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Certified Reference Material — Certificate of Analysis

ISO 17034:2016 | ISO/IEC 17025:2017 | ISO 9001:2015

Product ID: IARM-Fe1215-18

Product Description: Carbon Steel, AISI 1215 / UNS G12150

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** accredited 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.

Certified Values listed in wt.% with associated uncertainties

As	**0.0043**	± 0.0004	**C**	**0.043**	± 0.002	**Co**	**0.0055**	± 0.0005	**Cr**	**0.051**	± 0.002
Cu	**0.164**	± 0.006	**Mn**	**0.96**	± 0.02	**Mo**	**0.016**	± 0.001	**N**	**0.0109**	± 0.0002
Nb	**0.0012**	± 0.0004	**Ni**	**0.055**	± 0.002	**O**	**0.010**	± 0.002	**P**	**0.059**	± 0.003
S	**0.29**	± 0.02	**Sb**	**0.0018**	± 0.0003	**Sn**	**0.0083**	± 0.0004	**Ti**	**0.0007**	± 0.0003
V	**0.0020**	± 0.0001									

Indicative Values listed in ppm

Al	(20)	B	(10)	Bi	(<100)	Fe	(98.4%)	Mg	(<50)	Pb	(20)	Se	(<100)
Si	(60)	W	(30)	Zn	(50)	Zr	(10)						

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.

$$1.\ N_{MIN} = \max\left(10, \sqrt[3]{N_{PROD}}\right) \qquad 2.\ U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$$

Certification Laboratories: 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.

- LGC Standards - Manchester, NH
- Dirats Laboratories - Westfield, MA
- NSL Analytical Services - Cleveland, OH
- Laboratory Testing, Inc. - Hatfield, PA
- Element Material Technology - Middlesbrough, UK
- Connecticut Metallurgical, Inc. - East Hartford, CT
- IMR Test Labs - Lansing, NY
- SGS MSi - Melrose Park, IL
- Scrooby's Laboratory Service - Rynfield, South Africa
- AnchorCert Analytical - Birmingham, UK
- Sheffield Assay Office - Sheffield, UK
- EAG Laboratories - Liverpool, NY
- TCR Engineering Services - Maharashtra, India
- Luvak Inc. - Boylston, MA

Instructions for Use: 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. 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. The material should be stored in a cool, dry location when not in use. Chips are not recommended for gas analysis.

Period of Validity: 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 Hatkiotis, Global Product Manager

September 30, 2021
Certification Date

ISO 17034 Accredited: Reference Materials Producer, Certificate # 2848.02
ISO/IEC 17025 Accredited: Chemical Testing, Certificate # 2848.01

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

	Al	As	B	Bi	C	Co	Cr	Cu	Fe	Mg	Mn	Mo	N	Nb
1	0.0001	0.0034	0.0001	0.0001	0.0381	0.0040	0.0434	0.1393	97.780	0.0001	0.8730	0.0113	0.0104	0.0002
2	0.0006	0.0035	0.0002	<0.00005	0.0397	0.0041	0.0471	0.1470	98.300	0.0001	0.9030	0.0135	0.0105	0.0010
3	0.0007	0.0038	0.0004	<0.0001	0.0410	0.0043	0.0486	0.1500	98.323	<0.00005	0.9050	0.0136	0.0107	0.0010
4	0.0007	0.0039	0.0010	<0.0005	0.0420	0.0044	0.0488	0.1527	98.372	<0.0005	0.9080	0.0137	0.0110	0.0012
5	0.0008	0.0040	0.0012	<0.001	0.0430	0.0050	0.0490	0.1530	98.473	<0.0005	0.9123	0.0140	0.0110	0.0012
6	0.0010	0.0040	0.0012	<0.001	0.0430	0.0050	0.0497	0.1580	98.940	<0.0005	0.9170	0.0145	0.0110	0.0015
7	0.0019	0.0040	0.0027	<0.001	0.0430	0.0050	0.0500	0.1610	98.960	<0.0005	0.9200	0.0150	0.0110	0.0017
8	0.0020	0.0041	<0.00005	<0.001	0.0440	0.0050	0.0504	0.1610		<0.001	0.9200	0.0150	0.0110	0.0020
9	0.0021	0.0044	<0.0005	<0.002	0.0447	0.0055	0.0509	0.1644		<0.001	0.9320	0.0155	0.0110	<0.00005
10	0.0021	0.0045	<0.0005	<0.005	0.0450	0.0055	0.0510	0.1649		<0.001	0.9430	0.0160		<0.0005
11	0.0021	0.0049	<0.0005	<0.01	0.0452	0.0056	0.0510	0.1670		<0.001	0.9500	0.0160		<0.001
12	0.0030	0.0050	<0.001		0.0460	0.0056	0.0520	0.1690		<0.001	0.9630	0.0161		<0.001
13	0.0032	0.0060	<0.001			0.0058	0.0520	0.1690		<0.005	0.9631	0.0169		<0.002
14	0.0050	<0.001	<0.005			0.0060	0.0520	0.1700			0.9819	0.0170		<0.005
15	<0.001	<0.005	<0.005			0.0060	0.0521	0.1750			0.9837	0.0171		<0.005
16	<0.002	<0.005				0.0062	0.0560	0.1750			0.9990	0.0180		<0.005
17	<0.002	<0.005				0.0074	0.0570	0.1752			1.0190	0.0186		
18	<0.005	<0.005				0.0077		0.1805			1.0312	0.0196		
19						<0.005		0.1817			1.0400			
20											1.0440			
21														
Mean	0.0018	0.0043	0.0010	0.0001	0.0429	0.0055	0.0506	0.1639	98.450	0.0001	0.9554	0.0156	0.0109	0.0012
STDV	0.0013	0.0007	0.0009		0.0024	0.0010	0.0031	0.0117	0.4071	0.0000	0.0509	0.0021	0.0002	0.0005
Certified	(0.002)	0.0043	(0.001)	(<0.01)	0.043	0.0055	0.051	0.164	(98.4)	(<0.005)	0.96	0.016	0.0109	0.0012
U_{CRM}		0.0004			0.002	0.0005	0.002	0.006			0.02	0.001	0.0002	0.0004
Methods	I,IM,O,X	IM,O,I,X	I,IM,O	IM,X,O,I	C,O	I,IM,O,X	I,IM,O,X	I,IM,O,X	O,I,X	I,IM,O,X	I,O,X	I,IM,O,X	F,C	I,IM,O,X

	Ni	O	P	Pb	S	Sb	Se	Si	Sn	Ti	V	W	Zn	Zr
1	0.0490	0.0070	0.0470	0.0001	0.2239	0.0011	0.0001	0.0020	0.0070	0.0002	0.0014	0.0004	0.0005	0.0001
2	0.0500	0.0074	0.0470	0.0001	0.2600	0.0011	0.0021	0.0027	0.0079	0.0003	0.0018	0.0005	0.0007	0.0008
3	0.0529	0.0090	0.0500	0.0001	0.2600	0.0016	<0.00005	0.0033	0.0080	0.0005	0.0019	0.0020	0.0052	0.0012
4	0.0530	0.0093	0.0540	0.0001	0.2720	0.0017	<0.0001	0.0040	0.0080	0.0007	0.0019	0.0021	0.0056	0.0012
5	0.0531	0.0101	0.0554	0.0006	0.2720	0.0018	<0.0001	0.0040	0.0080	0.0009	0.0019	0.0022	0.0058	0.0019
6	0.0541	0.0110	0.0560	0.0008	0.2812	0.0019	<0.001	0.0040	0.0080	0.0010	0.0020	0.0029	0.0060	<0.00005
7	0.0544	0.0110	0.0598	0.0016	0.2870	0.0019	<0.001	0.0060	0.0081	0.0010	0.0020	0.0032	0.0060	<0.0005
8	0.0552	0.0114	0.0600	0.0018	0.2873	0.0020	<0.002	0.0085	0.0082	0.0012	0.0020	0.0040	0.0060	<0.001
9	0.0553	0.0145	0.0610	0.0018	0.2890	0.0020	<0.005	0.0091	0.0082	<0.0005	0.0021	0.0044	0.0069	<0.001
10	0.0555		0.0620	0.0020	0.2893	0.0020	<0.01	0.0095	0.0083	<0.0005	0.0022	0.0050	0.0100	<0.001
11	0.0566		0.0623	0.0025	0.2930	0.0021		0.0100	0.0083	<0.0005	0.0022	<0.0005	<0.005	<0.001
12	0.0570		0.0630	0.0040	0.3000	0.0021		<0.005	0.0085	<0.0005	0.0022	<0.001	<0.005	<0.002
13	0.0580		0.0640	0.0050	0.3000	0.0027		<0.005	0.0089	<0.001	0.0023	<0.002	<0.01	<0.005
14	0.0584		0.0643	<0.001	0.3030	<0.001		<0.005	0.0090	<0.001	<0.001	<0.005		<0.005
15	0.0590		0.0650	<0.001	0.3130	<0.005		<0.005	0.0090	<0.001	<0.005	<0.005		<0.005
16	0.0600		0.0650	<0.001	0.3272	<0.005		<0.01	0.0100	<0.005	<0.005	<0.005		
17	0.0601		0.0670	<0.005	0.3510			<0.01	<0.005	<0.005	<0.005	<0.01		
18				<0.005	0.3681							<0.010		
19														
20														
21														
Mean	0.0554	0.0101	0.0590	0.0016	0.2932	0.0018	0.0011	0.0057	0.0083	0.0007	0.0020	0.0027	0.0053	0.0010
STDV	0.0032	0.0023	0.0064	0.0016	0.0333	0.0004	0.0014	0.0030	0.0007	0.0004	0.0002	0.0015	0.0028	0.0007
Certified	0.055	0.01	0.059	(0.002)	0.29	0.0018	(<0.01)	(0.006)	0.0083	0.0007	0.002	(0.003)	(0.005)	(0.001)
U_{CRM}	0.002	0.002	0.003		0.02	0.0003			0.0004	0.0003	0.0001			
Methods	I,IM,O,X	F,C	I,IM,O,X,W	I,IM,O,X	C,O,X	I,IM,O,X	I,IM,O,A	I,IM,O,X,W	I,IM,O,X	I,IM,O,X	I,IM,O,X	I,IM,O,X	I,IM,O,X	I,IM,O,X

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