

Analytical Reference Materials International

Certificate of Analysis Certified Reference Material



Grade: **AISI 309 / S30900**

Part Number (Q.A. NO.): **IARM 3C**

Certification Date: **11/03/2004**

Certificate No.: **3C-11032004-IARM-F**

Revision Date: **10/10/2005**

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> 0.004 (0.001)	<u>Boron</u> 0.0003 (0.0001)	<u>Carbon</u> 0.066 (0.002)	<u>Cobalt</u> 0.078 (0.003)	<u>Chromium</u> 22.28 (0.03)	<u>Copper</u> 0.130 (0.003)	<u>Manganese</u> 1.573 (0.003)
<u>Molybdenum</u> 0.195 (0.003)	<u>Nitrogen</u> 0.037 (0.001)	<u>Niobium</u> 0.013 (0.001)	<u>Nickel</u> 14.88 (0.04)	<u>Oxygen</u> 0.015 (0.001)	<u>Phosphorus</u> 0.023 (0.001)	<u>Sulfur</u> 0.027 (0.001)
<u>Silicon</u> 0.27 (0.01)	<u>Tantalum</u> <0.005	<u>Tin</u> 0.003 (0.001)	<u>Titanium</u> 0.004 (0.001)	<u>Vanadium</u> 0.116 (0.004)	<u>Tungsten</u> 0.032 (0.001)	<u>Zirconium</u>

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

AK Steel - Middletown, OH

Anderson Laboratories, Inc. - Greendale, WI

Carpenter Technology Corporation - Reading, PA

Huntington Alloys Corporation - Huntington, WV

Laboratory Testing, Inc. - Hatfield, PA

The Timken Company - Canton, OH

Allvac - Monroe, NC

Bodycote Materials Testing - Portland, OR

Crucible Specialty Metals - Syracuse, NY

IMR Test Labs - Lansing, NY

MetalTek International, Inc. - Waukesha, WI

Timken Latrobe Steel Co. - Latrobe, PA

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 170A, 364, 1152, 2171, BS 12B, CA304-2, 82D, IARM 4C, LECO 501-502, 501-645, 501-647, 502-257, NIST 335, 2166, 2167, BS 82A, DDA, LECO 501-644, 501-645, NIST 1154A, BS 83H, IARM 27C, ES0115A, IC 31391, 57960, LECO 501-645, NIST 121D, 101E, LECO 501-503, 501-645, AR 512, NIST 1761, 1762, 1763, 1764, 1765, 1766, 1767, IARM 2F, 3B, 4B, CRM 186B, NIST 1154, IARM 3A, 4B, BS 83G, 83H, 180, LECO 501-501, 502-106, IARM 3B, LECO 501-501, 502-106, NIST 101A, 160A, 337A, C1151, C1152, C1153, C1154, 1160, 1161, 1162, 1163, 1164, C1287, C1288, C1289, 1754, 1761, 1762, 1763, 1764, 1765, 1766, 1767, 1772, C2400, C2401, 2172, JSS 650-11, 651-11, 652-11, 653-11, 654-11, 655-11, ST01, ST02, ST03, ST04, ST05, ST06, 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, BS XAAS, XCCV, XCCS, BAM AK-327-2, JA-NR-8F, LECO 501-510, 501-645, IARM 3A, 3B, LECO 502-106, NIST 3107, 3109A, 3155, 3161A, IARM 1A, 2A, 2B, 6A, 6B, 8A, 8B, 9B, 10B, 13B, 154A, BS 89D, 89E, 97, 17-4A, 17-4B, 317L, 9941, 9942, LECO 501-502, 501-504, 501-643, 501-644, 501-646, 501-647, 501-674, 501-676, NIST 131G, 898, 1606, HAS 321A, 400M, 405D, 600C, 801C, 805A, 805B, 832A, 902B, AR 881, LECO 501-550, 502-256, IARM 3B

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 10/10/2005.

3C	Al	B	C	Co	Cr	Cu	Mn	Mo	N	Nb	Ni	O	P	S	Se
1	0.0047	0.0004	0.060	0.074	22.234	0.125	1.570	0.205	0.0367	0.0138	14.81	0.0155	0.022	0.026	0.0047
2	0.0048	0.0002	0.0674	0.0733	22.30	0.135	1.580	0.195	0.037	0.013	14.850	0.015	0.0232	0.0282	0.0001
3	0.0061	0.0004	0.0646	0.0777	22.316	0.126	1.580	0.194	0.0355	0.0126	14.963	0.0142	0.0223	0.0260	<0.0001
4	0.0038	0.00015	0.0648	0.0764	22.230	0.1365	1.577	0.2032	0.0381	0.0106	14.901	0.0153	0.0232	0.0262	0.002
5	0.002	0.0004	0.0656	0.072	22.22	0.134	1.576	0.193	0.0348	0.012	14.842	0.0133	0.0191	0.0267	<0.01
6	0.0035	0.0002	0.0686	0.079	22.335	0.124	1.572	0.194	0.0369	0.012	14.870	0.0130	0.0232	0.025	0.0006
7	0.0068		0.0654	0.082	22.267	0.139	1.569	0.198	0.0369	0.0121	14.96	0.01450	0.019	0.0265	
8	0.0049		0.066	0.0767	22.295	0.138	1.568	0.189	0.03752	0.015	14.821	0.0156	0.022	0.0257	
9	0.0029		0.0642	0.084	22.30	0.130	1.570	0.192	0.0370	0.0137	14.846		0.0259	0.0286	
10	0.0017		0.0721	0.0858		0.1255	1.5737	0.1887	0.0391	0.011	14.97		0.0226	0.0290	
11	0.0071		0.0675	0.077		0.124	1.565	0.196	0.0374	0.012	14.84		0.0259	0.025	
12			0.0621	0.082		0.125	1.577	0.190	0.0395	0.0136			0.0231		
13			0.068	0.0800		0.1313							0.0204		
14			0.0669										0.0264		
Mean	0.0044	0.0003	0.0659	0.0785	22.2774	0.1303	1.5731	0.1948	0.0372	0.0126	14.8794	0.0146	0.0227	0.0266	0.0019
STDV.	0.0018	0.0001	0.0029	0.0042	0.0413	0.0057	0.0049	0.0052	0.0013	0.0013	0.0595	0.0010	0.0023	0.0014	0.0021
Certified	0.004	0.0003	0.066	0.078	22.28	0.130	1.573	0.195	0.037	0.013	14.88	0.015	0.023	0.027	
95% C.I.	0.001	0.0001	0.002	0.003	0.03	0.003	0.003	0.003	0.001	0.001	0.04	0.001	0.001	0.001	
Methods	X,A,I,O	I,O	C,O	X,A,I,O	X,O	X,A,I,O	X,A,I,O	X,A,I,O	F,O	X,I,O	X,W,A,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

3C	Si	Sn	Ta	Ti	V	W	Ag	As	Bi	Ca	H	Mg	Pb	Zn	Zr
1	0.27	0.00439	<0.005	0.00461	0.113	0.0293	0.0005	0.0023	<0.0001	0.0051		0.0005	0.0006	0.00015	0.0001
2	0.275	0.0031	0.0037	0.006	0.114	0.0322	<0.0001	0.0026	<0.00001	0.0031		0.0020	0.0014		0.0020
3	0.264	0.0044	<0.0001	0.0051	0.125	0.0324		0.0028		0.0024		0.0002	0.0011		0.0050
4	0.276	0.0025	<0.001	0.0012	0.1190	0.029				0.0015					0.0002
5	0.275	0.004	0.001	0.0060	0.110	0.034				0.0005					0.0028
6	0.274	0.0015	0.0024	0.006	0.1185	0.0291			0.0008						0.001
7	0.242	0.0044	0.0045	0.0026	0.117	0.034									0.00007
8	0.263	0.0046	<0.001	0.0056	0.115	0.032									
9	0.264	0.0019	0.00003	0.004	0.110	0.033									
10	0.259	0.0048		0.0019	0.1253	0.031									
11	0.2381	0.0027		0.0055	0.115	0.0336									
12	0.260				0.120										
13	0.283				0.1037										
14	0.2772														
Mean	0.2657	0.0035	0.0023	0.0044	0.1158	0.0318	0.0005	0.0026		0.0022		0.0009	0.0010	0.0002	0.0016
STDV.	0.0130	0.0012	0.0018	0.0018	0.0060	0.0019		0.0003		0.0017		0.0010	0.0004		0.0018
Certified	0.27	0.003	<0.005	0.004	0.116	0.032		(0.003)		(0.002)			<0.002		<0.005
95% C.I.	0.01	0.001		0.001	0.004	0.001							O		X,I,O
Methods	X,W,A,O	X,I,O	X,I,O	X,I,O	X,A,I,O	X,I,O		A,I,O		X,I,O			O		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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