Analytical Reference Materials International

Certificate of Analysis
Certified Reference Material

Grade: Alloy 625 / UNS N06625

Part Number (Q.A. NO.): **IARM 54E**

Certificate Date: **01/15/2008**   Certificate No.: **54E-01152008-IARM-F**   Revision Date: **03/31/2015**

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!

Aluminum	Antimony	Arsenic	Bismuth	Boron	Calcium	Carbon	Chromium	Cobalt	Copper	Hafnium
0.301	(0.0003)	(0.0008)		0.0025	(0.001)	0.028	21.9	0.22	0.09	
(0.003)				(0.0003)		(0.001)	(0.05)	(0.004)	(0.01)	

Iron	Lanthanum	Lead	Magnesium	Manganese	Molybdenum	Nickel	Niobium	Nitrogen	Oxygen	Phosphorus
3.68		(0.00004)	0.0022	0.11	9.19	60.4	3.54	0.0096	0.0002	0.0074
(0.02)			(0.0003)	(0.003)	(0.01)	(0.1)	(0.01)	(0.0003)	(0.0001)	(0.0003)

Rhenium	Silicon	Silver	Sulfur	Tantalum	Tin	Titanium	Tungsten	Vanadium	Yttrium	Zirconium
	0.1046	(0.00001)	0.0003	0.004	0.0011	0.29	0.10	0.015		0.0007
	(0.0110)		(0.0001)	(0.001)	(0.0002)	(0.01)	(0.004)	(0.001)		(0.0003)

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 Specialty Materials, Lockport - Lockport, NY**
ATI Specialty Materials, Monroe - Monroe, NC	**Exova - Portland, OR**
Haynes International, Inc. - Kokomo, IN	**Huntington Alloys Corporation - Huntington, WV**
Jorgensen Forge Corp. - Seattle, WA	**Laboratory Testing, Inc. - Hatfield, PA**
Latrobe Specialty Metals - Latrobe, PA	**PM Kalco, Inc - Wheatland, PA**
Special Metals IncoTest - Hereford, UK	**VDM-Metals USA, LLC - 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: **IARM 6C, 54B, BS 625A, 625B, CSN-4, IH ALV RF02, LECO 501-644, 501-674, 502-456, NIST 1245, 2159, ALPHA AR659, AR872, AR890, HAS 400M, 625G, LECO 501-644, ALPHA AR881, LECO 501-991, NIST 865, 3102A, 3103A, 3107, 3109A, 3127A, 3128, 3131A, 3139A, 3155, 3161A, 3162A, 3163, 3165, 3169, MBH 28X6256L, ALPHA AR511, AR669, LECO 501-503, 501-643, HAS 625G, BCS 351, 454/1, 462/1, LECO 501-551, 502-102, NIST 15H, 72G, 131G, 1245, 1261A, 1262A, 1263A, 1264A, 1265A, BCS 346A, BS 625, ALPHA AR669, NIST 897, 1765, HAYNES IH 2650, IM 145, IS H19, ALPHA AR890, LECO 501-644, BS 625B, ALPHA AR657, AR668, AR881, NIST 346, 889, 899, BCS CRM 346, BS 625, 625A, 625B, IARM 54B, 54C, CRM-346, LECO 501-643, 501-644, 501-992, 502-456, NIST 1761, 1762, 1763, 1764, 1765, 1766, 1767, 1245, 1295, IARM 54C, 64B, 64C, IARM 54A, 54B, NIST 867, 3106, 3107, 3109A, 3128, 3131A, 3151, 3161A, RF02, LECO 501-147, 501-643, 501-644, NIST 1245A, IARM 54C, MBH 28X6251L, RNI 11/10, 12/12, 13/11, 14/11, 15/12, LECO 501-643.**

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 03/31/2015.

54E	Al	B	C	Co	Cr	Cu	Fe	Mg	Mn	Mo	N	Nb	Ni	O	P
1	0.300	0.0025	0.030	0.2159	21.97	0.0800	3.70	0.0025	0.100	9.19	0.0094	3.51	60.54	0.00009	0.0070
2	0.3023	0.0016	0.0276	0.207	21.802	0.088	3.686	0.0027	0.1153	9.197	0.0088	3.552	60.342	0.00033	0.0077
3	0.300	0.0026	0.030	0.220	21.95	0.086	3.74	0.0022	0.110	9.19	0.0099	3.56	60.25	0.0001	0.0079
4	0.296	0.0022	0.0275	0.2091	21.97	0.0942	3.68	0.0022	0.103	9.18	0.0104	3.54	60.34	0.0003	0.0070
5	0.3051	0.0023	0.0286	0.213	22.063	0.094	3.65	0.0022	0.1193	9.209	0.0102	3.519	60.417	0.00027	0.0076
6	0.306	0.0029	0.0284	0.2222	21.87	0.076	3.671	0.0019	0.107	9.20	0.0099	3.519	60.47	0.0003	0.0068
7	0.306	0.0030	0.0289	0.219	21.779	0.103	3.62	0.0019	0.115	9.184	0.0094	3.563	60.51	0.0003	0.0075
8	0.300	0.0027	0.027	0.2232	21.94	0.102	3.692		0.115	9.194	0.0094	3.54	60.24	0.00010	0.0075
9	0.300	0.0032	0.0263	0.218	21.908	0.0802	3.704		0.1119	9.188	0.0094	3.567	60.300		0.0080
10	0.296	0.0024	0.0267	0.2190	21.89	0.094	3.641		0.115	9.170	0.0095	3.556	60.326		0.0072
11	0.2952	0.0028	0.0282	0.215	21.861	0.0866	3.675		0.1163	9.209	0.0088	3.52	60.50		0.0077
12	0.3075	0.0020	0.0279	0.2076	21.844	0.080	3.738		0.108	9.197	0.0091	3.534	60.430		
13		0.0029	0.0278		21.986	0.0823			0.1104		0.0105	3.529	60.274		
14			0.0286									3.560			
Mean	0.3012	0.0025	0.0281	0.2158	21.910	0.0882	3.683	0.0022	0.1112	9.192	0.0096	3.541	60.380	0.0002	0.0074
STDV.	0.0042	0.0004	0.0011	0.0055	0.080	0.0087	0.036	0.0003	0.0056	0.011	0.0006	0.019	0.104	0.0001	0.0004
Certified	**0.301**	**0.0025**	**0.028**	**0.22**	**21.9**	**0.09**	**3.68**	**0.0022**	**0.11**	**9.19**	**0.0096**	**3.54**	**60.4**	**0.0002**	**0.0074**
95% C.I.	**0.003**	**0.0003**	**0.001**	**0.004**	**0.05**	**0.01**	**0.02**	**0.0003**	**0.003**	**0.01**	**0.0003**	**0.01**	**0.1**	**0.0001**	**0.0003**
Methods	X,I,O	I,O	X,I,O	X,I,O	X,W,O	X,I,O	H,A,I,O	X,I,O	X,I,O	X,I,O	F,O	X,I,O	X,I,O	F	X,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

54E	S	Si	Ta	Ti	V	W	Ag	As	Bi	Ca	La	Pb	Sb	Sn	Zr
1	0.00026	0.110	0.0041	0.300	0.0147	0.0920	0.00003	0.0008	<0.0001	0.0009	0.0024	0.0001	0.0003	0.0014	0.00028
2	0.0001	0.0910	0.0039	0.2810	0.0155	0.0994	0.00001	0.0007	0.0001	0.001	<0.0001	0.00001	0.0002	0.0013	0.0005
3	0.00037	0.122	0.0069	0.276	0.0142	0.098	0.000004	0.0008	<0.0001	0.0005		0.000002	0.00031	0.0012	0.0013
4	0.0003	0.0988	0.003	0.279	0.014	0.093	0.00001	0.00089	<0.0001			0.000007	0.00025	0.0007	0.0005
5	0.0004	0.1419	0.0033	0.2988	0.0147	0.0965			0.000003			0.000007	0.00027	0.00097	0.0004
6	0.00016	0.084	0.004	0.297	0.014	0.109			<0.00003			0.0001		0.0010	0.0008
7	0.0001	0.101	0.0061	0.276	0.0140	0.1024			<0.000001					0.0011	0.0010
8	0.0004	0.110	0.003	0.305	0.016	0.103								0.00085	
9	0.00024	0.086		0.284	0.015	0.0997									
10	0.0003	0.0935		0.2859											
11	0.00027	0.103		0.287											
12		0.0884		0.2807											
13		0.093		0.283											
14		0.1424		0.2908											
Mean	0.0003	0.1046	0.0043	0.2874	0.0147	0.0992	0.00001	0.0008	0.00001	0.0008	0.0024	0.00004	0.0003	0.0011	0.0007
STDV.	0.0001	0.0190	0.0014	0.0094	0.0007	0.0052	0.000005	0.0003	0.000005	0.0003		0.00005	0.0004	0.0002	0.0004
Certified	**0.0003**	**0.1046**	**0.004**	**0.29**	**0.015**	**0.10**	**(0.00001)**	**(0.0008)**		**(0.001)**		**(0.00004)**	**(0.0003)**	**0.0011**	**0.0007**
95% C.I.	**0.0001**	**0.0110**	**0.001**	**0.01**	**0.001**	**0.004**								**0.0002**	**0.0003**
Methods	C,G	X,G,I,O	C,O	X,I,O	X,I,O	X,I,O	G,H,I	G,H,I		I		G,H,A,I,O	G,H,I	G,H,A,I,O	X,I

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 intended 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.

Daniel Geist, Operations Manager
Analytical Reference Materials International, Part of LGC Standards