

Certificate of Analysis

IARM Fe1020-18

Carbon Steel / AISI 1020 / UNS G10200

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	0.003 ± 0.001	As	0.0044 ± 0.0004	C	0.226 ± 0.004	Ca	0.002 ± 0.001
Co	0.0065 ± 0.0006	Cr	0.125 ± 0.004	Cu	0.198 ± 0.004	Fe	98.5 ± 0.1
Mn	0.547 ± 0.005	Mo	0.0252 ± 0.0009	N	0.0098 ± 0.0004	Nb	0.0012 ± 0.0007
Ni	0.078 ± 0.003	O	0.007 ± 0.002	P	0.006 ± 0.001	S	0.024 ± 0.001
Sb	0.0018 ± 0.0002	Si	0.235 ± 0.008	Sn	0.0080 ± 0.0005	Ta	0.003 ± 0.002
V	0.036 ± 0.002	Zn	0.003 ± 0.002				

B (6)	Bi (<50)	Cd (<10)	H (2)	Mg (<50)	Pb (3)	Se (<50)
Ti (10)	W (7)	Zr (20)				

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.

	Al	As	C	Ca	Co	Cr	Cu	Fe	Mn	Mo	N	Nb	Ni	O	P	S
1	0.0020	0.0040	0.219	0.0007	0.0050	0.107	0.180	98.35	0.530	0.0230	0.0090	0.0001	0.0700	0.0048	0.0041	0.0190
2	0.0020	0.0042	0.220	0.0016	0.0057	0.117	0.190	98.40	0.533	0.0236	0.0094	0.0002	0.0711	0.0060	0.0043	0.0212
3	0.0026	0.0043	0.221	0.0020	0.0059	0.120	0.191	98.40	0.537	0.0240	0.0094	0.0010	0.0712	0.0061	0.0045	0.0230
4	0.0030	0.0044	0.222	0.0026	0.0060	0.120	0.192	98.41	0.543	0.0240	0.0096	0.0013	0.0758	0.0062	0.0052	0.0231
5	0.0040	0.0046	0.224	0.0031	0.0060	0.122	0.195	98.43	0.543	0.0245	0.0097	0.0018	0.0760	0.0063	0.0053	0.0234
6	0.0041	0.0050	0.226	0.0033	0.0070	0.123	0.197	98.48	0.546	0.0246	0.0098	0.0020	0.0760	0.0070	0.0055	0.0239
7	0.0062		0.228		0.0070	0.124	0.197	98.50	0.548	0.0250	0.0100	0.0020	0.0770	0.0070	0.0056	0.0240
8			0.228		0.0072	0.124	0.198	98.50	0.549	0.0253	0.0100		0.0790	0.0110	0.0069	0.0240
9			0.228		0.0074	0.126	0.200	98.71	0.551	0.0254	0.0106		0.0795	0.0124	0.0069	0.0241
10			0.230		0.0074	0.127	0.201	98.90	0.553	0.0254			0.0810		0.0070	0.0254
11			0.239			0.128	0.201		0.553	0.0254			0.0810		0.0070	0.0260
12						0.130	0.202		0.554	0.0260			0.0813		0.0080	0.0260
13						0.131	0.203		0.554	0.0280			0.0828		0.0093	0.0265
14						0.134	0.207		0.556	0.0290			0.0830		0.0100	
15						0.135	0.214		0.562				0.0844			
Mean	0.0034	0.0044	0.226	0.0022	0.0065	0.125	0.198	98.51	0.547	0.0252	0.0098	0.0012	0.0779	0.0074	0.0064	0.0238
STDV.	0.0015	0.0003	0.006	0.0010	0.0008	0.007	0.008	0.17	0.009	0.0016	0.0005	0.0008	0.0046	0.0025	0.0018	0.0021
Certified	0.003	0.0044	0.226	0.002	0.0065	0.125	0.198	98.5	0.547	0.0252	0.0098	0.0012	0.078	0.007	0.006	0.024
U _{CRM}	0.001	0.0004	0.004	0.001	0.0006	0.004	0.004	0.1	0.005	0.0009	0.0004	0.0007	0.003	0.002	0.001	0.001
Methods	I,IM,O	IM,I,O	C,O	I,IM	I,IM,O	I,IM,O,X	I,IM,O,X	I,O,X	I,O,X	I,IM,O,X	F	I,IM,O	I,IM,O,X	F	I,IM,O,X	C,O

	Sb	Si	Sn	Ta	V	Zn	B	Bi	Cd	H	Mg	Pb	Se	Ti	W	Zr
1	0.0014	0.209	0.0070	0.0010	0.0320	0.0005	0.0002	0.0030	<0.001	<0.001	0.0002	0.0029	0.0002	<0.001	0.0003	0.0005
2	0.0015	0.216	0.0070	0.0010	0.0322	0.0016	0.0004	<0.001	<0.001	0.0002	<0.001	0.0002	<0.005	0.0004	0.0005	0.0008
3	0.0016	0.222	0.0076	0.0020	0.0330	0.0030	0.0006			0.0002	<0.001	0.0003		0.0005	0.0007	0.0025
4	0.0018	0.227	0.0079	0.0022	0.0332	0.0036	0.0006			<0.001		0.0003		0.0017	0.0010	0.0029
5	0.0020	0.230	0.0079	0.0053	0.0344	0.0045	0.0010					0.0004		0.0020	0.0010	<0.001
6	0.0020	0.234	0.0080	0.0060	0.0346	0.0050	<0.0005					<0.001		<0.001	<0.001	<0.001
7	0.0020	0.234	0.0080		0.0346	0.0057	<0.001					<0.001		<0.001	<0.005	<0.002
8		0.234	0.0082		0.0348		<0.001					<0.001		<0.001	<0.005	<0.005
9		0.236	0.0084		0.0350		<0.005					<0.002		<0.002	<0.01	<0.005
10		0.238	0.0085		0.0360		<0.005					<0.005		<0.005		
11		0.240	0.0094		0.0375							<0.005		<0.005		
12		0.243			0.0392											
13		0.244			0.0400											
14		0.260			0.0420											
15		0.262														
Mean	0.0018	0.235	0.0080	0.0029	0.0356	0.0034	0.0006			0.0002	0.0029	0.0003		0.0010	0.0007	0.0017
STDV.	0.0003	0.014	0.0007	0.0022	0.0030	0.0019	0.0003			0.0000		0.0001		0.0008	0.0003	0.0012
Certified	0.0018	0.235	0.0080	0.003	0.036	0.003	(0.0006)	(<0.005)	(<0.001)	(0.0002)	(<0.005)	(0.0003)	(<0.005)	(0.001)	(0.0007)	(0.002)
U _{CRM}	0.0002	0.008	0.0005	0.002	0.002	0.002										
Methods	IM,I	I,IM,O,X	IM,I,O,X	I,IM	I,IM,O,X	I,IM	I,IM,O	IM	IM	F	IM	IM,I,O	IM	I,IM,O	I,IM,O	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

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	Luvak Laboratories Inc.	Boylston, MA
Massachusetts Materials Research Inc.	West Boylston, MA	Connecticut Metallurgical Inc	East Hartford, CT
SGS MSI	Melrose Park, IL		

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 139B NIST 184 NIST 293 NIST 361 NIST 363 NIST 37E

Homogeneity and Uncertainty

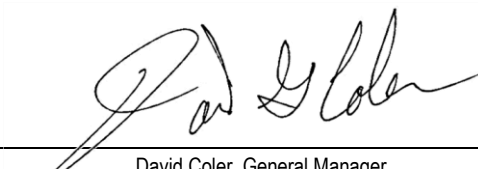
"Uncertainty" values, as reported adjacent to certified concentration values, are based on a 95% Confidence Interval. These estimated uncertainties include the combined effects of method imprecision, material inhomogeneity, and any bias between methods. Homogeneity data from experimental XRF results 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.


 David Coler, General Manager
 Analytical Reference Materials International

