

Analytical Reference Materials International

Certificate of Analysis Certified Reference Material



Grade: **Grade 91 / UNS K91560**

Part Number (Q.A. NO.): **IARM 238A**

Certificate Date: **01/24/2002**

Certificate No.: **238A-01242002-IARM-F**

Revision Date: **05/07/2008**

Interpretation of Data

1. Certified values listed below reflect analysis results submitted by qualified analytical laboratories using a combination of methods and instrumentation that emulate actual methods and instrumental techniques currently utilized in the analytical community and are reported as % wt. unless otherwise noted.
2. Any data reported and enclosed by a **parentheses ()** is a **"best estimate"** and is **NOT CERTIFIED**. This data could not be quantified sufficiently for certification. It was however, reported by enough laboratories to be considered as potentially present in the matrix of the material being examined.
3. The "Inter-laboratory Analysis Program" (ILAP) utilized in the establishment of the data are an ongoing program with permanent membership. Certain elements may be selected by a consensus of the members for more extensive testing. Therefore the data in **brackets []** indicates **further testing is in process**.
4. The **"±Estimated Uncertainty"** is enclosed by a **parentheses ()** below the individual **element's concentration** and is based on a Confidence Interval at 95%. Included in this estimated uncertainty, are the combined effects of method imprecision, material inhomogeneity, and any bias between methods.

Important: A "User Registration Card" accompanies all shipments. This card should be completed immediately upon receipt of materials with the appropriate user information. This is the only way in which ARMI can guarantee customer updates or possible data modifications!

<u>Aluminum</u>	<u>Antimony</u>	<u>Arsenic</u>	<u>Boron</u>	<u>Calcium</u>	<u>Carbon</u>	<u>Chromium</u>	<u>Cobalt</u>
0.03 (0.004)		0.012 (0.002)	0.0004 (0.0001)		0.110 (0.001)	8.23 (0.03)	0.026 (0.003)
<u>Copper</u>	<u>Lead</u>	<u>Manganese</u>	<u>Molybdenum</u>	<u>Nickel</u>	<u>Niobium</u>	<u>Nitrogen</u>	<u>Oxygen</u>
0.17 (0.004)		0.40 (0.005)	0.94 (0.01)	0.256 (0.003)	0.086 (0.001)	0.047 (0.001)	0.003 (0.001)
<u>Phosphorus</u>	<u>Sulfur</u>	<u>Silicon</u>	<u>Tin</u>	<u>Titanium</u>	<u>Tungsten</u>	<u>Vanadium</u>	<u>Zirconium</u>
0.007 (0.0003)	0.010 (0.0004)	0.31 (0.01)	0.013 (0.0005)	0.003 (0.0005)	<0.03	0.22 (0.01)	0.002 (0.0004)

The laboratories participating in the "Inter-Laboratory Analysis Program" (ILAP) and certification of this material are as follows:

AK Steel, Butler Works - Butler, PA
Anderson Laboratories, Inc. - Greendale, WI
Bodycote Testing - Gary, IN
Colorado Metallurgical Services - Denver, CO
IPSCO Koppel Tubulars - Koppel, PA
The Timken Company - Canton, OH

Algoma Steel, Inc. - Sault Ste. Marie, ON
ArcelorMittal Indiana Harbor - East Chicago, IN
Carpenter Technology Corporation - Reading, PA
Crucible Specialty Metals - Syracuse, NY
Laboratory Testing, Inc. - Hatfield, PA
Wheeling Pittsburgh Steel Corp. - Mingo Junction, OH

Traceability: All members of the "Inter-Laboratory Analysis Program" (ILAP) listed above validate test methods and instrument performance utilizing SRMs produced by the National Institute of Standards and Technology, (NIST) as well as other CRMs and RMs produced by recognized Certifying Bodies from around the world. The specific SRMs, CRMs, and RMs applicable to the material covered by this certificate are: NIST 1254, 1261, 1262, 1265, 1761, 1762, 1763, 1764, 1765, 1766, 1767, BS 11, 13, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, ST 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, LST 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, IARM 27B, 28A, 29A, 29B, 30A, 30B, 31A, 31B, 32A, 32B, 33A, 34A, 34B, 35A, 35B, 36A, 37A, 38A, 39A, 40A, 41A, 42A, 43A, 44A, 45A, 46A, 47A, 48A, 49A, 49B, 156A, 166A, 167A, 168A, 180A, 183A, NIST 1160, 1161, 1162, 1163, 1164, 1261, 1262, 1263, 1264, 1265, 1761, 1762, 1763, 1764, 1765, 1766, 1767, 337a, 1754, JSS ST01, ST02, ST03, ST04, ST05, ST06, 168-4, 169-4, 170-4, 171-4, 172-4, 173-4, 174-4, 175-4, BAS 401/1, 402/1, 403/1, 404/1, 405/1, 406/1, 407/1, 408/2, 409/2, 410/2, 14, 14B, XEEH, XAAS, XCCV, XCCS, CA-1, CA-2, CA-3, CA-4, CA1A, CA2A, CA3A, LECO 501-510, 501-645, NIST 15H, 73C, 1761, 1763, 1766, IARM 38A, BS 11A, 13A, 98, 156, ST 31-1, CMSI 2167, 2168, ARMCO V2859, V2860, V3196-1, AK 240534, 340810, NIST 121D, 133A, 361, 363, 1091A, LECO 501-645, BS 9905, 89E, LECO 501-510, 501-553, IARM 38A, BS 3941, NIST 362, IARM 27B, LECO 501-647, IC 64356, NIST 339, 153, 50C, IARM 38A, 39B, 42B, 44B, NIST 343A, 32B, BS 48, LECO 501-553, NIST 1160, 1161, 1162, 1163, 1164, 1261, 1262, 1263, 1264, 1265, 1761, 1762, 1763, 1764, 1765, 1766, 1767, 1768, 15h, 361, 2165, NIST 1761, 1762, 1763, 1764, 1765, 1766, 1767, SUS RE 12/2, 12/19, C/8, C/17, D/8, INOX, AR 871, 872, 873, BS CSN 2-1, 3, 4, NIST 11H, 12H, 368, 153, 1091A, IARM 38A

A specific line of traceability is established to NIST and other Certifying Bodies for those elements that are noted as "Certified Values" on the Certificates of Analyses referenced above.

See Reverse Side for Statistical Data and Additional Information Regarding this Material.

The following data and accompanying statements represent all pertinent information reported in the ILAP as it applies to the chemical characterization of this material as of 05/07/2008.

238A	Al	As	B	C	Co	Cr	Cu	Mn	Mo	N	Nb	Ni	O	P	Pb
1	0.031	0.0127	0.0003	0.110	0.0280	8.21	0.180	0.39	0.95	0.048	0.084	0.250	0.00240	0.008	<0.001
2	0.033	0.0081	0.0004	0.108	0.0257	8.169	0.164	0.403	0.916	0.0469	0.0846	0.257	0.0029	0.008	0.0014
3	0.0302	0.0143	0.0006	0.108	0.0229	8.197	0.169	0.395	0.932	0.0462	0.0866	0.258	0.0042	0.0071	<0.0001
4	0.0285	0.0161	0.0004	0.1125	0.024	8.2670	0.1606	0.402	0.939	0.0467	0.085	0.256	0.0024	0.0077	0.0005
5	0.0418	0.010	0.0001	0.1110	0.0325	8.20	0.172	0.4147	0.9212	0.0504	0.086	0.2514	0.0051	0.008	<0.0001
6	0.030	0.009	0.0005	0.110	0.025	8.256	0.1726	0.399	0.933	0.0498	0.0868	0.259	0.0023	0.0072	0.0002
7	0.0354	0.01362	0.0003	0.108	0.02	8.225	0.170	0.4070	0.968	0.0459	0.086	0.2558		0.0067	0.0002
8	0.0238	0.0150	0.0005	0.108	0.030	8.32	0.170	0.405	0.947	0.0490	0.089	0.262		0.007	
9	0.019		0.00015	0.1135	0.022	8.25	0.168	0.402	0.961	0.0467	0.08709	0.250		0.0069	
10	0.021		0.0003	0.1070	0.026	8.142	0.168	0.403	0.934	0.0436	0.0868	0.255		0.0074	
11	0.028			0.109	0.0314	8.28	0.181	0.414	0.920	0.04864		0.261		0.0074	
12	0.041			0.10872			0.1727	0.41207	0.947	0.04715		0.250			
13	0.03772			0.1125				0.4127		0.0477		0.2609			
14	0.0300			0.1137											
Mean	0.0307	0.0124	0.0004	0.1100	0.0261	8.2287	0.1707	0.4046	0.9390	0.0474	0.0862	0.2559	0.0032	0.0074	0.0006
STDV.	0.0068	0.0030	0.0002	0.0023	0.0040	0.0519	0.0058	0.0075	0.0162	0.0018	0.0014	0.0044	0.0012	0.0005	0.0006
Certified	0.03	0.012	0.0004	0.110	0.026	8.23	0.17	0.40	0.94	0.047	0.086	0.256	0.003	0.007	
95% C.I.	0.004	0.002	0.0001	0.001	0.003	0.03	0.004	0.005	0.01	0.001	0.001	0.003	0.001	0.0003	
Methods	I,O	D,I,O	I,O	C,O	X,I,O	X,W,O	X,A,I,O	X,A,I,O	X,A,I,O	F,O	X,O	X,A,I,O	F	X,O	

Legend: W = Classical, C = Combustion, F = Fusion, A = AA or GFAA, I = ICP or DCP, D = DC Arc, O = OE, X = XRF, G = GDMS, H = Hollow Cathode OE

238A	S	Si	Sn	Ti	V	W	Bi	Ca	Cd	Mg	Sb	Se	Ta	Zn	Zr
1	0.009	0.300	0.014	0.002	0.210	0.0059	0.0012	0.0001		0.0022	0.0023	<0.0001	0.001	0.0040	0.001
2	0.010	0.325	0.013	0.003	0.215	0.001	0.0033	0.0072		0.0067	0.0024	0.0037	<0.001		0.001
3	0.0093	0.303	0.01175	0.0014	0.212	0.0005	0.0013	<0.0001		0.0002	0.0002	<0.0001	0.0225		0.0010
4	0.0088	0.306	0.0137	0.0025	0.2129	0.0015	<0.0001				0.0049	<0.001	0.0089		0.0021
5	0.0107	0.3128	0.0120	0.0024	0.2338	0.0241					<0.001		0.001		0.0016
6	0.0095	0.313	0.012	0.0018	0.222	<0.001					0.015		<0.01		0.001
7	0.0110	0.334	0.0132	0.0040	0.2330	0.021					0.0174				0.0024
8	0.0097	0.301	0.0119	0.0025	0.228	0.003									0.0019
9	0.010	0.295	0.014	0.001	0.215	<0.0050									0.0021
10	0.0098	0.310	0.013	0.0039	0.226										
11	0.0094	0.315	0.0115	0.0021	0.235										
12	0.00933	0.306	0.013	0.003	0.23252										
13	0.0104	0.33834	0.01329	0.0029	0.2216										
14	0.0101	0.3228	0.0133	0.0028											
Mean	0.0098	0.3130	0.0128	0.0025	0.2228	0.0081	0.0019	0.0037		0.0030	0.0070	0.0037	0.0084	0.0040	0.0016
STDV.	0.0006	0.0129	0.0008	0.0008	0.0092	0.0100	0.0012	0.0050		0.0033	0.0073		0.0101		0.0006
Certified	0.010	0.31	0.013	0.003	0.22	<0.03									0.002
95% C.I.	0.0004	0.01	0.0005	0.0005	0.01										0.0004
Methods	C,O	X,W,A,O	X,I,O	X,I,O	X,I,O	X,I,O									X,O

Legend: W = Classical, C = Combustion, F = Fusion, A = AA or GFAA, I = ICP or DCP, D = DC Arc, O = OE, X = XRF, G = GDMS, H = Hollow Cathode OE

The International Standards Organization (ISO) definitions, expressed in ISO Guide 30-1992 list the following:

Certifying Body: Any technically competent body (organization or firm, public or private) that issues a reference material certificate which provides the information detailed in ISO Guide 31. The only generally accepted certifying body in the United States for primary standards - Standard Reference Materials (SRM) is the U. S. Department of Commerce, National Institute of Standards & Technology, (NIST), Gaithersburg, MD. All other certifying bodies in the United States produce Reference Materials (RM) or Certified Reference Materials (CRM).

Reference Material (RM): Material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Certified Reference Material (CRM): Reference material, accompanied by a certificate, one or more of whose property values are certified by a procedure which establishes its traceability to an accurate realization of the unit in which the property values are expressed, and for which each certified value is accompanied by an uncertainty at a stated level of confidence.

Inter-Laboratory Analysis Program (ILAP): Although ASTM Standard E691-87 applies to inter-laboratory studies to "Determine the Precision of a Single Test Method", it is also a well thought out and logical plan for conducting an inter-laboratory program involving multiple techniques. Therefore, the planning, conducting, analyzing, protocol, and treatment of data resulting from this inter-laboratory program were performed utilizing the guidelines established in ASTM E691-87.

Methods of Analysis: In view of the fact, that the "Inter-Laboratory Analysis Program" entails a wide variety of materials, no single analytical method would provide optimum data results. Therefore, the methods utilized were a combination of ASTM Standard Methods for classical wet chemistry, ICP, AA, Optical Emission, and X-Ray spectrometric methods. The determinations for Carbon, Sulfur, Nitrogen, and Oxygen are the result of combustion instrument procedures.

Selection of Materials: A "batch" or "series" is defined as a single bar of one continuous length and heat. The majority of materials are in wrought condition; other methods of manufacture are utilized as a less desirable resort. ILAP samples are taken by removing a section, a minimum of, every one-twelfth of total length from the entire bar. A portion of the section is converted to chips and thin (pin) disk for analysis by classical wet chemistry, ICP, AA, and combustion procedures, and the balance remains as a thick disk for OES and X-Ray analysis. Each member of the ILAP is furnished a sample pack from a specific location on the batch bar. This systematic sampling procedure results in the homogeneity being reflected as a product of the overall statistics and certified data. This method of homogeneity testing is in accordance with ISO Guide 34, regarding the systematic selection and testing of a representative number of units for the assessment of homogeneity.

Certified by: 
 William D. Britt, President & General Manager
 Analytical Reference Materials International Corporation

Certificate No.: 238A-01242002-IARM-F
 Certificate Date: 01/24/2002
 Revision Date/No.: 05/07/2008