

Analytical Reference Materials International



Certificate of Analysis Certified Reference Material



Grade: **AISI 310 / UNS S31000**

Part Number (Q.A. NO.): **IARM 4F**

Certificate Date: **04/03/2017**

Certificate No.: **4F-04032017-IARM-F**

Revision Date: **10/06/2017**

Interpretation of Data

- 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.
- 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.
- 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**.
Chips are not certified for Oxygen analysis.
- 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>Cerium</u>	<u>Chromium</u>	<u>Cobalt</u>
0.015 (0.001)	(0.001)	0.003 (0.001)	0.0012 (0.0005)	(0.002)	0.047 (0.001)	(<0.005)	24.5 (0.1)	0.067 (0.003)
<u>Copper</u>	<u>Lead</u>	<u>Magnesium</u>	<u>Manganese</u>	<u>Molybdenum</u>	<u>Nickel</u>	<u>Niobium</u>	<u>Nitrogen</u>	<u>Oxygen</u>
0.146 (0.002)	(<0.001)	(<0.002)	1.17 (0.01)	0.142 (0.004)	20.1 (0.1)	0.007 (0.001)	0.056 (0.001)	0.004 (0.001)
<u>Phosphorus</u>	<u>Selenium</u>	<u>Silicon</u>	<u>Sulfur</u>	<u>Tantalum</u>	<u>Tin</u>	<u>Titanium</u>	<u>Tungsten</u>	<u>Vanadium</u>
0.0195 (0.0003)	(0.001)	0.494 (0.006)	0.0015 (0.0002)	0.007 (0.002)	0.005 (0.001)	0.0031 (0.0004)	0.012 (0.001)	0.146 (0.002)
<u>Zinc</u>	<u>Zirconium</u>							
(0.001)	0.002 (0.001)							

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

AADFV, Inc. - Euless, TX	Ellwood National Steel - Irvine, PA
Anderson Laboratories, Inc. - Greendale, WI	Exova - Gary, IN
Certified Alloy Products - Long Beach, CA	Laboratorio Prove Materiali S. Marco srl - Schio, It
Crucible Industries - Syracuse, NY	Laboratory Testing, Inc. - Hatfield, PA
Davis Alloys Manufacturing, LLC - Sharon, PA	PM Kalco, Inc - Wheatland, PA
Element - Huntington Beach, CA	SPECTRO Analytical Instruments Inc. - Mahwah, NJ

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:

ALPHA AR654	BCS SS464	BS 84J	IARM 21A	IARM 4D	LECO 502-414	NIST 3101A	NIST 316A	NIST363
ALPHA AR662	BS 60C	BS 8620B	IARM 21B	IARM 4E	MBH 13X30908A	NIST 3107	NIST 334	
ALPHA AR870	BS 83B	BS 88F	IARM 241A	IARM AR882	MBH 13X31008A	NIST 3109A	NIST 339	
ALPHA AR881	BS 83C	CARTECH 166	IARM 289A	LECO 501-494	MBH 13X31008-A	NIST 3131A	NIST 348A	
ALPHA AR891	BS 83D	CARTECH 249	IARM 2C	LECO 501-502	MBH 13XNSA11-A	NIST 3149	NIST 361	
ASTM 0322	BS 83E	IARM 162B	IARM 2F	LECO 501-550	NIST 101G	NIST 3155	NIST 363	
ASTM 9841	BS 83F	IARM 16B	IARM 4A	LECO 501-592	NIST 121D	NIST 3162A	NIST 897	
ASTM 9842	BS 83G	IARM 1B	IARM 4B	LECO 501-675	NIST 160A	NIST 3168A	NIST 898	
BCS 346	BS 83H	IARM 212B	IARM 4C	LECO 501-952	NIST 160B	NIST 3169	NIST 899	

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.

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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 10/06/2017

	Al	Sb	As	B	Ca	C	Ce	Cr	Co	Cu	Pb	Mg	Mn	Mo	Ni
1	0.0127	0.00055	0.0020	0.0003	0.0010	0.044	<0.0001	24.280	0.0598	0.1394	0.00002	0.0014	1.150	0.1339	19.950
2	0.0131	0.0006	0.0023	0.0004	0.0015	0.0457	<0.005	24.3214	0.0632	0.1397	0.0003	0.0018	1.160	0.134	19.991
3	0.0134	0.0008	0.0026	0.0005	0.0024	0.0459		24.3352	0.0634	0.141	0.0003		1.161	0.1343	20.000
4	0.014	0.0008	0.0031	0.0011	0.0029	0.046		24.34	0.064	0.1428	0.00033		1.1625	0.136	20.01
5	0.014		0.0038	0.0012		0.046		24.378	0.066	0.1438	0.0010		1.163	0.137	20.05
6	0.0144		0.0039	0.0013		0.046		24.405	0.066	0.145	0.0011		1.1660	0.138	20.0513
7	0.0144		0.0040	0.0014		0.046		24.50	0.0689	0.146			1.169	0.140	20.060
8	0.0157			0.0018		0.0462		24.51	0.069	0.1469			1.1692	0.1415	20.09
9	0.0159			0.0018		0.0466		24.516	0.0692	0.147			1.1694	0.144	20.119
10	0.0168			0.0023		0.0476		24.535	0.0723	0.1475			1.17	0.1441	20.18
11	0.0170					0.0483		24.581	0.0739	0.1484			1.177	0.1458	20.224
12						0.0484		24.618		0.149			1.1798	0.1470	20.303
13						0.0485		24.7302		0.150			1.187	0.150	20.308
14								24.76		0.1510				0.154	
15														0.155	
Mean	0.015	0.0007	0.003	0.001	0.002	0.047		24.5	0.067	0.146	0.0005	0.0016	1.17	0.142	20.1
STDV.	0.001	0.0001	0.001	0.0007	0.0009	0.001		0.2	0.004	0.004	0.0004	0.0003	0.01	0.007	0.1
Certified	0.015	(0.001)	0.003	0.0012	(0.002)	0.047	(<0.005)	24.5	0.067	0.146	(<0.001)	(<0.002)	1.17	0.142	20.1
95% C.I.	0.001		0.001	0.0005		0.001		0.1	0.003	0.002			0.01	0.004	0.07
Methods	O,I	O,IM,A	O,IM,A	O,I	O,I	O,C	O,IM	X,W,O	X,O,I	X,O,I	X,O,IM,A	IM	X,O,I	X,O,I	X,O,I

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

	Nb	N	O	P	Se	Si	S	Ta	Sn	Ti	W	V	Zn	Zr
1	0.0057	0.0549	0.0012	0.0189	0.0007	0.4828	0.0010	0.0049	0.0031	0.0024	0.0089	0.1388	0.0001	0.0001
2	0.0057	0.0550	0.0021	0.019	0.0008	0.483	0.001	0.0049	0.0036	0.0024	0.0101	0.139	0.0006	0.0001
3	0.0059	0.055	0.0036	0.019	0.0010	0.4833	0.0012	0.0052	0.0036	0.0025	0.0106	0.1450	0.0010	0.0011
4	0.006	0.0553	0.0037	0.0190	0.0013	0.4859	0.0014	0.0054	0.0038	0.0027	0.0110	0.1453	0.0012	0.0013
5	0.0062	0.0556	0.0043	0.0194	0.0013	0.489	0.0015	0.006	0.0044	0.0029	0.0111	0.1461		0.0014
6	0.0063	0.056	0.0049	0.0195		0.492	0.0016	0.008	0.0047	0.0029	0.0119	0.147		0.002
7	0.0074	0.0572	0.0051	0.0195		0.4938	0.0016	0.010	0.005	0.0030	0.0123	0.147		0.0032
8	0.0082	0.0575	0.0055	0.0195		0.4951	0.0016	0.010	0.0051	0.0036	0.0128	0.148		0.0034
9	0.0090	0.0579		0.0199		0.500	0.0016	0.010	0.0051	0.0037	0.014	0.1488		
10	0.0091	0.0581		0.020		0.5023	0.0018		0.0053	0.0038	0.015	0.1489		
11	0.010			0.020		0.5040	0.0019		0.0055	0.0038		0.149		
12				0.0200		0.506	0.002		0.006			0.150		
13				0.0204		0.508			0.0070			0.150		
14									0.0070					
15														
Mean	0.007	0.056	0.004	0.0195	0.001	0.494	0.0015	0.007	0.005	0.0031	0.012	0.146	0.0007	0.002
STDV.	0.002	0.001	0.001	0.0005	0.0003	0.009	0.0003	0.002	0.001	0.0006	0.002	0.004	0.0005	0.001
Certified	0.007	0.056	0.004	0.0195	(0.001)	0.494	0.0015	0.007	0.005	0.0031	0.012	0.146	(0.001)	0.002
95% C.I.	0.001	0.001	0.001	0.0003		0.006	0.0002	0.002	0.001	0.0004	0.001	0.002		0.001
Methods	X,O,I	O,F	O,F	X,O,I	X,O,IM	X,W,O,I	X,O,C	X,O,I	X,O,I,A	O,I	X,O,I	X,O,I	IM,A	X,O,IM,I

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

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 and OE instrument procedures.

Expiration of Certification: The certification of this IARM is valid indefinitely, within the uncertainty specified, provided the IARM is handled and stored in accordance with the instructions stated on this certificate. The certification is nullified if the IARM is damaged, contaminated, otherwise modified, or used in a manner for which it was not intended.

Instructions for Use: The test surface is the side opposite to the labeled surface, which includes the IARM number. 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. When not in use, the material should be stored in a cool, dry location. This material was tested using both the solid disks and chips prepared from the disks. The certified values are considered representative of the overall average composition of the material. Chips are not to be used for Oxygen analysis.

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. 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.


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 Analytical Reference Materials International

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