

Analytical Reference Materials International

Certificate of Analysis Certified Reference Material



Grade: **KOVAR / UNS K94610**

Part Number (Q.A. NO.): **IARM 98B**

Certificate Date: **09/21/2007**

Certificate No.: **98B-09212007-IARM-F**

Revision Date: **11/08/2007**

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>Arsenic</u>	<u>Boron</u>	<u>Calcium</u>	<u>Carbon</u>	<u>Cobalt</u>	<u>Chromium</u>	<u>Copper</u>	<u>Iron</u>
0.07	<0.002	0.001	<0.0005	0.007	17.0	0.012	0.028	52.9
(0.01)		(0.0005)		(0.0004)	(0.1)	(0.002)	(0.001)	(0.2)
<u>Lead</u>	<u>Magnesium</u>	<u>Manganese</u>	<u>Molybdenum</u>	<u>Nitrogen</u>	<u>Niobium</u>	<u>Nickel</u>	<u>Oxygen</u>	<u>Phosphorus</u>
<0.0005	0.0040	0.18	0.010	0.0024	0.002	29.4	0.0021	0.002
	(0.0003)	(0.004)	(0.001)	(0.0002)	(0.001)	(0.1)	(0.0003)	(0.001)
<u>Sulfur</u>	<u>Silicon</u>	<u>Tantalum</u>	<u>Tin</u>	<u>Titanium</u>	<u>Vanadium</u>	<u>Tungsten</u>	<u>Zinc</u>	<u>Zirconium</u>
0.0007	0.17	<0.05	0.002	0.03	(0.003)	(0.02)	<0.0005	<0.01
(0.0003)	(0.01)		(0.001)	(0.01)	(0.002)			

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

Anderson Laboratories, Inc. - Greendale, WI
Bodycote Materials Testing - Los Angeles, CA
Crucible Research - Pittsburgh, PA
Kalco Metals, Inc - Farrell, PA
Latrobe Specialty Steel Co. - Latrobe, PA
Special Metals IncoTest - Hereford, UK

ATI Allvac - Lockport, NY
Carpenter Technology Corporation - Reading, PA
Huntington Alloys Corporation - Huntington, WV
Laboratory Testing, Inc. - Hatfield, PA
MetalTek International, Inc. - Waukesha, WI
Staveley Services / Bodycote - Gary, IN

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: **IARM 98A, ALPHA AR 660, AR 881, HAS KA, BCS 351, 454/1, 462/1, LECO 501-557, 502-102, R5657, IS 0146A, 0031A, IARM 99A, BS 160, LECO 501-503, 501-643, ALPHA AR512, NIST 50C, 126C, 885, 1763, 1765, 1767, IARM 98A, BS 346A, IARM 98A, LECO 501-551, 501-673, ALPHA AR656, CPI4400, 1000373, 10M613, 10M553, 1000651, 100031, 10M311, 10M691, IARM 98A, LECO 501-501, 502-106, Kovar C48, IARM 27C, 99B, 254A, IARM 98A, 152A, 162A, NIST 868, LECO 501-550, 502-064, 502-106, ALPHA AR892, NIST 2168, IARM 98A, BS 160, CSN-4, MBH 147330, 14933Q, ALV03PA, LECO 501-643, 501-673, 501-674, 502-075, NIST 131G, 898, HAS KA, 400M, 400T, 600C, 805B, 902B, IARM 98A, LECO 502-256BS 160**

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 11/08/2007.

98B	Al	B	C	Co	Cr	Cu	Mn	Mo	N	Nb	Ni	O	P	S	Se
1	0.070	0.0006	0.0065	16.90	0.010	0.030	0.18	0.010	0.0027	0.001	29.10	0.0024	0.0017	0.0015	<0.0001
2	0.071	0.0019	0.00731	17.380	0.017	0.025	0.177	0.012	0.0024	0.0027	29.300	0.0019	0.001	0.0002	<0.0001
3	0.0710	0.0015	0.0080	16.80	0.010	0.027	0.180	0.0083	0.00223	0.0016	29.08	0.00164	0.0006	0.0010	0.00002
4	0.0801	0.0005	0.0078	17.051	0.0117	0.0323	0.191	0.0086	0.0028	0.0011	29.451	0.0022	0.0013	0.0003	
5	0.0745	0.0007	0.00755	16.848	0.0113	0.0305	0.1783	0.008	0.0022	0.0028	29.708	0.0027	0.0017	0.0002	
6	0.068	0.0010	0.0065	17.243	0.010	0.026	0.169	0.0121	0.0025	0.0023	29.82	0.0015	0.0033	0.0003	
7	0.055	0.0015	0.0069	17.087	0.0085	0.027	0.179	0.010	0.00242	0.0013	29.47	0.0032	0.002	0.0015	
8	0.062		0.0075	17.18	0.011	0.031	0.171	0.011	0.0022	0.0012	29.75	0.0020	0.0027	0.0004	
9	0.087		0.00692	16.92	0.016	0.028	0.189	0.0097	0.0020		29.45	0.0026	0.0018	0.00044	
10	0.075		0.0072	17.25	0.011	0.026	0.181		0.00243		29.35	0.00154	0.0023	0.00038	
11	0.075			16.83	0.018	0.0264	0.180		0.0023		29.514	0.0017	0.0025	0.0010	
12	0.0794			16.848	0.0105	0.0286	0.183				29.33	0.0022	0.0039		
13				16.96	0.014		0.1827				29.40				
14				16.83	0.0155										
Mean	0.0723	0.0011	0.0072	17.0091	0.0125	0.0282	0.1801	0.0100	0.0024	0.0018	29.4402	0.0021	0.0021	0.0007	0.0000
STDV.	0.0084	0.0005	0.0005	0.1900	0.0030	0.0023	0.0060	0.0015	0.0002	0.0007	0.2246	0.0005	0.0009	0.0005	
Certified	0.07	0.001	0.007	17.0	0.012	0.028	0.18	0.010	0.0024	0.002	29.4	0.0021	0.002	0.0007	
95% C.I.	0.01	0.0005	0.0004	0.1	0.002	0.001	0.004	0.001	0.0002	0.001	0.1	0.0003	0.001	0.0003	
Methods	X,A,I,O	D,I,O	C,O	X,I,O	X,I,O	X,I,O	X,I,O	X,I,O	F	I,O	X,W,I,O	F	X,I,O	X,C,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

98B	Si	Sn	Ta	Ti	V	W	Ag	As	Bi	Ca	Fe	Mg	Pb	Zn	Zr
1	0.15	0.002	0.065	0.06	0.004	0.030	0.00001	0.0011	<0.0001	0.001	53.26	0.0042	0.00004	0.0001	0.015
2	0.155	0.0017	0.0005	0.037	0.0004	0.0018	<0.00001	0.0009	<0.0001	<0.0001	52.991	0.0044	0.0010	0.0005	0.018
3	0.174	0.0021	0.0050	0.032	0.0005	0.032		0.0011	<0.001	0.0004	52.725	0.0043	0.0003	<0.005	0.0065
4	0.170	0.0033	0.002	0.0342	0.0007	0.029		0.0020	<0.001	0.0002	52.69	0.0037	0.0001	0.0001	0.0068
5	0.1763	0.0002	0.0027	0.0371	0.007	0.018			<0.00001	0.0002	53.11	0.0040	0.0001		0.0038
6	0.178	0.0015	0.0098	0.0293	0.001	0.009			0.0304		52.98	0.0036	0.00002		0.0036
7	0.180	0.0026		0.0336	0.0035	0.020					52.751				0.0105
8	0.181			0.011	0.0008	0.0022									0.014
9	0.175			0.0361	0.0051	0.0171									0.007
10	0.183			0.018											0.0085
11	0.168			0.039											0.0070
12	0.176			0.042											0.0158
13	0.1586			0.036											
14				0.0095											
Mean	0.1711	0.0019	0.0292	0.0325	0.0026	0.0177	0.0000	0.0013	0.0304	0.0005	52.9296	0.0040	0.0003	0.0002	0.0097
STDV.	0.0105	0.0010	0.0427	0.0129	0.0024	0.0115		0.0005		0.0004	0.2157	0.0003	0.0004	0.0002	0.0049
Certified	0.17	0.002	<0.05	0.03	(0.003)	(0.02)		<0.002		<0.0005	52.9	0.0040	<0.0005	<0.0005	<0.01
95% C.I.	0.01	0.001		0.01	0.002						0.2	0.0003			
Methods	X,I,O	H,D,A,I,O	X,D,I,O	X,D,I,O	X,I,O	X,I,O		H,A,I		I,O	X,I,O	I,O	X,H,D,A,I,O	H,I	X,I,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 30-1981- (E) list the following:

Certifying Body: A technically competent body (organization or firm, public or private) that issues a Reference Material Certificate. The only generally accepted certifying body in the United States is the U. S. Department of Commerce, National Institute of Standards & Technology, (NIST), Gaithersburg, MD.


Reference Material (RM): A material or substance with one or more properties which are sufficiently well established to be used for calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Certified Reference Material (CRM): A reference material with one or more properties whose values are certified by a technically valid procedure accompanied by or traceable to a certificate or other documentation, which is issued by a Certifying Body.

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

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