

# Analytical Reference Materials International

## Certificate of Analysis Certified Reference Material



Grade: Alloy 718 / UNS N07718

Part Number (Q.A. NO.): IARM 56D

Certification Date: 07/26/1999

Certificate No.: 56D-07261999-IARM-F

Revision Date: 03/19/2003

### 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 "**± Confidence Interval at 95%**" is enclosed by a **parentheses ( )** below the individual element's concentration.

**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> 0.60 (0.01)	<u>Boron</u> 0.0044 (0.0003)	<u>Carbon</u> 0.041 (0.001)	<u>Cobalt</u> 0.298 (0.007)	<u>Chromium</u> 18.37 (0.03)	<u>Copper</u> 0.063 (0.004)	<u>Iron</u> 18.10 (0.04)	<u>Magnesium</u> 0.0051 (0.0004)
<u>Manganese</u> 0.200 (0.005)	<u>Molybdenum</u> 3.06 (0.02)	<u>Nitrogen</u> 0.0084 (0.0007)	<u>Niobium</u> 5.22 (0.02)	<u>Nickel</u> 52.8 (0.1)	<u>Oxygen</u> 0.0014 (0.0003)	<u>Phosphorus</u> 0.010 (0.0006)	<u>Sulfur</u> 0.0003 (0.0001)
<u>Silicon</u> 0.119 (0.004)	<u>Tantalum</u> 0.007 (0.001)	<u>Tin</u> 0.0019 (0.0005)	<u>Titanium</u> 0.98 (0.01)	<u>Vanadium</u> 0.033 (0.002)	<u>Tungsten</u> 0.064 (0.007)	<u>Zirconium</u> (0.001)	

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

Allegheny Ludlum Corp. - Brackenridge, PA  
Allvac Lockport - Lockport, NY  
AvestaPolarit Stainless OY - Tornio Finland  
Chicago Spectro Service Laboratories - Chicago, IL  
Howmet Dover Alloy - Dover, NJ  
Laboratory Testing, Inc. - Hatfield, PA  
Special Metals Corporation - Huntington, WV

Allvac - Monroe, NC  
Anderson Laboratories, Inc. - Greendale, WI  
Bodycote Metal Analysis, Inc. - Huntington Park, CA  
Haynes International, Inc. - Kokomo, IN  
Howmet Research Center - Whitehall, MI  
Lockheed Martin Astronautics - Littleton, CO  
Special Metals Wiggin LTD. - 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: 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, NIST 16f, 123b, 134a, 135, 155, 160b, 168, 173b, 343a, 348a, 349, 349a, 361, 363, 364, 367, 661, 1187, 1208-1, 1254, 1765, 2165, c2402, 2423, 2424a, 2425a, 3167, LECO 401-553, 502-016, BS 718a, RV 7898, NIST 1249, IARM 56b, BS 718B, CT 642, LECO 501-674, 501-643, 501-644, NIST 1249, 3107, 3149, 3161, 3128, 3106, 3151, 131F, 3107, NBS 1208-1, 1208-2, 1249, BCS 351, IARM 56A, 56B, NBS C1151, C11525, C1153, C1154, 1155, 1193, 1194, 1195, 1230, C2400, JSS 650, 651, 652, 653, 654, 655, BCS 331, 332, 333, 334, 335, 336, 337, 338, ARMCO 8709, 8710, 8711, CARTECH 440F, 303-SE, 316, 455, 630, 416C, 430F, D2, CUSTOM 450, NIST 865, 868, 2159, TMONF-500, TMGN-500, TVN-250, TWNF-250, TZRN-250, TASN-100, TBIN-250, TCAN-500, TLAN-100, TSBIN-100, TPBN-250, TSEN-100, TSNN-500, TTAF-250, TYN-100, TZNN-500, LECO 501-644, 501-643, IARM 56A, LECO 501-505, 501-645, SPEX 6-38As, 5-94ZN, KD 760-3, BCS 351, NIST 1249, IAL REF R6975, LECO 501-503, 501-551, 501-102, 501-529, AR 546, IN 718, NIST 2402, 1198, 1247, 1208-1, 893, 348A, 126C, BAS 287-1, NR 2D, BAM 327-2BS 500, IARM 52B, 55A, 56C, 56D, 55B, SKF 100-1, 200S-1, AR 657, 661, 662, 654

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.

700 Corporate Cr., Suite A · Golden, Colorado 80401 · Telephone (303) 216-2621 · FAX (303) 216-2649

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 3/19/2003.

56D	Al	B	C	Co	Cr	Cu	Fe	Mg	Mn	Mo	N	Nb	Ni	O	P	S	Si
1	0.62	0.0052	0.040	0.3105	18.38	0.066	18.18	0.0045	0.193	3.08	0.0078	5.21	52.94	0.0011	0.008	0.0002	0.1155
2	0.575	0.0045	0.041	0.306	18.35	0.059	18.09	0.0049	0.209	3.045	0.0070	5.194	52.78	0.0010	0.010	0.0004	0.115
3	0.594	0.0045	0.0383	0.315	18.35	0.071	17.96	0.0053	0.207	3.026	0.0084	5.22	52.91	0.0011	0.009	0.0004	0.108
4	0.62	0.0043	0.0411	0.287	18.42	0.071	18.114	0.0052	0.194	3.06	0.0085	5.175	52.869	0.0012	0.011	0.0001	0.124
5	0.597	0.0039	0.042	0.296	18.382	0.058	18.11	0.0058	0.199	3.064	0.0095	5.20	52.86	0.0012	0.009	0.0001	0.126
6	0.599	0.0048	0.040	0.299	18.380	0.0643	18.10	0.0053	0.199	3.043	0.0080	5.20	52.75	0.0018	0.0093	0.0001	0.120
7	0.58	0.0046	0.039	0.304	18.39	0.0563	18.16	0.0054	0.208	3.05	0.0082	5.260	52.85	0.0023	0.011	0.0003	0.121
8	0.618	0.0045	0.040	0.314	18.39	0.067	18.00	0.0043	0.201	3.09	0.0100	5.27	52.742	0.0016	0.0104	0.0006	0.1255
9	0.599	0.0040	0.042	0.284	18.45	0.058	18.04594		0.2095	3.118	0.0092	5.2406	52.92	0.00091	0.009	0.00012	0.118
10	0.60	0.0040	0.0421	0.2922	18.300		18.199		0.1951	3.04	0.00705	5.226	52.9	0.00206	0.0080	0.0005	
11	0.57638		0.0402	0.2830	18.33		18.11		0.190	3.107		5.226	52.685		0.0103	0.00025	
12	0.6096		0.041	0.288	18.37		18.08			2.997		5.22			0.009		
13	0.59									3.036		5.251			0.0108		
14	0.588									3.06							
										3.103							
Mean	0.5976	0.0044	0.0406	0.2982	18.3743	0.0634	18.0957	0.0051	0.2004	3.0613	0.0084	5.2225	52.8369	0.0014	0.0096	0.0003	0.1192
STDV.	0.0152	0.0004	0.0012	0.0116	0.0394	0.0057	0.0694	0.0005	0.0070	0.0332	0.0010	0.0275	0.0845	0.0005	0.0011	0.0002	0.0058
Certified	0.60	0.0044	0.041	0.298	18.37	0.063	18.10	0.0051	0.200	3.06	0.0084	5.22	52.8	0.0014	0.010	0.0003	0.119
95% C.I.	0.01	0.0003	0.001	0.007	0.03	0.004	0.04	0.0004	0.005	0.02	0.0007	0.02	0.1	0.0003	0.0006	0.0001	0.004
Methods	X,I,O	D,I,O	C	X,I,O	X,W,I,O	X,I,O	X,W,I,O	D,A,I,O	X,I,O	X,I,O	F	X,I,O	X,W	F	X,I,O	C	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

56D	Sn	Ta	Ti	V	W	Zr	Ag	As	Bi	Ca	H	La	Pb	Sb	Se	Y	Zn
1	0.0025	0.0072	1.00	0.030	0.0765	0.001	<0.0001	<0.01	0.00003	<0.010	0.0008	0.0024	0.0001	0.0001	<0.0001	0.001	0.0006
2	0.0015	0.005	0.98	0.034	0.068	<0.01	0.000031	0.0008	0.00003	0.0018	0.0002		<0.001	0.00024	0.0025	0.0021	<0.001
3	0.0019	0.007	0.966	0.035	0.074	0.018	0.00002	0.0001	0.000036	<0.001			<0.0001		<0.00005		
4	0.0026	0.008	0.97	0.035	0.059	0.009		0.0009	<0.001				0.00015		<0.00005		
5	0.0017	0.007	0.960	0.029	0.058	0.003			0.0002				<0.001		<0.0001		
6	0.0014	0.0075	0.983	0.034	0.067	0.001		<0.00003					<0.0001		0.0001		
7		0.010	1.00	0.034	0.074	<0.01		0.0002					<0.0001		<0.00005		
8			0.97	0.030	0.051	<0.01							<0.0001		<0.0001		
9			0.996	0.0313	0.0774	0.00078											
10			0.97	0.0366	0.0534	0.0018											
11			0.96751	0.034	0.051	0.0057											
12			0.9735			0.001											
13			1.00														
Mean	0.0019	0.0074	0.9797	0.0330	0.0645	0.0046	0.0000	0.0006	0.0001	0.0018	0.0005	0.0024	0.0009	0.0002	0.0013	0.0016	0.0006
STDV.	0.0005	0.0015	0.0146	0.0025	0.0103	0.0057	0.0000	0.0004	0.0001	#DIV/0!	0.0004	#DIV/0!	0.0013	0.0001	0.0017	0.0008	#DIV/0!
Certified	0.0019	0.007	0.98	0.033	0.064	(0.001)	<0.0001	<0.001	<0.0002				<0.0001		<0.0001		
95% C.I.	0.0005	0.001	0.01	0.002	0.007												
Methods	A,I,O	X,G,D,I,O	X,I,O	X,I,O	X,I,O	X,D,I,O	A,I,O	D,A,O	D,A,O				D,A,O		X,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

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