

Analytical Reference Materials International

Certificate of Analysis Certified Reference Material



Grade: Alloy C276 / UNS N10276

Part Number (Q.A. NO.): IARM 66C

Certificate Date: 02/23/2006

Certificate No.: 66C-02232006-IARM-F

Revision Date: 02/12/2008

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> 0.23 (0.01)	<u>Boron</u> 0.0023 (0.0001)	<u>Carbon</u> 0.004 (0.001)	<u>Cobalt</u> 0.23 (0.005)	<u>Chromium</u> 15.7 (0.1)	<u>Copper</u> 0.15 (0.005)	<u>Iron</u> 5.24 (0.02)	<u>Lead</u> (0.0001)
<u>Magnesium</u> 0.02 (0.005)	<u>Manganese</u> 0.41 (0.004)	<u>Molybdenum</u> 15.7 (0.1)	<u>Nitrogen</u> 0.029 (0.001)	<u>Niobium</u> 0.03 (0.004)	<u>Nickel</u> 59.1 (0.2)	<u>Oxygen</u> <0.001	<u>Phosphorus</u> 0.008 (0.001)
<u>Silicon</u> 0.025 (0.003)	<u>Sulfur</u> 0.001 (0.0004)	<u>Tantalum</u> (0.01)	<u>Tin</u> (0.003)	<u>Titanium</u> 0.007 (0.001)	<u>Tungsten</u> 3.25 (0.03)	<u>Vanadium</u> 0.012 (0.002)	<u>Zirconium</u> 0.01 (0.004)

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

Anderson Laboratories, Inc. - Greendale, WI
Cannon Muskegon Corp. - Muskegon, MI
Haynes International, Inc. - Kokomo, IN
Laboratory Testing, Inc. - Hatfield, PA
Massachusetts Materials Research - West Boylston, MA
Special Metals IncoTest - Hereford, UK

ATI Allvac - Lockport, NY
Carpenter Technology Corporation - Reading, PA
Huntington Alloys Corporation - Huntington, WV
Latrobe Specialty Steel Co. - Latrobe, PA
Outokumpu Stainless OY - Tornio Finland
ThyssenKrupp VDM USA - Florham Park, NJ

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 73C, 131G, 885, 1261A, IARM 66B, CRM 186B, 187A, NIST 131G, IARM 66B, LECO 501-645, NIST 899, BS H-2A, 66A, 66B, BCS-CRM N346, LECO 502-148, 501-644, 501-674, NIST C2402, IARM 66A, X2 NI31, NR 36, 839, CRM 295-1, NBS 101F, HAS C276C, BCS 351, 454/1, 462/1, LECO 502-102, 501-551, 501-147, RM R5657, IARM 66A, BS H2A, H2B, CSN-4, PT 63, 51221E, LECO 501-674, 501-645, 502-106, 502-256, NIST 131G, 160B, HAS 25-6A, C276A, C276B, 400M, 600T, 805B, 902B, IARM 66B, LECO 501-550, 502-256, IARM 66B, MONITOR 142, LECO501-553, ALPHA AR892, IARM 56A, 59B, 66A, 66B, NIST C2402, IARM 27D, 66A, 66B, LECO, 501-645, IS 02439, 02440, 02441, ES 0115A, IC 81725, 82081, IARM 56B, 66B, ALPHA AR881, LECO 501-645, ALPHA AR 892, 657, IARM 66B

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 02/12/2008.

66C	Al	B	C	Co	Cr	Cu	Fe	Mg	Mn	Mo	N	Nb	Ni	O	P
1	0.227	0.0025	0.0030	0.240	15.56	0.162	5.26	0.0098	0.410	15.76	0.0279	0.015	59.45	0.0002	0.007
2	0.251	0.0022	0.0035	0.216	15.768	0.160	5.24	0.0217	0.404	15.755	0.0293	0.04	58.978	0.0004	0.0101
3	0.2356	0.0022	0.004	0.223	15.721	0.152	5.176	0.027	0.422	15.723	0.02819	0.0243	59.117	0.000856	0.005
4	0.220	0.0022	0.0041	0.220	15.783	0.1517	5.258	0.0232	0.423	15.722	0.0305	0.028	59.00	0.0005	0.0059
5	0.2340	0.0026	0.0027	0.232	15.670	0.144	5.2865	0.026	0.408	15.478	0.02924	0.017	59.327	0.00029	0.0073
6	0.215	0.0023	0.0049	0.2345	15.60	0.15	5.23	0.018	0.403	15.65	0.0316	0.0287	59.22	0.0015	0.0067
7	0.2232	0.0020	0.00334	0.24	15.811	0.155	5.237	0.0186	0.4165	15.629	0.029	0.020	58.613	0.0008	0.0073
8	0.240	0.0025	0.0041	0.2323	15.60	0.146	5.22	0.0319	0.407	15.61	0.0283	0.0303	58.965	0.0008	0.008
9	0.242	0.0026	0.0032	0.240	15.75	0.1455	5.3056	0.0258	0.4143	15.70	0.0291	0.029	59.092	0.0017	0.0080
10	0.2380	0.0023	0.0042	0.234	15.577	0.1614	5.18	0.0273	0.422	15.75	0.0315	0.0301		0.001	0.0089
11	0.2278	0.0020	0.0026	0.2210	15.667		5.264	0.0379	0.419	15.733		0.0218			0.0082
12			0.0053	0.2348	15.696		5.245		0.4133	15.788		0.0269			0.0080
13			0.0027	0.2351			5.23		0.4127			0.0316			
14			0.0017				5.227		0.4211	15.511					
Mean	0.2321	0.0023	0.0035	0.2310	15.6836	0.1528	5.2399	0.0243	0.4140	15.6776	0.0295	0.0264	59.0847	0.0008	0.0075
STDV.	0.0106	0.0002	0.0010	0.0082	0.0854	0.0067	0.0354	0.0074	0.0069	0.0971	0.0013	0.0067	0.2416	0.0005	0.0013
Certified	0.23	0.0023	0.004	0.23	15.7	0.15	5.24	0.02	0.41	15.7	0.029	0.03	59.1	<0.001	0.008
95% C.I.	0.01	0.0001	0.001	0.005	0.1	0.005	0.02	0.005	0.004	0.1	0.001	0.004	0.2		0.001
Methods	X,A,I,O	I,O	C,O	X,I,O	X,W,I,O	X,I,O	X,I,O	A,I,O	X,I,O	X,I,O	F	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

66C	S	Si	Ta	Ti	V	W	Ag	As	Bi	Ca	La	Pb	Sb	Sn	Zr
1	0.0001	0.022	0.0015	0.0075	0.010	3.28	0.00004	0.0060	<0.00001	<0.001	<0.0001	0.000045	0.0004	0.0008	0.010
2	0.0001	0.0275	0.0056	0.010	0.0114	3.203	0.0008	0.0014	<0.00001	<0.001	0.0005	0.00004	0.00070	0.0017	0.0034
3	0.00052	0.020	0.0001	0.00489	0.0134	3.221		0.0015	<0.001			0.00004	<0.01	0.0017	0.0057
4	0.000518	0.022	0.0060	0.008	0.012	3.174		<0.01				0.0001		0.0020	0.0001
5	0.0005	0.019	0.0094	0.006	0.016	3.206		0.0028						0.0040	0.0080
6	0.00026	0.0233	0.0108	0.0070	0.0093	3.25								0.0033	0.0091
7	0.0001	0.029		0.0057	0.0094	3.249									0.0143
8	0.0016	0.020		0.010	0.010	3.26									
9	0.0002	0.031		0.0075	0.0055	3.19									
10	0.0010	0.0234		0.0050	0.0144	3.25									
11	0.0014	0.0319		0.0086	0.0168	3.321									
12		0.0304		0.00557		3.366									
13				0.0098		3.3127									
14						3.210									
Mean	0.0006	0.0250	0.0056	0.0074	0.0117	3.2495	0.0004	0.0029			0.0005	0.0001	0.0006	0.0023	0.0072
STDV.	0.0005	0.0047	0.0042	0.0019	0.0033	0.0550	0.0005	0.0021				0.0000	0.0002	0.0012	0.0047
Certified	0.001	0.025	(0.01)	0.007	0.012	3.25		<0.003				(0.0001)		(0.003)	0.01
95% C.I.	0.0004	0.003		0.001	0.002	0.03									0.004
Methods	C,O	X,A,I,O	X,I,O	X,I,O	X,I,O	X,I,O		H,D,A,I,O					H,D,A,I	H,D,I,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.

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

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