

Certificate of Analysis IARM 338A

Alloy 602CA / UNS N06025 Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

AI	2.13 ± 0.02	В	0.0049 ± 0.0007	С	0.168 ± 0.002	Ca	0.002 ± 0.001
Co	0.035 ± 0.002	Cr	25.0 ± 0.3	Cu	0.0059 ± 0.0009	Fe	9.74 ± 0.03
Mg	0.0058 ± 0.0003	Mn	0.052 ± 0.003	Мо	0.0017 ± 0.0005	Ν	0.0276 ± 0.0006
Nb	0.004 ± 0.001	Ni	62.3 ± 0.2	0	0.0010 ± 0.0003	Ρ	0.003 ± 0.001
Pb	0.00007 ± 0.00002	S	0.0008 ± 0.0002	Si	0.020 ± 0.002	Sn	$\textbf{0.00037} \pm 0.00009$
Ti	0.130 ± 0.003	V	0.0026 ± 0.0005	Y	0.06 ± 0.01	Zr	0.081 ± 0.004

	Indicative Values listed in ppm							
Ag (1)	As (<5)	Bi (<1)	Sb (0.9)	Ta (20)	W (<200)			

Description and Intended Use

This CRM may come in the form of a solid disc or chips. The intended use of this CRM may include, but is not limited to, the calibration of instruments and the validation of analytical methods.

Interpretation of Data

1. Certified values listed 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. This material was tested using both the solid disks and chips prepared from individual sections of bar. The certified values are considered representative of the overall average composition of the material.

3. 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.

4. "Provisional Certificate of Analysis" reports values that support a fully certified reference material; it also indicates that values may be in a continued process of statistical evaluation and are subject to change.

5. Chips are not certified for Oxygen analysis.



Analytical Reference Materials International • 276 Abby Road • Manchester, NH 03103 Telephone (603) 935-4100 • Fax (603) 935-4101 • www.ARMI.com • ARMI@LGCgroup.com The following data and accompanying statements represent all pertinent information reported in the ILAP as it applies to the chemical characterization of this material.

	Ag	AI	As	В	Bi	С	Са	Co	Cr	Cu	Fe	Mg	Mn	Мо	N	Nb
1	0.00001	2.076	0.0001	0.0026	0.00001	0.162	0.001	0.031	23.90	0.0039	9.666	0.005	0.042	0.001	0.0263	0.002
2	0.00002	2.098	0.0002	0.0034	< 0.00001	0.164	0.0012	0.0319	24.039	0.0048	9.6901	0.0056	0.047	0.001	0.0265	0.0024
3	0.00002	2.030	0.00042	0.0041	<0.00001	0.165	0.0012	0.0313	24.000	0.005	9.70	0.0058	0.047	0.0012	0.0268	0.003
4	0.0002	2.10	< 0.005	0.0041	<0.0001	0.1666	0.0017	0.0328	25.014	0.005	9.70	0.0058	0.05	0.0012	0.0200	0.0033
5	0.00031	2.12	<0.005	0.0045	<0.0001	0.167	0.0028	0.0320	25.0316	0.005	9.7008	0.0058	0.05	0.0015	0.0275	0.0038
6	< 0.0002	2.12		0.0045		0.167	0.0020	0.034	25.0510	0.0053	9.702	0.0059	0.051	0.0013	0.0276	0.0039
7	<0.0002	2.1286		0.005		0.168	0.0000	0.035	25.071	0.0054	9.75	0.006	0.0519	0.002	0.0278	0.0055
8		2.1200		0.0052		0.1681		0.035	25.073	0.0054	9.751	0.006	0.0519	0.002	0.0278	0.0055
9		2.15		0.0052		0.1689		0.0353	25.351	0.006	9.766	0.0063	0.0527	0.002	0.0281	0.0030
9 10		2.15		0.0052		0.1009		0.0353	25.351	0.006	9.766	0.0005	0.0527	0.003	0.0282	0.0078
10		2.159		0.00555		0.17		0.0369	25.40	0.0063	9.77		0.0537		0.0285	
		2.10		0.00555		0.1753		0.0369	25.417	0.0083	9.834		0.054		0.0294	
12 13		2.209		0.0056		0.1763		0.041	25.443	0.0087	9.834		0.055			
13				0.0077					25.7301	0.009			0.0604			
14									25.7501				0.001			
Mean	0.0001	2.13	0.0002	0.0049		0.168	0.002	0.035	25	0.0059	9.74	0.0058	0.052	0.0017	0.0276	0.004
STDV.	0.0001	0.04	0.0002	0.0049		0.108	0.002	0.003	0.5	0.0039	0.05	0.0058	0.005	0.0007	0.0278	0.004
Certified	(0.0001)	2.13	(<0.0002	0.001	(<0.0001)	0.004	0.0009	0.003	25.0	0.001	9.74	0.0004	0.003	0.0008	0.0009	0.002
95% C.I.	(0.0001)	0.02	(<0.0005)	0.0049	(<0.0001)	0.002	0.002	0.003	0.3	0.0009	0.03	0.0003	0.002	0.0007	0.0276	0.004
Methods	I,IM,H,A	X,O,I,G	IM,I,H	0.0007 O,IM,I,G	IM,H,A	0.002 O,C	0.001		X,W,O,I,G			0.0003 O,IM,I		X,O,IM,I,G	0.0008 F	X,O,IM,I,G
Methous	1,1101,11,7												A,O,IIVI,I,G			
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	Ni	0	P	Pb	S	Sb	Si	Sn	Та	Ti	v	W	Y	Zr		, , , , , , , , , , , , , , , , , , , ,
1	61.852	0.0005	P 0.001	Pb 0.00004	S 0.0004	Sb 0.000056	0.0159	Sn 0.00014	Ta 0.001	Ti 0.121	V 0.0016	W 0.0002	0.021	0.0654		
1 2	61.852 61.983	0.0005 0.0005	P 0.001 0.0011	Pb 0.00004 0.00006	S 0.0004 0.0005	Sb 0.000056 0.00006	0.0159 0.018	Sn 0.00014 0.0003	Ta 0.001 0.001	Ti 0.121 0.126	V 0.0016 0.002	W 0.0002 0.0013	0.021 0.0516	0.0654 0.0721		
1 2 3	61.852 61.983 62.12	0.0005 0.0005 0.0006	P 0.001 0.0011 0.0012	Pb 0.00004 0.00006 0.00008	S 0.0004 0.0005 0.0005	Sb 0.000056 0.00006 0.0001	0.0159 0.018 0.0184	Sn 0.00014 0.0003 0.0004	Ta 0.001 0.001 0.0019	Ti 0.121 0.126 0.126	V 0.0016 0.002 0.002	W 0.0002 0.0013 0.006	0.021 0.0516 0.058	0.0654 0.0721 0.0778		
3 4	61.852 61.983 62.12 62.20	0.0005 0.0005 0.0006 0.0008	P 0.001 0.0011 0.0012 0.0012	Pb 0.00004 0.00006 0.00008 0.000082	S 0.0004 0.0005 0.0005 0.0006	Sb 0.000056 0.00006 0.0001 0.0001	0.0159 0.018 0.0184 0.019	Sn 0.00014 0.0003 0.0004 0.0004	Ta 0.001 0.001 0.0019 0.002	Ti 0.121 0.126 0.126 0.127	V 0.0016 0.002 0.002 0.0023	W 0.0002 0.0013 0.006 0.015	0.021 0.0516 0.058 0.0633	0.0654 0.0721 0.0778 0.079		
3 4 5	61.852 61.983 62.12 62.20 62.24	0.0005 0.0005 0.0006 0.0008 0.0009	P 0.001 0.0011 0.0012 0.0012 0.0015	Pb 0.00004 0.00006 0.00008 0.000082 0.00009	S 0.0004 0.0005 0.0005 0.0006 0.000752	Sb 0.000056 0.00006 0.0001 0.0001 0.00011	0.0159 0.018 0.0184 0.019 0.019	Sn 0.00014 0.0003 0.0004 0.0004 0.0004	Ta 0.001 0.001 0.0019	Ti 0.121 0.126 0.126 0.127 0.128	V 0.0016 0.002 0.002 0.0023 0.0023	W 0.0002 0.0013 0.006 0.015 0.02	0.021 0.0516 0.058 0.0633 0.0653	0.0654 0.0721 0.0778 0.079 0.0795		
3 4	61.852 61.983 62.12 62.20 62.24 62.3992	0.0005 0.0005 0.0006 0.0008 0.0009 0.00094	P 0.001 0.0011 0.0012 0.0012 0.0015 0.0016	Pb 0.00004 0.00006 0.00008 0.000082	S 0.0004 0.0005 0.0005 0.0006 0.000752 0.0009	Sb 0.000056 0.00006 0.0001 0.0001	0.0159 0.018 0.0184 0.019 0.019 0.02	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004	Ta 0.001 0.001 0.0019 0.002	Ti 0.121 0.126 0.126 0.127 0.128 0.129	V 0.0016 0.002 0.002 0.0023 0.0023 0.0023	W 0.0002 0.0013 0.006 0.015 0.02 <0.0004	0.021 0.0516 0.058 0.0633 0.0653 0.067	0.0654 0.0721 0.0778 0.079 0.0795 0.08		
3 4 5 6 7	61.852 61.983 62.12 62.20 62.24 62.3992 62.433	0.0005 0.0005 0.0006 0.0008 0.0009 0.00094 0.0011	P 0.001 0.0011 0.0012 0.0012 0.0015 0.0016 0.0019	Pb 0.00004 0.00006 0.00008 0.000082 0.00009	S 0.0004 0.0005 0.0005 0.0006 0.000752 0.0009 0.001	Sb 0.000056 0.00006 0.0001 0.0001 0.00011	0.0159 0.018 0.0184 0.019 0.019 0.019 0.02 0.02	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004	Ta 0.001 0.001 0.0019 0.002	Ti 0.121 0.126 0.126 0.127 0.128 0.129 0.1294	V 0.0016 0.002 0.0023 0.0023 0.0023 0.003 0.003	W 0.0002 0.0013 0.006 0.015 0.02 <0.0004 <0.005	0.021 0.0516 0.058 0.0633 0.0653 0.067 0.0684	0.0654 0.0721 0.0778 0.079 0.0795 0.08 0.0807		
3 4 5	61.852 61.983 62.12 62.20 62.24 62.3992 62.433 62.507	0.0005 0.0005 0.0006 0.0008 0.0009 0.00094 0.0011 0.0011	P 0.001 0.0011 0.0012 0.0015 0.0016 0.0019 0.0023	Pb 0.00004 0.00006 0.00008 0.000082 0.00009	S 0.0004 0.0005 0.0005 0.0006 0.000752 0.0009 0.001 0.001	Sb 0.000056 0.00006 0.0001 0.0001 0.00011	0.0159 0.018 0.0184 0.019 0.019 0.02 0.02 0.02 0.02	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004	Ta 0.001 0.001 0.0019 0.002	Ti 0.121 0.126 0.126 0.127 0.128 0.129 0.1294 0.13	V 0.0016 0.002 0.0023 0.0023 0.0023 0.003 0.0031 0.0032	W 0.0002 0.0013 0.006 0.015 0.02 <0.0004 <0.005 <0.010	0.021 0.0516 0.058 0.0633 0.0653 0.067 0.0684 0.07	0.0654 0.0721 0.0778 0.079 0.0795 0.08 0.0807 0.0816		
3 4 5 6 7	61.852 61.983 62.12 62.20 62.24 62.3992 62.433 62.507 62.51	0.0005 0.0005 0.0006 0.0008 0.0009 0.00094 0.0011 0.0011 0.0013	P 0.001 0.0011 0.0012 0.0012 0.0015 0.0016 0.0019 0.0023 0.0039	Pb 0.00004 0.00006 0.00008 0.000082 0.00009	S 0.0004 0.0005 0.0005 0.0006 0.000752 0.0009 0.001	Sb 0.000056 0.00006 0.0001 0.0001 0.00011	0.0159 0.018 0.0184 0.019 0.019 0.02 0.02 0.02 0.02 0.021	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004	Ta 0.001 0.001 0.0019 0.002	Ti 0.121 0.126 0.126 0.127 0.128 0.129 0.1294 0.13 0.1303	V 0.0016 0.002 0.0023 0.0023 0.0023 0.0031 0.0031 0.0032 0.0033	W 0.0002 0.0013 0.006 0.015 0.02 <0.0004 <0.005	0.021 0.0516 0.058 0.0633 0.0653 0.067 0.0684 0.07 0.0702	0.0654 0.0721 0.0778 0.079 0.0795 0.08 0.0807 0.0816 0.082		
3 4 5 6 7 8	61.852 61.983 62.12 62.20 62.24 62.3992 62.433 62.507	0.0005 0.0005 0.0006 0.0008 0.0009 0.00094 0.0011 0.0011 0.0013 0.0013	P 0.001 0.0011 0.0012 0.0012 0.0015 0.0016 0.0019 0.0023 0.0039 0.004	Pb 0.00004 0.00006 0.00008 0.000082 0.00009	S 0.0004 0.0005 0.0005 0.0006 0.000752 0.0009 0.001 0.001	Sb 0.000056 0.00006 0.0001 0.0001 0.00011	0.0159 0.018 0.0184 0.019 0.019 0.02 0.02 0.02 0.021 0.0216	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004	Ta 0.001 0.001 0.0019 0.002	Ti 0.121 0.126 0.126 0.127 0.128 0.129 0.1294 0.13 0.1303 0.1305	V 0.0016 0.002 0.0023 0.0023 0.0023 0.003 0.0031 0.0032	W 0.0002 0.0013 0.006 0.015 0.02 <0.0004 <0.005 <0.010	0.021 0.0516 0.058 0.0633 0.0653 0.067 0.0684 0.07 0.0702 0.0702	0.0654 0.0721 0.0778 0.079 0.0795 0.08 0.0807 0.0816 0.082 0.082		
3 4 5 6 7 8 9	61.852 61.983 62.12 62.20 62.24 62.3992 62.433 62.507 62.51	0.0005 0.0005 0.0006 0.0008 0.0009 0.00094 0.0011 0.0011 0.0013	P 0.001 0.0011 0.0012 0.0012 0.0015 0.0015 0.0016 0.0023 0.0023 0.0039 0.004 0.0047	Pb 0.00004 0.00006 0.00008 0.000082 0.00009	S 0.0004 0.0005 0.0005 0.0006 0.000752 0.0009 0.001 0.001	Sb 0.000056 0.00006 0.0001 0.0001 0.00011	0.0159 0.018 0.018 0.019 0.019 0.02 0.02 0.02 0.021 0.0216 0.0235	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004	Ta 0.001 0.001 0.0019 0.002	Ti 0.121 0.126 0.126 0.127 0.128 0.129 0.1294 0.13 0.1303 0.1305 0.136	V 0.0016 0.002 0.0023 0.0023 0.0023 0.0031 0.0031 0.0032 0.0033	W 0.0002 0.0013 0.006 0.015 0.02 <0.0004 <0.005 <0.010	0.021 0.0516 0.058 0.0633 0.0653 0.067 0.0684 0.07 0.0702	0.0654 0.0721 0.0778 0.079 0.0795 0.08 0.0807 0.0816 0.082 0.082 0.086		
3 4 5 6 7 8 9 10	61.852 61.983 62.12 62.20 62.24 62.3992 62.433 62.507 62.51	0.0005 0.0005 0.0006 0.0008 0.0009 0.00094 0.0011 0.0011 0.0013 0.0013	P 0.001 0.0011 0.0012 0.0012 0.0012 0.0015 0.0016 0.0023 0.0023 0.0039 0.004 0.0047 0.0057	Pb 0.00004 0.00006 0.00008 0.000082 0.00009	S 0.0004 0.0005 0.0005 0.0006 0.000752 0.0009 0.001 0.001	Sb 0.000056 0.00006 0.0001 0.0001 0.00011	0.0159 0.018 0.0184 0.019 0.019 0.02 0.02 0.02 0.021 0.0216	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004	Ta 0.001 0.001 0.0019 0.002	Ti 0.121 0.126 0.127 0.128 0.129 0.129 0.1294 0.13 0.1303 0.1305 0.136 0.138	V 0.0016 0.002 0.0023 0.0023 0.0023 0.0031 0.0031 0.0032 0.0033	W 0.0002 0.0013 0.006 0.015 0.02 <0.0004 <0.005 <0.010	0.021 0.0516 0.058 0.0633 0.0653 0.067 0.0684 0.07 0.0702 0.0702	0.0654 0.0721 0.0778 0.079 0.0795 0.08 0.0807 0.0816 0.082 0.082 0.086 0.087		
3 4 5 6 7 8 9 10 11	61.852 61.983 62.12 62.20 62.24 62.3992 62.433 62.507 62.51	0.0005 0.0005 0.0006 0.0008 0.0009 0.00094 0.0011 0.0011 0.0013 0.0013	P 0.001 0.0011 0.0012 0.0012 0.0015 0.0015 0.0016 0.0023 0.0023 0.0039 0.004 0.0047	Pb 0.00004 0.00006 0.00008 0.000082 0.00009	S 0.0004 0.0005 0.0005 0.0006 0.000752 0.0009 0.001 0.001	Sb 0.000056 0.00006 0.0001 0.0001 0.00011	0.0159 0.018 0.018 0.019 0.019 0.02 0.02 0.02 0.021 0.0216 0.0235	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004	Ta 0.001 0.001 0.0019 0.002	Ti 0.121 0.126 0.126 0.127 0.128 0.129 0.1294 0.13 0.1303 0.1305 0.136	V 0.0016 0.002 0.0023 0.0023 0.0023 0.0031 0.0031 0.0032 0.0033	W 0.0002 0.0013 0.006 0.015 0.02 <0.0004 <0.005 <0.010	0.021 0.0516 0.058 0.0633 0.0653 0.067 0.0684 0.07 0.0702 0.0702	0.0654 0.0721 0.0778 0.079 0.0795 0.08 0.0807 0.0816 0.082 0.082 0.086		
3 4 5 6 7 8 9 10 11 12 13 14	61.852 61.983 62.12 62.20 62.24 62.3992 62.433 62.507 62.51	0.0005 0.0005 0.0006 0.0008 0.0009 0.00094 0.0011 0.0011 0.0013 0.0013	P 0.001 0.0011 0.0012 0.0012 0.0012 0.0015 0.0016 0.0023 0.0023 0.0039 0.004 0.0047 0.0057	Pb 0.00004 0.00006 0.00008 0.000082 0.00009	S 0.0004 0.0005 0.0005 0.0006 0.000752 0.0009 0.001 0.001	Sb 0.000056 0.00006 0.0001 0.0001 0.00011	0.0159 0.018 0.018 0.019 0.019 0.02 0.02 0.02 0.021 0.0216 0.0235	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004	Ta 0.001 0.001 0.0019 0.002	Ti 0.121 0.126 0.127 0.128 0.129 0.129 0.1294 0.13 0.1303 0.1305 0.136 0.138	V 0.0016 0.002 0.0023 0.0023 0.0023 0.0031 0.0031 0.0032 0.0033	W 0.0002 0.0013 0.006 0.015 0.02 <0.0004 <0.005 <0.010	0.021 0.0516 0.058 0.0633 0.0653 0.067 0.0684 0.07 0.0702 0.0702	0.0654 0.0721 0.0778 0.079 0.0795 0.08 0.0807 0.0816 0.082 0.082 0.086 0.087		
3 4 5 6 7 8 9 10 11 12 13	61.852 61.983 62.12 62.20 62.24 62.3992 62.433 62.507 62.51 62.531	0.0005 0.0005 0.0006 0.0009 0.00094 0.0011 0.0011 0.0013 0.0013 0.002	P 0.001 0.0011 0.0012 0.0015 0.0015 0.0016 0.0019 0.0023 0.0039 0.0047 0.0047 0.0057 0.006	Pb 0.00004 0.00006 0.000082 0.00009 0.00009	S 0.0004 0.0005 0.0005 0.0006 0.000752 0.0009 0.001 0.001 0.0014	Sb 0.000056 0.00006 0.0001 0.0001 0.00011 <0.005	0.0159 0.018 0.0184 0.019 0.02 0.02 0.02 0.02 0.021 0.0216 0.0235 0.027	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004 0.0005	Ta 0.001 0.001 0.002 0.002 0.005	Ti 0.121 0.126 0.127 0.128 0.1294 0.1303 0.1305 0.138 0.138	V 0.0016 0.002 0.0023 0.0023 0.003 0.0031 0.0032 0.0033 0.0034	W 0.0002 0.0013 0.006 0.015 0.02 <0.0004 <0.005 <0.010 <0.02	0.021 0.0516 0.058 0.0633 0.0653 0.067 0.0684 0.07 0.0702 0.0707 0.10	0.0654 0.0721 0.0778 0.079 0.0795 0.08 0.0807 0.0816 0.082 0.082 0.086 0.087 0.09 0.0901		
3 4 5 6 7 8 9 10 11 12 13 13 14 15 Mean	61.852 61.983 62.12 62.20 62.24 62.3992 62.433 62.507 62.51 62.531	0.0005 0.0005 0.0006 0.0009 0.00094 0.0011 0.0013 0.0013 0.002	P 0.001 0.0012 0.0012 0.0015 0.0016 0.0019 0.0023 0.004 0.0047 0.0057 0.006 0.003	Pb 0.00004 0.00006 0.000082 0.00009 0.00009 0.00009 0.00009	S 0.0004 0.0005 0.0005 0.0006 0.000752 0.0001 0.001 0.001 0.0014	Sb 0.000056 0.0001 0.0001 0.0001 0.00011 <0.0055	0.0159 0.018 0.0184 0.019 0.02 0.02 0.02 0.0216 0.0235 0.027 0.027	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004 0.0005 0.0005	Ta 0.001 0.001 0.002 0.005	Ti 0.121 0.126 0.127 0.128 0.129 0.1294 0.13 0.1303 0.1305 0.136 0.138 0.14	V 0.0016 0.002 0.0023 0.0023 0.003 0.0031 0.0032 0.0033 0.0034	W 0.0002 0.013 0.006 0.015 0.02 <0.0004	0.021 0.0516 0.058 0.0633 0.0653 0.067 0.0684 0.07 0.0702 0.0707 0.10	0.0654 0.0721 0.0778 0.0795 0.08 0.0807 0.0816 0.082 0.082 0.086 0.086 0.087 0.09 0.0901		
3 4 5 6 7 8 9 10 11 12 13 14 15 Mean STDV.	61.852 61.983 62.12 62.20 62.24 62.3992 62.433 62.507 62.51 62.531 62.531	0.0005 0.0005 0.0006 0.0009 0.00094 0.0011 0.0011 0.0013 0.0013 0.002	P 0.001 0.0012 0.0015 0.0015 0.0019 0.0023 0.0039 0.0047 0.0057 0.006 0.003	Pb 0.00004 0.00008 0.00008 0.00009 0.00009 0.00009	S 0.0004 0.0005 0.0005 0.0006 0.000752 0.0009 0.001 0.001 0.0014	Sb 0.000056 0.00006 0.0001 0.0001 0.00011 <0.005	0.0159 0.0184 0.019 0.02 0.02 0.02 0.021 0.0216 0.0235 0.027 0.022 0.023	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004 0.0005	Ta 0.001 0.001 0.002 0.002 0.005	Ti 0.121 0.126 0.126 0.127 0.128 0.1294 0.13 0.1305 0.136 0.138 0.14 0.13	V 0.0016 0.002 0.0023 0.0023 0.0033 0.0031 0.0032 0.0033 0.0034 0.0034	W 0.0002 0.0013 0.006 0.015 0.02 <0.0004 <0.005 <0.010 <0.02	0.021 0.0516 0.058 0.0633 0.0653 0.067 0.0684 0.07 0.0702 0.0702 0.10 0.10	0.0654 0.0721 0.0778 0.0795 0.08 0.0807 0.0816 0.082 0.082 0.082 0.082 0.082 0.087 0.09 0.0901		
3 4 5 6 7 8 9 10 11 12 13 14 15 Mean STDV. Certified	61.852 61.983 62.12 62.20 62.24 62.3992 62.433 62.507 62.51 62.531 62.531	0.0005 0.0005 0.0006 0.0008 0.0009 0.00094 0.0011 0.0011 0.0013 0.002 0.0013 0.002	P 0.001 0.0011 0.0012 0.0012 0.0015 0.0016 0.0023 0.0039 0.0047 0.0057 0.006 0.003 0.003 0.003 0.003 0.002 0.003	Pb 0.00004 0.00006 0.00008 0.00008 0.00009 0.00009 0.00007 0.00007 0.00007	S 0.0004 0.0005 0.0005 0.0009 0.001 0.001 0.001 0.0014	Sb 0.000056 0.0001 0.0001 0.0001 0.00011 <0.0055	0.0159 0.0184 0.019 0.019 0.02 0.02 0.02 0.021 0.0235 0.0235 0.027	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004 0.0005 0.0005	Ta 0.001 0.001 0.002 0.005	Ti 0.121 0.126 0.127 0.128 0.129 0.1294 0.13 0.1303 0.1305 0.136 0.138 0.14	V 0.0016 0.002 0.0023 0.0023 0.0023 0.0031 0.0031 0.0032 0.0033 0.0034 0.0034 0.0026 0.0026 0.0026	W 0.0002 0.013 0.006 0.015 0.02 <0.0004	0.021 0.0516 0.058 0.0633 0.0667 0.0684 0.07 0.0702 0.0707 0.10 0.0707 0.10	0.0654 0.0721 0.0778 0.0795 0.0807 0.0816 0.082 0.082 0.086 0.087 0.090 0.0901 0.0901		
3 4 5 6 7 8 9 10 11 12 13 14 15 Mean STDV.	61.852 61.983 62.12 62.20 62.24 62.3992 62.433 62.507 62.51 62.531 62.531	0.0005 0.0005 0.0006 0.0008 0.00094 0.0011 0.0011 0.0013 0.002 0.0001 0.0004	P 0.001 0.0012 0.0015 0.0015 0.0019 0.0023 0.0039 0.0047 0.0057 0.006 0.003	Pb 0.00004 0.00008 0.00008 0.00009 0.00009 0.00009	S 0.0004 0.0005 0.0005 0.0006 0.000752 0.0009 0.001 0.001 0.0014	Sb 0.000056 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.00003 (0.00009)	0.0159 0.0184 0.019 0.02 0.02 0.02 0.021 0.0216 0.0235 0.027 0.022 0.023	Sn 0.00014 0.0003 0.0004 0.0004 0.0004 0.0004 0.0004 0.0005	Ta 0.001 0.001 0.002 0.005 0.002 0.002 0.002 0.002 0.002 0.002 0.002	Ti 0.121 0.126 0.126 0.127 0.128 0.129 0.1303 0.1305 0.136 0.138 0.148 0.13 0.1300 0.14	V 0.0016 0.002 0.0023 0.0023 0.0033 0.0031 0.0032 0.0033 0.0034 0.0034	W 0.0002 0.013 0.005 0.015 0.02 <0.005	0.021 0.0516 0.058 0.0633 0.0653 0.0667 0.0684 0.07 0.0702 0.0707 0.10 0.10	0.0654 0.0721 0.0778 0.0795 0.08 0.0807 0.0816 0.082 0.082 0.082 0.082 0.082 0.087 0.09 0.0901		



Participating Laboratories

Exova - Portland	Portland, OR	NSL Analytical Services	Cleveland, OH
ATI Specialty Materials, Monroe	Monroe, NC	Laboratory Testing, Inc.	Hatfield, PA
Special Metals IncoTest	Hereford, UK	ATI Flat Rolled Products, Natrona	Natrona Heights, PA
Dirats Laboratories	Westfield, MA	Anderson Laboratories, Inc.	Greendale, WI
ATI Specialty Materials, Lockport	Lockport, NY	IMR Test Labs	Lansing, NY
Haynes International, Inc.	Kokomo, IN	Exova - Portland	Portland, OR

Traceability

Members of the "Inter-Laboratory Analysis Program" (ILAP) validate test methods and instrument performance utilizing SRMs, CRMs, and RMs produced by recognized Certifying Bodies. The specific SRMs, CRMs, and RMs applicable to the material covered by this certificate are:

ALPHA AR65 BS 690 IARM 56A LECO 501-14 LECO 502-25 NIST 136C NIST 3128 NIST 3163 NIST 6151	BS 750 IARM 56D I7 LECO 501-503 I7 LECO 502-328 NIST 1765 NIST 3131A NIST 3165 NIST 65A	ALPHA AR669 BS CSN-4 IARM 60A LECO 501-510 LECO 502-414 NIST 2424A NIST 3134 NIST 3167A NIST 864	ALPHA AR872 CT631 IARM 62B LECO 501-550 NIST 1206-2 NIST 3102A NIST 3102 NIST 3169 NIST 865	ALPHA AR890 HAS 601A IARM 68B LECO 501-643 NIST 1244 NIST 3103A NIST 3139A NIST 349A NIST 849A NIST 867	BCS 351 HF4112 IARM69A LECO 501-644 NIST 1245 NIST 3106 NIST 3150 NIST 361 NIST 897	BCS 454/1 HF4113 IH 021313 LECO 501-676 NIST 1249 NIST 3107 NIST 3151 NIST 362 NIST3107	BCS 462/1 IARM 207A IH R5657 LECO 502-102 NIST 125 NIST 3109A NIST 3155 NIST 363 NIST349	BS 223D IARM 54A IH RV675 LECO 502-195 NIST 1254 NIST 3114 NIST 3161A NIST 364 RV676
NIST 6151 SUS 12/12	NIST 65A SUS 13/11	NIST 864 SUS 14/11	NIST 865 SUS RN11/10	NIST 867 TRAMPS 100412	NIST 897	NIS13107	NIS1349	RV676

Homogeneity and Uncertainty

"Uncertainty" values, as reported adjacent to certified concentration values, are based on a 95% Confidence Interval. These estimated uncertainties include the combined effects of method imprecision, material inhomogeneity, and any bias between methods. Homogeneity data from experimental XRF results are reflected in both the overall statistics and certified data. Homogeneity samples are selected by a systematic sampling procedure. The number of samples may be determined by equation 1, where N_{prod} is the number of units produced and N_{min} is the number of samples used for homogeneity testing. These samples are arranged in a simple randomized design such that each sample is analyzed multiple times by XRF. Homogeneity is also determined within sample using an applied version of ASTM E826. A single factor ANOVA is used to calculated uncertainty due to inhomogeneity (U_{hom}). Uncertainty of the material is calculated by equation 2, where H=U_{hom}, S= Standard deviation, t= t-value at 95% Cl, and n= number of observations.

$$N_{min} = \max(10, \sqrt[3]{N_{prod}})$$
 2. $U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$

The International Standards Organization (ISO) definitions, expressed in ISO Guide 30–1992 list the following:

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Certifying Body: Any technically competent body (organization or firm, public or private) that issues a reference material certificate with the information detailed in ISO Guide 31. The only generally accepted certifying body in the United States for primary standards or 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, with one or more property values that 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, with one or more property values 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): ASTM Standard E691-87 applies to inter-laboratory studies to "Determine the Precision of a Single Test Method", but also outlines a well thought out and logical plan for conducting an inter laboratory program involving multiple analytical techniques. Therefore, the guidelines established in ASTM E691-87 were applied to all aspects of this inter laboratory program, including the protocols for planning, handling, analysis and treatment of resulting data.

Methods of Analysis: The "Inter Laboratory Analysis Program" analyzes a wide variety of materials, and as a result, no single analytical method would provide optimum analytical results. Therefore, a combination of ASTM Standard Methods for classical wet chemistry, ICP, AA, Optical Emission, X-Ray spectrometric, and other accepted methods were used to produce analytical data. Carbon, Sulfur, Nitrogen, and Oxygen results were supplied from 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 on 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. The minimum sample size for chips should be individually evaluated based on the analytical technique used; this would typically be greater than 0.1 grams. The material should be stored in a cool, dry location when not in use. Chips are not to be used for Oxygen analysis.

Selection of Materials: A "batch" or "series" is defined as a continuous length of bar produced from a single heat. The majority of IARM materials are in wrought condition; other methods of manufacture are utilized if necessary. ILAP samples are removed from equal sections from the total length of the bar. A portion of each section is converted to chips and a 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.

David Coler, General Manager



Analytical Reference Materials International

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