ARMI | MBH
ANALYTICAL LTD

ISO Certified · 9001:2015 · 17025:2017 · 17043:2010 · 17034:2016

Certificate of Analysis

IARM FSiP-20

Ferrosilicon Powder

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	**0.31** ± 0.01	**C**	**0.026** ± 0.006	**Ca**	**0.17** ± 0.01	**Co**	**0.0019** ± 0.0008
Cr	**0.068** ± 0.004	**Cu**	**0.052** ± 0.002	**Fe**	**21.8** ± 0.8	**Mg**	**0.008** ± 0.001
Mn	**0.186** ± 0.005	**Mo**	**0.0082** ± 0.0004	**Nb**	**0.0018** ± 0.0001	**Ni**	**0.020** ± 0.001
P	**0.015** ± 0.002	**Si**	**77.0** ± 1.0	**Ti**	**0.057** ± 0.003	**W**	**0.0019** ± 0.0007
Zn	**0.0022** ± 0.0009	**Zr**	**0.0043** ± 0.0004				

Indicative Values listed in ppm

As (<10)	B (40)	Ba (<70)	Cd (<10)	H (23)	Hf (<10)	K (<50)
La (<18)	Li (<2)	N (50)	O (2600)	Pb (<10)	S (<20)	Sb (<20)
Sn (2)	Sr (<39)	Ta (<9)	Th (<2)	U (<1)	V (50)	Y (<3)

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 comes in a bottle, containing approximately 100 grams of fine 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 minimum sample size should be individually evaluated based on the analytical technique used; this would typically be greater than 0.1 grams.
2. The material should be stored in a cool, dry location when not in use.
3. The material should be well mixed within the bottle before sampling to ensure a representative sample is obtianed.

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

	Al	As	B	Ba	C	Ca	Co	Cr	Cu	Fe	H	Hf	Mg	Mn	Mo	N
1	0.2700	0.0003	0.0025	0.0063	0.0160	0.1500	0.0005	0.0593	0.0470	20.50	0.0019	0.0001	0.0062	0.1785	0.0077	0.0010
2	0.3016	0.0004	0.0030	0.0071	0.0200	0.1510	0.0010	0.0622	0.0472	20.65	0.0019	0.0003	0.0079	0.1794	0.0079	0.0051
3	0.3030	<0.001	0.0036		0.0250	0.1590	0.0019	0.0630	0.0500	21.05	0.0022	<0.001	0.0080	0.1800	0.0080	0.0056
4	0.3060	<0.005	0.0038		0.0260	0.1621	0.0019	0.0671	0.0509	21.34	0.0025		0.0082	0.1813	0.0080	0.0065
5	0.3100	<0.005	0.0063		0.0298	0.1643	0.0022	0.0680	0.0511	21.50	0.0030		0.0083	0.1825	0.0080	0.0074
6	0.3150		<0.005		0.0315	0.1690	0.0025	0.0680	0.0517	21.69			0.0090	0.1890	0.0085	
7	0.3165				0.0350	0.1784	0.0030	0.0690	0.0523	22.15			<0.001	0.1890	0.0087	
8	0.3167					0.2000	<0.001	0.0697	0.0535	22.33			<0.005	0.1950	0.0090	
9	0.3356					0.2000	<0.005	0.0780	0.0540	22.39			<0.01	0.1970		
10	0.3360							0.0782	0.0590	24.32			<0.01			
11																
12																
13																
14																
15																
Mean	0.3110	0.0004	0.0038	0.0067	0.0262	0.1704	0.0019	0.0682	0.0517	21.79	0.0023	0.0002	0.0079	0.1857	0.0082	0.0051
STDV.	0.0188	0.0001	0.0015	0.0006	0.0066	0.0189	0.0008	0.0062	0.0035	1.11	0.0005	0.0001	0.0009	0.0070	0.0005	0.0025
Certified	**0.31**	**(<0.005)**	**(0.004)**	**(0.007)**	**0.026**	**0.17**	**0.0019**	**0.068**	**0.052**	**21.8**	**(0.0023)**	**(<0.001)**	**0.008**	**0.186**	**0.0082**	**(0.005)**
U_{CRM}	0.01				0.006	0.01	0.0008	0.004	0.002	0.8			0.001	0.005	0.0004	
Methods	I,IM	IM	I,IM	I	C	I	I,IM	I,IM	I,IM	W,I	F	IM	I,IM	I,IM	I,IM	F

	Nb	Ni	O	P	S	Sb	Si	Sn	Ta	Th	Ti	V	W	Y	Zn	Zr
1	0.0016	0.0180	0.2230	0.0100	0.0005	0.0020	74.77	0.0001	0.0000	0.0002	0.0505	0.0024	0.0010	0.0003	0.0008	0.0039
2	0.0017	0.0191	0.2500	0.0110	0.0006	<0.00001	75.45	0.0002	0.0009	0.0002	0.0550	0.0039	0.0018	0.0005	0.0020	0.0040
3	0.0017	0.0192	0.2500	0.0130	0.0040	<0.00001	76.90	0.0002	<0.00005		0.0550	0.0040	0.0019	0.0005	0.0020	0.0040
4	0.0018	0.0196	0.2657	0.0135	<0.001	<0.001	77.02	0.0002	<0.001		0.0560	0.0050	0.0019	<0.001	0.0022	0.0042
5	0.0018	0.0200	0.3188	0.0146	<0.001	<0.005	77.43	0.0003	<0.001		0.0573	0.0056	0.0020		0.0027	0.0043
6	0.0020	0.0209		0.0150	<0.005		77.60	<0.001	<0.005		0.0574	0.0058	0.0030		0.0034	0.0045
7	0.0020	0.0215		0.0152	<0.01		78.05	<0.005			0.0590	0.0060	<0.005		<0.001	0.0050
8	<0.005	0.0220		0.0168			78.40				0.0600	0.0061			<0.005	<0.001
9				0.0170							0.0600	0.0083				<0.005
10				0.0199							0.0634	<0.005				
11																
12																
13																
14																
15																
Mean	0.0018	0.0200	0.2615	0.0146	0.0017	0.0020	76.95	0.0002	0.0005	0.0002	0.0574	0.0052	0.0019	0.0004	0.0022	0.0043
STDV.	0.0002	0.0013	0.0355	0.0029	0.0020		1.25	0.0001	0.0006	0.0000	0.0035	0.0017	0.0006	0.0001	0.0009	0.0004
Certified	**0.0018**	**0.020**	**(0.26)**	**0.015**	**(0.002)**	**(0.002)**	**77.0**	**(0.0002)**	**(0.0009)**	**(0.0002)**	**0.057**	**(0.005)**	**0.0019**	**(0.0003)**	**0.0022**	**0.0043**
U_{CRM}	0.0001	0.001		0.002			1				0.003		0.0007		0.0009	0.0004
Methods	I,IM	I,IM	F	I,IM	C	IM	W,BAL,I	IM	IM	I	I,IM	I,IM	IM	IM	IM	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

Laboratory Testing, Inc.	Hatfield, PA	NSL Analytical Services	Cleveland, OH
IMR Test Labs	Lansing, NY	Dirats Laboratories	Westfield, MA
Applied Technical Services	Marietta, GA	EAG Laboratories	Liverpool, NY
LGC Standards	Manchester, NH	Scrooby's Laboratory Services	Benoni, South Africa
AGAT Labs	Canada		

Much of the analytical work performed to assess this material has been carried out by laboratories with proven competence, as indicated by their accreditation to ISO 17025. It is an implicit requirement for this accreditation that analytical work should be performed with due traceability, via an unbroken chain of comparisons, each with stated uncertainty, to primary standards such as the mole, or to nationally- or internationally-recognised reference materials. Of the individual results herein, some have traceability (to the mole) via primary analytical methods. Some are traceable to substances of known stoichiometry. Most have traceability via commercial solutions. Furthermore, some results have additional traceability to NIST standards, as part of the analytical calibration or process control.

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.

Kimberly Halkiotis, Global Product Manager

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