

Analytical Reference Materials International

Certificate of Analysis Certified Reference Material



Grade: **Alloy 188 / UNS R30188 (Modified)**

Part Number (Q.A. NO.): **IARM 97B**

Certificate Date: **07/15/2004**

Certificate No.: **97B-07152004-IARM-F**

Revision Date: **07/15/2004**

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> 0.08 (0.01)	<u>Boron</u> (0.002)	<u>Carbon</u> 0.096 (0.002)	<u>Cobalt</u> 42.5 (0.1)	<u>Chromium</u> 21.2 (0.1)	<u>Copper</u> 0.07 (0.02)	<u>Iron</u> 1.92 (0.04)	<u>Lanthanum</u> 0.005 (0.001)
<u>Magnesium</u> <0.002	<u>Manganese</u> 0.76 (0.02)	<u>Molybdenum</u> 0.56 (0.02)	<u>Nitrogen</u> 0.014 (0.001)	<u>Niobium</u> 0.022 (0.003)	<u>Nickel</u> 19.4 (0.1)	<u>Oxygen</u> 0.003 (0.001)	<u>Phosphorus</u> 0.009 (0.001)
<u>Sulfur</u> (0.001)	<u>Silicon</u> 0.34 (0.02)	<u>Tantalum</u> 0.019 (0.007)	<u>Tin</u> <0.005	<u>Titanium</u> 0.006 (0.002)	<u>Tungsten</u> 12.9 (0.1)	<u>Vanadium</u> 0.012 (0.002)	<u>Zirconium</u> (0.001)

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

Allvac - Monroe, NC

Bodycote Materials Testing, Inc. - Los Angeles Laboratory

Carpenter Technology Corporation - Reading, PA

Haynes International, Inc. - Kokomo, IN

Howmet Research Center - Whitehall, MI

Laboratory Testing, Inc. - Hatfield, PA

Anderson Laboratories, Inc. - Greendale, WI

Cannon Muskegon Corp. - Muskegon, MI

Deloro Stellite - Belleville, Ontario, Canada

Howmet Dover Alloy - Dover, NJ

Huntington Alloys Corporation - Huntington, WV

Special Metals IncoTest - Hereford, England

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 97A, NIST167, SPEX TS 456, CM HEAT VV253, 13217, LECO STD, CLAX ST 188, BS 171, NIST 16f, 123b, 132b, 134a, 135, 155, 160b, 168, 173b, 343a, 348a, 349a, 361, 363, 364, 367, 661, 1187, 1208-1, 1254, 1765, 2165, c2402, 2423, 2424a, 2425a, 3167, LECO 501-553, 502-01, NIST C1251, 1159, 1160, 1186, 1187, 1188, 1190, 1191, 1192, 1193, 1195, 1197, 1198, 1201, 1203, 1204, 1205, 1206/2, 1207/1, 1207/2, 1208/1, 1208/2, 1243, 1244, 1245A, 1247, 1271, 1762, 131F, 367, 6G, LECO 501, 502, 501-550, 502-256, 501-644, 502-016, 502-255, NBS 1199, 1200, BS 170B, 171B, U3933, U3934, LECO 501-503, BCS401, BS 170A, SPEX 5-106AL, 5-140B, 6-17CO, 5-146CU, 6-48FE, 5-151MG, 5-148MN, 5-96MO, 5-78NB, 5-68NI, 5-149P, 5-89SIA, 5-156TI, 6-24V, 6-51W, 5-85ZR, 5-19AG, 5-30AS, 6-50BI, 5-24CA, 4-255LA, 5-43PB, 6-1SN, 6-2TA, 5-139Y, 5-46ZN, LECO 501-505, NIST 349, KD760-3, TALN-500, TBA-250, TCUN-500, TFEN-500, TMNN-500, TMONF-500, TNBF-250, TNIN-500, TPN-250, TSINF-500, TTINF-500, TVN-250, TWNF-250, TZRH-250, NIST 2160, LECO 501-553, IARM-97A, LECO 501-504, 501-503, 501-501, 502-016, 502-195, 501-551, 501-550, NIST 362, IARM 27B, GE/SNEEMA HS-188, NIST 131F, 3107, 3131A, 3127A, IARM 97A, LECO 501-647, NIST 1199, BS 172A, IARM 97A, LECO 502-195

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 07/15/2004.

97B	Al	B	C	Co	Cr	Cu	Fe	Mg	Mn	Mo	N	Nb	Ni	O	P	S	Si
1	0.106	0.003	0.098	42.55	20.99	0.02	1.85	0.001	0.71	0.49	0.0170	0.02	19.60	0.0013	0.008	0.0002	0.39
2	0.066	0.0005	0.096	42.3	21.4	0.055	1.92	<0.001	0.739	0.50	0.010	0.030	19.595	0.0052	0.0134	0.0015	0.334
3	0.082	<0.002	0.095	42.46	21.28	0.088	1.914	<0.002	0.824	0.597	0.014	0.020	19.18	0.004	0.008	<0.005	0.328
4	0.067	0.0040	0.0957	42.692	21.20	0.110	1.922	0.0002	0.758	0.567	0.013	0.020	19.32	0.0011	0.0092	<0.002	0.386
5	0.064	<0.001	0.098	42.540	21.16	0.11	1.94	<0.001	0.73	0.57	0.014	0.017	19.28	0.0015	0.006	0.0008	0.341
6	0.0811	0.0006	0.095	42.45	21.1096	0.105	1.98	0.0007	0.75	0.60	0.0138	0.0269	19.7	0.005	0.008	<0.001	0.32
7	0.077	0.0025	0.0934	42.766	21.50	0.0627	2.03	0.0050	0.77	0.581	0.0132	0.0180	19.42	0.0016	0.0095	0.00027	0.34
8	0.086	0.0026	0.099		21.282	0.056	1.885	0.0002	0.7646	0.5931	0.0147	0.021	19.31	0.0013	0.010	0.0012	0.3882
9	0.074	0.0014	0.091		21.16	0.042	1.947	0.0005	0.7713	0.547	0.0130	0.02	19.344		0.0115	0.0002	0.2814
10	0.0969	0.0006	0.093		21.197	0.036	1.91		0.814	0.558	0.0136	0.0284	19.395		0.0110	0.0010	0.422
11		0.0012	0.1017			0.0451	1.816		0.754	0.576	0.0122		19.28		0.012	0.0001	0.322
12									0.734	0.5751			19.514		0.0065	0.0005	0.288
13									0.7448								0.3429
Mean	0.0800	0.0018	0.0960	42.5369	21.2279	0.0663	1.9195	0.0013	0.7587	0.5629	0.0135	0.0221	19.4115	0.0026	0.0094	0.0006	0.3449
STDV.	0.0136	0.0012	0.0030	0.1562	0.1456	0.0318	0.0582	0.0019	0.0318	0.0353	0.0017	0.0046	0.1580	0.0018	0.0023	0.0005	0.0412
Certified	0.08	(0.002)	0.096	42.5	21.2	0.07	1.92	<0.002	0.76	0.56	0.014	0.022	19.4	0.003	0.009	(0.001)	0.34
95% C.I.	0.01		0.002	0.1	0.1	0.02	0.04		0.02	0.02	0.001	0.003	0.1	0.001	0.001		0.02
Methods	X,A,I,O	X,D,G,I,O	C,O	X,I,O	X,W,I,O	X,I,O	X,A,I,O	X,D,A,I,O	X,I,O	X,I,O	F	X,I,O	X,W,I,O	F	X,W,A,I,O	G,C,O	X,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

97B	Sn	Ta	Ti	V	W	Zr	La	Pb	Ag	As	Bi	Ca	H	Sb	Se	Y	Zn
1	<0.0020	0.03	0.008	0.015	12.54	0.001	0.0066	<0.0005	<0.0005	0.00028	<0.00005	0.0074		<0.0020	<0.0001	<0.0001	<0.0020
2	<0.01	0.021	0.003	0.011	12.67	0.01	0.006	<0.001	0.00008	<0.001	<0.00005			0.0002	<0.0001		<0.0001
3	0.00072	0.008	0.004	0.011	13.152	<0.010	0.004	<0.00005	<0.0001	0.0009	<0.0001			0.0004	0.0021		0.0003
4	<0.005	0.017	0.0077	0.008	12.90	0.00001	0.0048	<0.0001	<0.0001		<0.0001				<0.0001		
5	0.0118	0.026	0.0052	0.009	12.97	0.002	0.0058	<0.0001	<0.0001		<0.0002						
6	0.0014	0.019	0.006	0.015	12.90	0.0005	0.005	0.0066			<0.0001						
7	0.0035	0.0141	0.007	0.0097	12.89	0.002		<0.0001									
8				0.013	13.03	0.0004		0.0040									
9				0.015	13.01	0.003											
10				0.0126	12.766	0.007											
11					12.809												
12					12.80												
Mean	0.0044	0.0193	0.0058	0.0119	12.8698	0.0029	0.0054	0.0053	0.0001	0.0006		0.0074		0.0003	0.0021		0.0003
STDV.	0.0051	0.0073	0.0019	0.0026	0.1666	0.0034	0.0009	0.0018		0.0004				0.0001			
Certified	<0.005	0.019	0.006	0.012	12.9	(0.001)	0.005	<0.005									
95% C.I.		0.007	0.002	0.002	0.1		0.001										
Methods	D,A,O	X,G,I,O	X,D,G,I,O	X,G,I,O	X,I,O	X,D,G,I,O	I	D,A,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 Corporation

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