



ARMI

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Certificate of Analysis

IARM FeP92-18

Low Alloy Steel / Grade P92 / UNS K92460

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	0.005 ± 0.003	B	0.0026 ± 0.0003	C	0.092 ± 0.004	Co	0.036 ± 0.002
Cr	9.4 ± 0.1	Cu	0.074 ± 0.007	Mn	0.737 ± 0.009	Mo	0.52 ± 0.01
N	0.0036 ± 0.0006	Nb	0.096 ± 0.003	Ni	0.82 ± 0.01	O	0.013 ± 0.003
P	0.005 ± 0.001	S	0.005 ± 0.001	Si	0.20 ± 0.01	Sn	0.006 ± 0.001
Ti	0.003 ± 0.002	V	0.188 ± 0.008	W	1.97 ± 0.05		

Indicative Values listed in ppm

As (<50)	Bi (<10)	Ca (<50)	Cd (<10)	H (<10)	Mg (<70)	Pb (<200)
Pd (<10)	Sb (<40)	Se (<200)	Ta (<80)	Zn (<20)	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	Bi	C	Ca	Cd	Co	Cr	Cu	H	Mg	Mn	Mo	N	Nb
1	0.0005	0.0017	0.00201	<0.001	0.0856	0.00013	0.00013	0.03	9.035	0.062	0.0001	0.007	0.716	0.497	0.0029	0.086
2	0.001	0.0041	0.0022		0.0869		0.001	0.033	9.1933	0.067		<0.001	0.72	0.50	0.00307	0.09
3	0.0025	0.00469	0.0024		0.087	<0.005	<0.001	0.0357	9.24	0.068			0.7277	0.508	0.0032	0.091
4	0.004	<0.005	0.0024		0.089			0.036	9.29	0.0697			0.7293	0.51	0.0032	0.0937
5	0.0048		0.0025		0.09			0.0367	9.35	0.073			0.734	0.5138	0.00321	0.097
6	0.00495		0.0026		0.09			0.0369	9.362	0.073			0.7395	0.5182	0.0034	0.097
7	0.009		0.00277		0.091			0.037	9.42	0.0751			0.74	0.526	0.0036	0.0972
8	0.0094		0.003		0.0938			0.039	9.424	0.0755			0.742	0.527	0.0044	0.099
9			0.0031		0.0944			0.039	9.45	0.0783			0.743	0.528	0.0055	0.10
10			0.0034		0.0984				9.525	0.097			0.745	0.536		0.1014
11					0.103				9.549				0.766	0.539		0.102
12									9.551					0.5604		
13																
14																
15																
Mean	0.005		0.0026		0.092			0.036	9.4	0.074			0.737	0.52	0.0036	0.096
STDV.	0.003		0.0004		0.005			0.003	0.2	0.009			0.01	0.02	0.0008	0.005
Certified	0.005	(<0.005)	0.0026	(<0.001)	0.092	(<0.005)	(<0.001)	0.036	9.4	0.074	(<0.001)	(<0.007)	0.737	0.52	0.0036	0.096
U _{CRM}	0.003		0.0003		0.004			0.002	0.1	0.007			0.009	0.01	0.0006	0.003
Methods	O,I,X,IM	O,I,X,IM	IM	IM	O,C	O,IM	O	O,I,G,X,IM	O,W,I,X,G	O,I,X,G,IM	F	IM	O,I,X,G	O,I,X,G,IM	F	O,I,G,X,IM

	Ni	O	P	Pb	Pd	S	Sb	Se	Si	Sn	Ta	Ti	V	W	Zn	Zr
1	0.7949	0.0054	0.002	0.0001	<0.001	0.0019	0.0007	0.0024	0.168	0.004	0.008	0.00037	0.168	1.84	0.00071	0.0015
2	0.7981	0.0133	0.0034	0.011		0.003	0.002	0.017	0.173	0.0041	<0.001	0.002	0.174	1.881	0.0019	0.003
3	0.80	0.01331	0.0039	0.016		0.003	0.0033	<0.005	0.18	0.0048		0.002	0.1786	1.903	<0.001	0.0042
4	0.808	0.0135	0.005	<0.001		0.0034	<0.001		0.188	0.005		0.00281	0.18	1.9107		0.005
5	0.812	0.014	0.0056			0.0037			0.1992	0.00601		0.0037	0.186	1.931		<0.001
6	0.813	0.016	0.00592			0.0038			0.206	0.007		0.006	0.188	1.9483		
7	0.8151	0.016	0.006			0.00404			0.208	0.008		0.006	0.189	1.951		
8	0.817		0.0069			0.00435			0.213				0.191	2.003		
9	0.82		0.0072			0.0069			0.2159				0.1916	2.01		
10	0.843		0.0074			0.007			0.222				0.1925	2.029		
11	0.863					0.0092			0.226				0.203	2.055		
12													0.2166	2.1453		
13																
14																
15																
Mean	0.82	0.013	0.005			0.005		0.0024	0.2	0.006		0.003	0.188	1.97		
STDV.	0.02	0.004	0.002			0.002		0.002	0.02	0.002		0.002	0.01	0.08		
Certified	0.82	0.013	0.005	(<0.02)	(<0.001)	0.005	(<0.004)	(<0.02)	0.20	0.006	(<0.008)	0.003	0.188	1.97	(<0.002)	(<0.005)
U _{CRM}	0.01	0.003	0.001			0.001		0.01	0.01	0.001		0.002	0.008	0.05		
Methods	O,I,X,G	F	O,I,X,G,IM	O,IM	IM	O,C,X	O,X,IM	X,IM	O,C,X,IM,I	O,I,X,IM	O,X,IM	O,I,X,G,IM	IM,I	O,I,X,G	X,IM	O,X,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

Ellwood Quality Steels Co.	New Castle, PA	Laboratory Testing, Inc.	Hatfield, PA
Exova - Burlington	Burlington, ON	Cronimet Specialty Metals USA, Inc.	Wheatland, PA
Anderson Laboratories, Inc.	Greendale, WI	TimkenSteel Corporation	Canton, OH
LECO Corporation	St. Joseph, MI	LGC Standards	Manchester, NH
NSL Analytical Services, Inc.	Cleveland, OH	IMR Test Labs	Lansing, NY
EAG Laboratories, Inc.	Liverpool, NY	Dirats Laboratories	Westfield, MA

Certification laboratories have demonstrated performance and traceability by utilizing a variety of test methods all under the scope of ISO 17025. Some of the specific CRMs and SRMs used in the analysis of the material covered by this certificate are:

NIST 1223 NIST 1261 NIST 1262 NIST 1263 NIST 1264 NIST 1265 NIST 132A NIST 1754 NIST 1761 NIST 1762 NIST 1763 NIST 1766 NIST 3163

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

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