

Analytical Reference Materials International

Certificate of Analysis Certified Reference Material



Grade: Alloy 718 / UNS N07718

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

Certificate Date: 12/18/2008

Certificate No.: 56F-12182008-IARM-F

Revision Date: 11/11/2011

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>Antimony</u>	<u>Arsenic</u>	<u>Boron</u>	<u>Calcium</u>	<u>Carbon</u>	<u>Chromium</u>	<u>Cobalt</u>	<u>Copper</u>
0.50 (0.01)			0.0039 (0.0002)		0.038 (0.001)	18.32 (0.03)	0.09 (0.004)	0.048 (0.001)
<u>Iron</u>	<u>Lead</u>	<u>Magnesium</u>	<u>Manganese</u>	<u>Molybdenum</u>	<u>Nitrogen</u>	<u>Niobium</u>	<u>Nickel</u>	<u>Oxygen</u>
17.9 (0.1)	(0.0001)	0.001 (0.0003)	0.076 (0.002)	3.02 (0.01)	0.009 (0.001)	5.33 (0.02)	53.7 (0.1)	0.0008 (0.0003)
<u>Phosphorus</u>	<u>Silicon</u>	<u>Sulfur</u>	<u>Tantalum</u>	<u>Tin</u>	<u>Titanium</u>	<u>Tungsten</u>	<u>Vanadium</u>	<u>Zirconium</u>
0.005 (0.001)	0.082 (0.003)	0.0004 (0.0001)	0.006 (0.002)	0.0013 (0.0003)	0.94 (0.02)	0.06 (0.005)	0.020 (0.001)	(0.0005)

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

Alcoa Howmet, Dover Alloy - Dover, NJ
ATI Allvac, Lockport - Lockport, NY
Carpenter Technology Corporation - Reading, PA
Laboratory Testing, Inc. - Hatfield, PA
Massachusetts Materials Research - West Boylston, MA
Special Metals IncoTest - Hereford, UK
ThyssenKrupp VDM USA - Florham Park, NJ

ATI Allegheny Ludlum Corp. - Brackenridge, PA
Cannon Muskegon Corp. - Muskegon, MI
Haynes International, Inc. - Kokomo, IN
Latrobe Specialty Steel Co. - Latrobe, PA
Outokumpu Stainless OY - Tornio Finland
The Sulzer Metco (Canada), Inc. - Fort Saskatchewan, AB

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 1249, BS 718A, 718B, CSN-4, IARM 56B, 56D, LECO 501-501, 501-502, 501-643, 501-644, 502-075, NIST 345A, LECO 501-991, IARM 56D, NIST 865, 3169, IARM 56B, BS 718, MBH 28X7184J, LECO 501-503, 501-643, 501-645, ALPHA AR512, AR881, HAS 718Q, BCS 351, 454/1, 462/1, LECO 501-551, 502-102, R5657, NIST 72C, 131F, 1208-1, 1208-2, 1249, BCS 351, NIST 1249, SS 451, IARM 56C, LECO 501-503, 501-644, 502-257, NIST 1765, IARM 56C, ALPHA AR654, AR890, HAYNES 2180-H5, 37969/1, 21102Z21, MONITOR-147, NIST 899, HT 6792E, BS 718B, BCS CRM346, IARM 56C, 56D, LECO 501-643, 501-644, 501-992, SS 351, PF 37, ES0115A, IARM 27D, LECO 501-645, IARM 56A, 56B, 56C, NIST 136E, 897, 898, 1249, BS 718B, BCS 346, CARTECH 996, IARM 56B, 56C, 56D.

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 11/11/2011.

56F	Al	B	C	Co	Cr	Cu	Fe	Mg	Mn	Mo	N	Nb	Ni	O	P
1	0.55	0.0040	0.040	0.100	18.38	0.045	17.820	0.0010	0.0765	3.03	0.00853	5.32	53.71	0.0007	0.0060
2	0.516	0.0037	0.0377	0.097	18.351	0.050	17.86	0.0018	0.080	3.0205	0.0098	5.332	53.675	0.0006	0.0052
3	0.48	0.0040	0.038	0.100	18.32	0.048	17.92	0.0011	0.076	3.01	0.0099	5.35	53.64	0.0010	0.002
4	0.521	0.0038	0.039	0.088	18.28	0.0480	17.811	0.0006	0.0731	3.04	0.0100	5.385	53.87	0.0010	0.0033
5	0.4951	0.0033	0.0381	0.0785	18.284	0.045	17.83	0.0006	0.080	3.00	0.0097	5.31	53.446	0.0012	0.0045
6	0.496	0.0042	0.0380	0.100	18.35	0.0451	18.02	0.0017	0.0740	3.012	0.0080	5.318	53.78	0.00058	0.0051
7	0.482	0.0040	0.0351	0.0911	18.277	0.050	17.680	0.0013	0.073	3.00	0.0082	5.35	53.73		0.006
8	0.514	0.00395	0.0366	0.094	18.353	0.050	17.803	0.00082	0.079	3.00	0.0103	5.39	53.69		0.002
9	0.52	0.00406	0.035	0.100	18.334	0.0485	17.90	0.0006	0.0716	3.027	0.0080	5.303	53.70		0.0070
10	0.471	0.0034	0.03891	0.098	18.282	0.0483	17.88	0.0012	0.0786	3.028		5.304	53.642		0.0043
11	0.471	0.0043	0.0378	0.0872		0.052	17.862	0.0020	0.0722	3.021		5.316	53.689		0.0048
12	0.4539		0.0408	0.0894		0.0479			0.0748	3.012		5.305	53.584		0.0080
13	0.513		0.03700	0.0886		0.0486				3.027		5.302	53.463		0.0060
14	0.515			0.0881						3.0084					0.0050
15	0.5091														
Mean	0.5005	0.0039	0.0378	0.0929	18.3211	0.0482	17.8493	0.0012	0.0757	3.0169	0.0092	5.3296	53.6630	0.0008	0.0049
STDV.	0.0251	0.0003	0.0017	0.0066	0.0379	0.0021	0.0938	0.0005	0.0031	0.0127	0.0010	0.0304	0.1156	0.0003	0.0017
Certified	0.50	0.0039	0.038	0.09	18.32	0.048	17.9	0.001	0.076	3.02	0.009	5.33	53.7	0.0008	0.005
95% C.I.	0.01	0.0002	0.001	0.004	0.03	0.001	0.1	0.0003	0.002	0.01	0.001	0.02	0.1	0.0003	0.001
Methods	X,I,O	I,O	C,O	X,A,I,O	X,W,I,O	X,A,I,O	X,I,O	I,O	X,I,O	X,I,O	F,O	X,I,O	X,W,I,O	F	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 AES

56F	S	Si	Ta	Ti	V	W	Ag	As	Bi	Ca	La	Pb	Sb	Sn	Zr
1	0.00038	0.080	0.0040	0.92	0.0217	0.058	<0.00002	0.00012	<0.00001	<0.010	0.0002	0.0001	0.00018	0.0008	0.0006
2	0.0003	0.0820	0.0045	0.929	0.020	0.056	0.00001	0.0013	<0.00002	0.0002		0.00005	0.0003	0.0014	0.0007
3	0.0003	0.080	0.0090	0.90	0.0210	0.0622	<0.0002		<0.0001	0.0010		0.00008		0.0013	0.0004
4	0.0005	0.0889	0.004	0.925	0.022	0.061			0.00001	0.003		0.00008		0.0010	0.00057
5	0.0006	0.086	0.010	0.9036	0.018	0.054			<0.0001	0.00011		0.00008		0.0015	0.0003
6	0.00022	0.075	0.0038	0.903	0.021	0.056			<0.00001					0.0011	
7	0.00048	0.087	0.0079	0.927	0.019	0.073								0.0015	
8	0.00024	0.074	0.0030	0.913	0.019	0.0593								0.0018	
9	0.00042	0.085	0.007	0.93	0.0200	0.0537									
10	0.0005	0.077		0.974	0.0195	0.065									
11	0.0003	0.0790		1.001	0.0225	0.0713									
12		0.0868		0.968		0.0474									
13				1.002		0.0724									
14				0.904											
15				0.9263											
Mean	0.0004	0.0817	0.0059	0.9351	0.0203	0.0607	0.0000	0.0007	0.0000	0.0011	0.0002	0.0001	0.0002	0.0013	0.0005
STDV.	0.0001	0.0050	0.0026	0.0345	0.0014	0.0079		0.0008		0.0013		0.0000	0.0001	0.0003	0.0002
Certified	0.0004	0.082	0.006	0.94	0.020	0.06						(0.0001)		0.0013	(0.0005)
95% C.I.	0.0001	0.003	0.002	0.02	0.001	0.005								0.0003	
Methods	X,C,O	X,I,O	X,I,O	X,I,O	X,I,O	X,I,O						H,A		X,H,A,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 30-1992 list the following:

Certifying Body: Any technically competent body (organization or firm, public or private) that issues a reference material certificate, which provides the information, detailed in ISO Guide 31. The only generally accepted certifying body in the United States for primary standards - Standard Reference Materials (SRM) is the U. S. Department of Commerce, National Institute of Standards & Technology, (NIST), Gaithersburg, MD. All other certifying bodies in the United States produce Reference Materials (RM) or Certified Reference Materials (CRM).

Reference Material (RM): Material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Certified Reference Material (CRM): Reference material, accompanied by a certificate, one or more of whose property values are certified by a procedure, which establishes its traceability to an accurate realization of the unit in which the property values are expressed, and for which each certified value is accompanied by an uncertainty at a stated level of confidence.

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 and OE instrument procedures.

Expiration of Certification: The certification of this IARM is valid indefinitely, within the uncertainty specified, provided the IARM is handled and stored in accordance with the instructions stated on this certificate. The certification is nullified if the IARM is damaged, contaminated, otherwise modified, or used in a manner for which it was not intended.

Instructions for Use: The test surface is the side opposite to the labeled surface, which includes the IARM number. The entire thickness of the unit is certified. However, the user is cautioned not to measure disks less than 2 mm thick when using X-ray fluorescence spectrometry. Each packaged disk has been prepared by finishing the test surface using a lathe. The user must determine the correct surface preparation procedure for each analytical technique. The user is cautioned to use care when either resurfacing the disk or performing additional polishing as these processes may contaminate the surface. When not in use, the material should be stored in a cool, dry location. This material was tested using both the solid disks and chips prepared from the disks. The certified values are considered representative of the overall average composition of the material. **Chips are not to be used for Oxygen analysis.**

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. 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.



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