0.024	12.17	0.209		<0.0005	0.422	0.0973	0.0304	0.0167
4	0.0025	<0.001	<0.0010		0.167	<0.005		0.0247	12.1882	0.218		<0.005	0.42367	0.0991	0.031	0.0183
5	0.003	<0.005	<0.005		0.1687			0.02793	12.3633	0.225			0.42367	0.10	0.0314	0.02287
6	0.003				0.1694			0.03	12.3633	0.228			0.4304	0.1006	0.032	0.0239
7	0.004				0.1735			0.031	12.378	0.2283			0.431	0.103		0.024
8	0.004				0.17367			0.03103	12.4167	0.2288			0.432	0.10323		0.025
9	0.015				0.177			0.032	12.42	0.2297			0.4329	0.1037		0.025
10								0.0325	12.66	0.2307			0.436	0.106		0.026
11								0.033	12.69	0.2309			0.43732	0.1073		
12								0.0343	12.719	0.234			0.44	0.114		
13								0.039367	13.0241	0.2371				0.121		
14																
15																
Mean	0.004	0.003			0.168			0.029	12.4	0.222			0.429	0.104	0.031	0.019
STDV.	0.004	0.001			0.006			0.006	0.3	0.01			0.007	0.008	0.001	0.008
Certified	0.004	(0.003)	(<0.005)	(<0.005)	0.168	(<0.005)	(<0.005)	0.029	12.4	0.222	(82.1)	(<0.005)	0.429	0.104	0.031	0.019
U _{CRM}	0.003				0.005			0.004	0.2	0.009			0.004	0.005	0.001	0.006
Methods	I,G,X,O	I,A	I	I	C,G,O	I	I	I,O,X,G	I,O,X,G	I,O,X,G	X	I	I,O,X,G	I,O,X,G	F,C	I,X,O

	Ni	O	P	Pb	S	Sb	Se	Si	Sn	Ta	Ti	V	W	Zn	Zr
1	1.88	0.001	0.0071	0.0002	0.0001	0.00066	<0.001	0.232	0.003	0.0007	0.00014	0.041	2.5185	0.0023	0.00203
2	1.941	0.0026	0.008	<0.001	0.0004	0.0022	<0.0001	0.2951	0.0037	0.004	0.0014	0.041	2.5429	<0.001	<0.0010
3	1.9446	0.0028	0.0092	<0.0010	0.0004	0.0467	<0.005	0.296	0.0049	<0.001	0.0019	0.04297	2.56	<0.0005	<0.002
4	1.95	0.00336	0.01527	<0.005	0.00067	<0.0020	<0.005	0.3193	0.00500	<0.0010	0.002	0.043	2.57	<0.005	<0.005
5	1.96	0.00631	0.0154		0.001	<0.005		0.32	0.00507	<0.005	0.003	0.044	2.6006		
6	1.9733	0.00671	0.01607		<0.001			0.3207	0.00563		0.0092	0.0448	2.6267		
7	2.002		0.01677		<0.0005			0.326	0.007		0.0122	0.045	2.6412		
8	2.01		0.0178		<0.0005			0.329			<0.005	0.04767	2.661		
9	2.0133		0.018					0.3307				0.0528	2.69		
10	2.05		0.0188					0.3343				0.0536	2.71		
11	2.057		0.019					0.337					2.713		
12	2.0757		0.0205					0.3443					2.76		
13	2.1102		0.0279					0.356							
14															
15															
Mean	2.00	0.004	0.016		0.0005			0.32	0.005		0.004	0.046	2.63		
STDV.	0.06	0.002	0.006		0.0003			0.03	0.001		0.005	0.004	0.08		
Certified	2.00	0.004	0.016	(<0.005)	(0.0005)	(<0.05)	(<0.005)	0.32	0.005	(<0.005)	(0.004)	0.046	2.63	(<0.005)	(<0.005)
U _{CRM}	0.04	0.002	0.003					0.02	0.001			0.003	0.05		
Methods	I,O,X,G	F,C	I,O,X,G	A,I	C,O	I,A	A,I	I,O,X,G	O,I,X,A	I	I,O	I,G,X,O	I,O,X,G	I	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	Dirts Laboratories	Westfield, MA
IMR Test Labs	Lansing, NY	VHG Labs	Manchester, NH
EAG Laboratories	Liverpool, NY	New Hampshire Materials Lab	Somerset, NH
Luvak Laboratories Inc.	Boylston, MA	Massachusetts Materials Research Inc.	West Boylston, MA

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 CRMs and SRMs used in the analysis of the material covered by this certificate are:

BCS CRM 345 IARM 175B IARM 5B IARM 6D NIST 160B BS 33E IARM 327A IARM 62C IARM 8C 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 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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