

Analytical Reference Materials International

Certificate of Analysis Certified Reference Material



Grade: **AISI O-6 / UNS T31506**

Part Number (Q.A. NO.): **IARM 45B**

Certification Date: **12/23/2003**

Certificate No.: **45B-12232003-IARM-F**

Revision Date: **12/23/2003**

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.
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> 0.010 (0.001)	<u>Antimony</u> (0.001)	<u>Arsenic</u> 0.002 (0.001)	<u>Boron</u> (0.0001)	<u>Calcium</u> (0.001)	<u>Carbon</u> 1.42 (0.01)	<u>Chromium</u> 0.061 (0.002)	<u>Cobalt</u> 0.004 (0.001)
<u>Copper</u> 0.018 (0.001)	<u>Lead</u>	<u>Manganese</u> 0.90 (0.01)	<u>Molybdenum</u> 0.24 (0.003)	<u>Nickel</u> 0.024 (0.001)	<u>Niobium</u> 0.002 (0.001)	<u>Nitrogen</u> 0.0080 (0.0002)	<u>Oxygen</u> 0.0005 (0.0003)
<u>Phosphorus</u> 0.010 (0.001)	<u>Sulfur</u> 0.008 (0.001)	<u>Silicon</u> 0.92 (0.01)	<u>Tin</u> 0.008 (0.001)	<u>Titanium</u> 0.002 (0.0005)	<u>Tungsten</u> (0.004)	<u>Vanadium</u> 0.003 (0.001)	<u>Zirconium</u> (0.001)

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

AK Steel, Butler Works - Butler, PA
Allegheny Ludlum Corp. - Brackenridge, PA
Dofasco Inc. - Hamilton, Ontario, Canada
Koppel Steel - Koppel, PA
Lockheed Martin Astronautics - Littleton, CO
Rautaruukki Steel - Raahel, Finland

Algoma Steel Corp. - Sault Ste. Marie, Ontario, Canada
Anderson Laboratories, Inc. - Greendale, WI
International Steel Group - East Chicago, IN
Laboratory Testing, Inc. - Hatfield, PA
National Steel-Great Lakes Operations - Ecorse, MI
The Timken Company - Canton, 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: BS 41, 85D, NIST 1760'S, 1160'S, 16F, 51B, 41B, 1754, BAS 401/1-410/2, LECO 501-645, 502-280, BS XAAS, XCCV, XCCS, CA1A, CA3A, CA1-CA4, JSS ST01-ST06, 172/4-175/4, NIST 1761, 1762, 1763, 1764, 1765, 1766, 1767, 341, 73c, 32E, 179, LECO 501-679, 501-553, AK B-85, NIST 361, 50C, 100B, 133A, 1091A, 293, NIST 1265A, 1168, BS 2001, 4001, 4941, 4982, BCS 453-1, EU 276-2, 195-1, TH 1012-3, LECO 501-644, 501-550, NIST 1761, 1762, 1763, 1764, 1765, 1766, 1767, 368, 12H, LECO 501-504, 501-550, 501-552, NIST 1226, 1261A, 1262A, 1265A, C1151, C1152, C1153, C1154, 1155, 1193, 1194, 1195, 1230, C2400, JSS 650, 651, 652, 653, 654, 655, BCS331, 332, 333, 334, 335, 336, 337, 338, ARMCO 8709, 8710, 8711, 8712, MBH14933, 14934, 14935, BSC 401/1, 402/1, 403/1, 404/1, 405/1, 406/1, 407/1, 408/1, 409/1, 410/1, IARM 1B, 2B, 4B, 5B, 9B, 11B, 152A, 157A162A, 163A, 205A, 27B, 28B, 29B, 30B, 31B, 32B, 33B, 34B, 35B, 36B, 48B, 49B, 155A, 156A, 164A, 165A, 166A, 167A, 168A, 169A, 170A, 171A, 172A, BS 3941, LECO 501-644, NIST 361, 362, 363, 364, JSS 170-5, IARM 35A, 45A, LECO 501-676, 501-553, 501-550, NIST 1761, 1762, 1763, 1764, 1765, 1766, 1767, 11H, 13G, 139B, 337A, 362, 363, EURO 031-3, SKF 200-1, ECRM 099-1, AR 654, NIST 1763, 1766, 361, SUS-C2, RE12, D5, HI, D8, AR 871, 873, BS CSN1, CSN4

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 12/23/2003.

45B	Al	B	C	Co	Cr	Cu	Mn	Mo	N	Nb	Ni	O	P	Pb	S
1	0.010	0.00013	1.420	0.0043	0.054	0.018	0.890	0.245	0.0076	0.0007	0.023	0.00038	0.012	0.0005	0.009
2	0.0078	0.0001	1.42	0.0036	0.064	0.018	0.896	0.245	0.00803	0.001	0.027	0.0004	0.012	0.0001	0.0076
3	0.0098	0.0001	1.419	0.004	0.0637	0.019	0.908	0.243	0.0076	0.002	0.0274	0.0005	0.0098	<0.001	0.0084
4	0.0116	0.0003	1.411	0.0023	0.058	0.0184	0.923	0.2373	0.0082	0.002	0.023	0.0006	0.0108	0.0021	0.0075
5	0.010	0.00009	1.427	0.0055	0.058	0.017	0.909	0.241	0.0078	0.0020	0.021	0.0010	0.0111	0.0001	0.0070
6	0.014		1.44	0.0044	0.0600	0.019	0.886	0.25	0.0083	0.0022	0.0219	0.00031	0.010		0.0068
7	0.0083		1.422	0.004	0.0612	0.0157	0.92	0.2528	0.0075	0.0031	0.0251		0.010		0.0092
8	0.0082		1.40		0.064	0.0157	0.8989	0.2422	0.00813	0.001945	0.025		0.0120		0.0069
9	0.010		1.40		0.0631	0.0179	0.8801	0.239	0.0084		0.0222		0.0089		0.0100
10	0.0102		1.411		0.060	0.016	0.930	0.2498	0.00777		0.024		0.0110		0.007
11	0.011		1.40075		0.06667	0.0175	0.8852	0.235	0.0080		0.024365		0.0104		0.00879
12	0.01038				0.060	0.020	0.890	0.23624	0.008423				0.011		0.00669
13	0.015						0.89176	0.24					0.00861		
14													0.009		
Mean	0.0105	0.0001	1.4155	0.0040	0.0611	0.0177	0.9006	0.2428	0.0080	0.0019	0.0240	0.0005	0.0105	0.0007	0.0079
STDV.	0.0021	0.0001	0.0125	0.0010	0.0035	0.0014	0.0160	0.0056	0.0003	0.0007	0.0020	0.0003	0.0011	0.0010	0.0011
Certified	0.010	(0.0001)	1.42	0.004	0.061	0.018	0.90	0.24	0.0080	0.002	0.024	0.0005	0.010		0.008
95% C.I.	0.001		0.01	0.001	0.002	0.001	0.01	0.003	0.0002	0.001	0.001	0.0003	0.001		0.001
Methods	X,I,O	O	C,O	X,I,O	X,I,O	X,I,O	X,I,O	X,I,O	F,O	X,O	X,I,O	F	X,I,O		C,O

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

45B	Si	Sn	Ti	V	W	As	Bi	Ca	Cd	Mg	Sb	Se	Ta	Zn	Zr
1	0.880	0.010	0.0015	0.0016	0.010	0.0020	<0.0001	0.00014		0.0035	0.0009	<0.0001	<0.001	<0.0001	0.0002
2	0.928	0.0092	0.002	0.0028	0.0030	0.0015	<0.001	0.0004		<0.001	0.0015	0.0003	0.013	0.001	0.0005
3	0.923	0.008	0.0015	0.0034	0.001	0.001	0.0004	0.0004		<0.0001	0.0009	<0.01	0.0017	0.0016	0.001
4	0.934	0.007	0.001	0.001	0.002	0.0004	<0.001	0.001		<0.001	0.002		<0.01	<0.0001	0.0003
5	0.928	0.007	0.003	0.004	0.0042	0.0013								0.0091	0.0018
6	0.894	0.0083	0.0019	0.0018	0.008	0.0023									
7	0.93	0.0091	0.0026	0.0019	0.0030	0.001									
8	0.9486	0.0084	0.0017	0.0029		0.002625									
9	0.9014	0.0085	0.0025	0.0017											
10	0.934	0.007	0.00221	0.004											
11	0.9127	0.00762	0.0032	0.003195											
12	0.958	0.009													
13	0.940985														
Mean	0.9241	0.0083	0.0021	0.0026	0.0045	0.0015	0.0004	0.0005	#DIV/0!	0.0035	0.0013	0.0003	0.0074	0.0039	0.0008
STDV.	0.0220	0.0010	0.0007	0.0010	0.0033	0.0007	#DIV/0!	0.0004	#DIV/0!	#DIV/0!	0.0005	#DIV/0!	0.0080	0.0045	0.0007
Certified	0.92	0.008	0.002	0.003	(0.004)	0.002		(0.001)				(0.001)			(0.001)
95% C.I.	0.01	0.001	0.0005	0.001		0.001									
Methods	X,W,O	X,O	X,I,O	X,O	X,I,O	X,A,I,O		A,O			A,I,O				I,O

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

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. The majority of materials are in wrought condition. Other methods of manufacture are utilized as a last resort, only in the case of those materials being unavailable in wrought condition. "Batch" samples are taken by removing a one-inch cross section for every thirteen inches of total length from the entire bar. Twenty-five percent of the one inch cross section is converted to chips for analysis by classical wet chemistry, ICP, AA, and combustion procedures and seventy-five percent remains in a solid disk form for OES and X-Ray analysis where applicable. Each member of the ILAP is furnished both a solid sample and the corresponding supply of chips from a specific location on the batch bar. This massive sampling procedure results in the homogeneity being reflected as a product of the overall statistics and certified data.

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

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