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ISO Certified · 9001 · 17025 · 17043 · 17034

Certificate of Analysis

IARM Fe155PH-18

Stainless Steel / AISI 15-5PH / UNS S15500

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	**0.014** ± 0.002	**As**	**0.0026** ± 0.0009	**B**	**0.0005** ± 0.0003	**C**	**0.015** ± 0.001
Co	**0.024** ± 0.003	**Cr**	**15.13** ± 0.05	**Cu**	**3.35** ± 0.03	**Fe**	**75.03** ± 0.09
Mn	**0.616** ± 0.007	**Mo**	**0.129** ± 0.003	**N**	**0.0494** ± 0.0007	**Nb**	**0.273** ± 0.005
Ni	**4.79** ± 0.02	**O**	**0.0028** ± 0.0005	**P**	**0.021** ± 0.002	**S**	**0.0004** ± 0.0003
Si	**0.430** ± 0.008	**Sn**	**0.0021** ± 0.0005	**V**	**0.055** ± 0.002	**W**	**0.019** ± 0.001

Indicative Values listed in ppm

Bi (<10)	Ca (20)	Cd (<10)	H (1)	Mg (<10)	Pb (<50)	Sb (<70)
Se (<50)	Ta (<50)	Ti (<70)	Zn (<70)	Zr (<50)		

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	B	C	Co	Cr	Cu	Fe	Mn	Mo	N	Nb	Ni	O	P	S
1	0.0084	0.0010	0.0000	0.0120	0.0130	14.920	3.258	74.866	0.6000	0.1210	0.0480	0.2530	4.740	0.0021	0.0178	0.0001
2	0.0094	0.0021	0.0002	0.0133	0.0170	15.070	3.263	74.900	0.6020	0.1212	0.0486	0.2630	4.740	0.0021	0.0180	0.0003
3	0.0100	0.0024	0.0004	0.0136	0.0208	15.087	3.318	74.973	0.6039	0.1260	0.0490	0.2647	4.763	0.0022	0.0183	0.0003
4	0.0117	0.0026	0.0006	0.0140	0.0220	15.100	3.321	75.000	0.6069	0.1277	0.0490	0.2650	4.778	0.0028	0.0197	0.0004
5	0.0130	0.0027	0.0006	0.0140	0.0230	15.117	3.345	75.004	0.6080	0.1283	0.0491	0.2700	4.780	0.0028	0.0198	0.0005
6	0.0140	0.0036	0.0009	0.0142	0.0238	15.123	3.350	75.030	0.6080	0.1287	0.0497	0.2720	4.784	0.0029	0.0203	0.0010
7	0.0140	0.0040	0.0010	0.0150	0.0240	15.148	3.358	75.090	0.6090	0.1290	0.0500	0.2724	4.785	0.0030	0.0206	
8	0.0140			0.0153	0.0260	15.153	3.360	75.200	0.6110	0.1300	0.0504	0.2730	4.796	0.0030	0.0220	
9	0.0145			0.0160	0.0267	15.156	3.363	75.210	0.6170	0.1300	0.0508	0.2753	4.805	0.0040	0.0220	
10	0.0148			0.0162	0.0270	15.160	3.370		0.6200	0.1300		0.2758	4.807		0.0230	
11	0.0173			0.0174	0.0271	15.170	3.370		0.6210	0.1320		0.2790	4.817		0.0239	
12	0.0200				0.0276	15.186	3.376		0.6243	0.1322		0.2790	4.820		0.0249	
13	0.0220				0.0306	15.234	3.400		0.6291	0.1330		0.2830	4.820		0.0250	
14					0.0315	15.239	3.410		0.6377	0.1330		0.2857	4.851		0.0250	
15									0.6430	0.1390		0.2873				
Mean	0.0141	0.0026	0.0005	0.0146	0.0243	15.133	3.347	75.030	0.6161	0.1294	0.0494	0.2732	4.792	0.0028	0.0215	0.0004
STDV.	0.0039	0.0010	0.0003	0.0015	0.0050	0.079	0.044	0.119	0.0130	0.0045	0.0009	0.0092	0.031	0.0006	0.0026	0.0003
Certified	**0.014**	**0.0026**	**0.0005**	**0.015**	**0.024**	**15.13**	**3.35**	**75.03**	**0.616**	**0.129**	**0.0494**	**0.273**	**4.79**	**0.0028**	**0.021**	**0.0004**
U_{CRM}	0.002	0.0009	0.0003	0.001	0.003	0.05	0.03	0.09	0.007	0.003	0.0007	0.005	0.02	0.0005	0.002	0.0003
Methods	I,IM,O	IM,I,A	I,IM	C,O	I,IM,O	W,I,O,X	I,O,X	I,O,X	I,IM,O,X	I,IM,O,X	F	I,IM,O,X	I,O,X	F	I,IM,O,X	C,O

	Si	Sn	V	W	Bi	Ca	Cd	H	Mg	Pb	Sb	Se	Ta	Ti	Zn	Zr
1	0.4120	0.0010	0.0480	0.0150	<0.001	0.0002	<0.001	0.0001	<0.001	0.0001	0.0002	<0.001	0.0002	0.0001	0.0004	0.0000
2	0.4121	0.0020	0.0503	0.0180	<0.001	0.0003	<0.001	0.0001	<0.001	0.0001	0.0004	<0.005	0.0002	0.0006	0.0011	0.0029
3	0.4180	0.0021	0.0520	0.0182		0.0006		0.0001	<0.001	0.0010	0.0010		0.0004	0.0008	0.0013	0.0032
4	0.4200	0.0022	0.0530	0.0187		0.0009		<0.001		0.0023	0.0060		0.0020	0.0009	0.0070	<0.0001
5	0.4210	0.0022	0.0530	0.0188		0.0060				0.0038	0.0067		0.0050	0.0030	<0.001	<0.001
6	0.4270	0.0025	0.0541	0.0196		<0.0005				<0.0005	<0.001		<0.001	0.0070	<0.001	<0.001
7	0.4270	0.0026	0.0543	0.0200		<0.001				<0.001			<0.001	<0.0001	<0.001	<0.001
8	0.4317		0.0546	0.0209		<0.001				<0.001			<0.001	<0.001	<0.001	<0.002
9	0.4330		0.0547	0.0210		<0.005				<0.005			<0.0020	<0.001	<0.005	<0.005
10	0.4363		0.0551	0.0213									<0.005	<0.001		
11	0.4400		0.0565	0.0222										<0.005		
12	0.4414		0.0580											<0.005		
13	0.4460		0.0580													
14	0.4580		0.0620													
15																
Mean	0.4303	0.0021	0.0545	0.0194		0.0016		0.0001		0.0015	0.0049		0.0016	0.0021	0.0025	0.0020
STDV.	0.0133	0.0005	0.0035	0.0020		0.0025		0.0000		0.0016	0.0058		0.0021	0.0026	0.0031	0.0017
Certified	**0.430**	**0.0021**	**0.055**	**0.019**	**(<0.001)**	**(0.002)**	**(<0.001)**	**(0.0001)**	**(<0.001)**	**(<0.005)**	**(<0.007)**	**(<0.005)**	**(<0.005)**	**(<0.007)**	**(<0.007)**	**(<0.005)**
U_{CRM}	0.008	0.0005	0.002	0.001							0.007			0.003		
Methods	I,IM,O,X	IM,I,O	I,IM,O,X	I,IM,O	IM,I	I,IM	IM,I,O,X	F	IM	IM,I,A	IM,A,I	IM,A	IM,I	I,IM,O	I,IM	I,IM

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 361 NIST 3109a NIST 3168a NIST 3169

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.

David Coler, General Manager

Analytical Reference Materials International