

Certificate of Analysis

IARM FCrP-20

Ferrochrome Powder

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

C	8.6 ± 0.2	Co	0.036 ± 0.005	Cr	68.8 ± 0.6	Cu	0.0040 ± 0.0004
Fe	20.6 ± 0.4	Mg	0.12 ± 0.02	Mn	0.12 ± 0.02	N	0.013 ± 0.005
Ni	0.32 ± 0.04	O	0.43 ± 0.05	P	0.019 ± 0.005	S	0.027 ± 0.005
Si	0.33 ± 0.03						

Indicative Values listed in ppm

Al (400)	As (30)	B (24)	Ca (300)	Ga (<20)	H (27)	Hf (<6)
K (<50)	Mo (20)	Nb (4)	Pb (<10)	Rb (<10)	Se (<200)	Sn (<1)
Ta (<2)	Ti (200)	V (900)	W (60)	Zn (<10)	Zr (<13)	

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 obtained.

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

	Al	As	B	C	Ca	Co	Cr	Cu	Fe	Ga	H	K	Mg	Mn	Mo	N
1	0.0130	0.0019	0.0017	8.2433	0.0130	0.0231	tle gru	0.0035	20.05	0.0020	0.0021	0.0050	0.0850	0.0739	0.0002	0.0040
2	0.0200	0.0022	0.0020	8.5700	0.0250	0.0280	68.19	0.0036	20.35	0.0022	0.0022	0.0370	0.0870	0.0920	0.0003	0.0070
3	0.0330	0.0023	0.0027	8.5750	0.0310	0.0350	68.33	0.0040	20.37		0.0030	<0.01	0.1100	0.0970	0.0005	0.0128
4	0.0340	0.0046	0.0027	8.6300	0.0313	0.0365	68.70	0.0040	20.38		0.0031		0.1200	0.1195	0.0030	0.0164
5	0.0400	<0.001	0.0030	8.7495	0.0329	0.0377	69.08	0.0040	20.45		0.0033		0.1239	0.1204	0.0060	0.0174
6	0.0513	<0.005	<0.005	8.7700	0.0470	0.0388	69.19	0.0045	20.48				0.1240	0.1230	<0.0001	0.0177
7	0.0536	<0.005		8.8900	0.0630	0.0400	69.26	0.0046	21.26				0.1245	0.1270	<0.001	0.0180
8	0.0590					0.0416	69.86	0.0080	21.42				0.1340	0.1280	<0.005	
9	0.0609					0.0450		<0.005					0.1443	0.1328		
10													0.1553	0.1420		
11																
12																
13																
14																
15																
Mean	0.0405	0.0028	0.0024	8.6325	0.0347	0.0362	68.9447	0.0045	20.5948	0.0021	0.0027	0.0210	0.1208	0.1156	0.0020	0.0133
STDV.	0.0170	0.0012	0.0005	0.2072	0.0161	0.0068	0.5809	0.0015	0.4783	0.0001	0.0005	0.0226	0.0223	0.0211	0.0025	0.0057
Certified	(0.04)	(0.003)	(0.0024)	8.6	(0.03)	0.036	68.8	0.005	20.6	(0.002)	(0.0027)	(0.005)	0.12	0.12	(0.002)	0.013
U _{CRM}				0.2		0.005	0.6	0.001	0.4				0.02	0.02		0.005
Methods	I,IM	IM,I	I,IM	C,I	IM,C	I,IM	W,BAL,I	I,IM	I		F	I	I,IM	I,IM	I,IM	F

	Nb	Ni	O	P	Pb	Rb	S	Se	Si	Sn	Ta	Ti	V	W	Zn	Zr
1	0.0003	0.2067	0.3960	0.0110	0.0000	0.0008	0.0175	0.0134	0.2680	0.0001	0.0002	0.0021	0.0395	0.0000	0.0010	0.0002
2	0.0003	0.2900	0.4060	0.0119	0.0002	0.0010	0.0211	0.0338	0.2969	0.0001	<0.0001	0.0080	0.0650	0.0001	0.0013	0.0013
3	0.0005	0.3040	0.4100	0.0130	0.0020		0.0230	<0.001	0.3130	0.0001	<0.0001	0.0155	0.0779	0.0040	<0.0001	<0.0006
4	0.0005	0.3057	0.4100	0.0168	<0.0005		0.0280	<0.005	0.3183	<0.001	<0.001	0.0160	0.0867	0.0138	<0.0005	<0.001
5	<0.0001	0.3135	0.4263	0.0190	<0.001		0.0290	<0.005	0.3200	<0.001	<0.005	0.0170	0.0915	<0.0001	<0.001	<0.001
6	<0.001	0.3250	0.5215	0.0200	<0.005		0.0310		0.3300	<0.005		0.0188	0.0978	<0.001	<0.001	<0.005
7	<0.001	0.3370		0.0224			0.0322		0.3602			0.0228	0.1040	<0.005	<0.005	
8	<0.005	0.3450		0.0248			0.0350		0.3700			0.0320	0.1108			
9		0.3483		0.0280			<0.0001		0.3900			0.0370	0.1803			
10		0.4400										<0.0001	<0.001			
11																
12																
13																
14																
15																
Mean	0.0004	0.3215	0.4283	0.0185	0.0008	0.0009	0.0271	0.0236	0.3296	0.0001	0.0002	0.0188	0.0948	0.0045	0.0011	0.0008
STDV.	0.0001	0.0581	0.0467	0.0059	0.0011	0.0001	0.0060	0.0144	0.0380			0.0108	0.0387	0.0065	0.0002	
Certified	(0.0004)	0.32	0.43	0.019	(0.001)	(0.001)	0.027	(0.02)	0.33	(0.00011)	(0.0002)	(0.019)	(0.09)	(0.006)	(0.001)	(0.0013)
U _{CRM}		0.04	0.05	0.005			0.005		0.03							
Methods	I,IM	I,IM	F	I,IM	IM,I		C	IM,I	I,IM	I,IM	IM,I	I,IM	I,IM	IM,I	IM,I	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.
IMR Test Labs
Applied Technical Services
LGC Standards
AGAT Labs

Hatfield, PA
Lansing, NY
Marietta, GA
Manchester, NH
Canada

NSL Analytical Services
Dirats Laboratories
EAG Laboratories
Scrooby's Laboratory Services

Cleveland, OH
Westfield, MA
Liverpool, NY
Benoni, South Africa

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-recognized 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 ICP 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 ICP. 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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