

# Analytical Reference Materials International

## Provisional Certificate of Analysis

### Certified Reference Material



Grade: Alloy 718 / UNS N07718

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

Certificate Date: 03/13/2007

Certificate No.: 56E-03132007-IARM-P

Revision Date: 03/13/2007

#### 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> [0.61] [(0.01)]	<u>Boron</u> [0.004] [(0.0001)]	<u>Carbon</u> [0.033] [(0.001)]	<u>Cobalt</u> [0.27] [(0.01)]	<u>Chromium</u> [18.44] [(0.04)]	<u>Copper</u> [0.056] [(0.003)]	<u>Iron</u> [18.3] [(0.1)]	<u>Lanthanum</u>
<u>Magnesium</u> [0.0024] [(0.0005)]	<u>Manganese</u> [0.097] [(0.003)]	<u>Molybdenum</u> [3.07] [(0.01)]	<u>Nitrogen</u> [0.0078] [(0.0003)]	<u>Niobium</u> [5.34] [(0.03)]	<u>Nickel</u> [52.6] [(0.1)]	<u>Oxygen</u> [0.001] [(0.0005)]	<u>Phosphorus</u> [0.008] [(0.001)]
<u>Sulfur</u> [0.0004] [(0.0002)]	<u>Silicon</u> [0.09] [(0.01)]	<u>Tantalum</u> [0.01] [(0.003)]	<u>Tin</u> [0.002] [(0.0001)]	<u>Titanium</u> [0.96] [(0.02)]	<u>Tungsten</u> [0.04] [(0.01)]	<u>Vanadium</u> [0.074] [(0.002)]	<u>Zirconium</u> [0.001] [(0.0003)]

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

Allegheny Ludlum Corp. - Brackenridge, PA

Cannon Muskegon Corp. - Muskegon, MI

Connecticut Metallurgical, Inc. - East Hartford, CT

Haynes International, Inc. - Kokomo, IN

Laboratory Testing, Inc. - Hatfield, PA

Outokumpu Stainless OY - Tornio Finland

Special Metals IncoTest - Hereford, UK

ATI Allvac - Lockport, NY

Carpenter Technology Corporation - Reading, PA

Deloro Stellite - Swindon, UK

Howmet Dover Alloy - Dover, NJ

Massachusetts Materials Research - West Boylston, MA

Precision Rolled Products - Florham Park, NJ

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, IARM 56B, LECO 501-503, 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 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, IARM 56B, 56C

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 03/13/2007.

56E	Al	B	C	Co	Cr	Cu	Fe	Mg	Mn	Mo	N	Nb	Ni	O	P
1	0.60	0.0039	0.030	0.26	18.36	0.05	18.12	0.002	0.09	3.08	0.00712	5.38	52.62	0.0001	0.007
2	0.598	0.0038	0.0338	0.272	18.466	0.055	18.206	0.0024	0.0945	3.063	0.0080	5.336	52.622	0.0012	0.00905
3	0.59	0.004	0.035	0.26	18.50	0.06	18.3	0.0024	0.100	3.06	0.0086	5.27	52.58	0.0002	0.004
4	0.610	0.0035	0.036	0.253	18.433	0.051	18.501	0.0024	0.098	3.07	0.0079	5.36	52.55	0.0005	0.0089
5	0.6385	0.004	0.0337	0.2829	18.42	0.0614	18.15	0.0022	0.1020	3.063	0.0077	5.28	52.67	0.00144	0.009
6	0.62	0.004	0.0334	0.27	18.46	0.050	18.25	0.0012	0.093	3.07	0.0077	5.381	52.68	0.00024	0.0086
7	0.585	0.00394	0.0327	0.2722	18.4599	0.0526	18.36	0.0025	0.0988	3.084	0.0075	5.40	52.6899	0.0010	0.005
8	0.61	0.0036	0.035	0.261	18.453	0.065	18.105	0.004	0.0975	3.064	0.00833	5.349	52.769		0.008
9	0.591	0.0040	0.032	0.278	18.347	0.053	18.216	0.0041	0.104	3.050	0.0077	5.334	52.570		0.0071
10	0.600		0.03403	0.252	18.381	0.0580	18.410	0.00241	0.0924	3.075		5.363	52.562		0.0084
11	0.5788		0.0318	0.255	18.538	0.0547	18.16	0.00143	0.1025	3.043		5.283			0.0059
12	0.638		0.0356	0.263		0.058	18.405	0.0020	0.0958	3.0883		5.325			0.0088
13	0.606		0.028	0.266		0.0572		0.0024	0.0866						0.0090
14	0.6081		0.0297	0.2700		0.0569									
Mean	0.6052	0.0039	0.0329	0.2654	18.4380	0.0559	18.2653	0.0024	0.0965	3.0675	0.0078	5.3384	52.6313	0.0007	0.0076
STDV.	0.0178	0.0002	0.0024	0.0093	0.0581	0.0044	0.1292	0.0008	0.0051	0.0133	0.0004	0.0425	0.0701	0.0005	0.0017
Certified	0.61	0.004	0.033	0.27	18.44	0.056	18.3	0.0024	0.097	3.07	0.0078	5.34	52.6	0.001	0.008
95% C.I.	0.01	0.0001	0.001	0.04	0.003	0.01	0.0005	0.003	0.01	0.0003	0.03	0.1	0.0005	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	A,I,O	X,I,O	X,I,O	F,O	X,I,O	X,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 OE

56E	S	Si	Ta	Ti	V	W	Ag	As	Bi	Ca	La	Pb	Sb	Sn	Zr
1	0.0010	0.09	0.0025	0.99	0.0721	0.0415	<0.00002	0.00026	<0.00003	<0.0002	0.0002	<0.0003	0.00039	0.0020	0.0013
2	0.00042	0.0883	0.009	0.954	0.0692	0.041	0.00001	0.0016	<0.00002	0.0002		<0.00002	0.0004	0.0019	0.001
3	0.0003	0.08	0.008	0.95	0.075	0.0134	<0.0002		<0.0001	0.0008		<0.0001		0.0018	0.0017
4	0.0003	0.1069	0.01	0.960	0.0715	0.01			0.00001	0.002		0.00002		0.0021	0.0014
5	0.0005	0.085	0.0035	1.0144	0.072	0.034			<0.0001	0.00013		<0.0005		0.0020	0.00143
6	0.0004	0.077	0.008	0.925	0.0789	0.065			<0.00001			0.00001			0.0010
7	0.0002	0.07	0.0016	0.974	0.0771	0.07						0.00001			
8	0.0003	0.0780	0.0093	0.951	0.075	0.0295						0.0082			
9	0.00017	0.0868		0.974	0.0763	0.062									
10	0.00037	0.071		0.946	0.0698	0.0631									
11	0.0004	0.1081		0.984		0.0303									
12	0.0010	0.0780		0.963		0.0542									
13		0.0861		0.9159											
14															
Mean	0.0004	0.0850	0.0065	0.9616	0.0737	0.0428	0.0000	0.0009	0.0000	0.0008	0.0002	0.0021	0.0004	0.0020	0.0013
STDV.	0.0003	0.0118	0.0034	0.0264	0.0032	0.0202		0.0009		0.0009		0.0041	0.0000	0.0001	0.0003
Certified	0.0004	0.09	0.01	0.96	0.074	0.04								0.002	0.001
95% C.I.	0.0002	0.01	0.003	0.02	0.002	0.01								0.0001	0.0003
Methods	X,C,O	X,I,O	X,I,O	X,I,O	X,I,O	X,I,O								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 30-1981-(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.

  
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Certificate No.: 56E-03132007-IARM-P  
 Certificate Date: 03/13/2007  
 Revision Date/No.: 03/13/2007