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Certified Reference Material

Certificate of Analysis

ISO 17034:2016

ISO/IEC 17025:2017



Product ID: MBH-AL3104-20

Product Description: Aluminum Alloy, AA3104 / A93104

Description and Intended Use: This Certified Reference Material is covered under the scope of accreditation to ISO 17034 by LGC Standards - Manchester, NH. As an ISO 17034 certified reference material, appropriate use of this material will fulfill the certified reference material and traceability requirements for use in ISO 17025 accredited laboratories. This CRM may come in the form of a solid disk, 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.

			Certifie	ed Values	listed in wt.9	% with as	sociated u	ncertainties			
Be	0.0005	± 0.0001	Bi	0.009	± 0.001	Cd	0.0053	± 0.0002	Cr	0.024	± 0.001
Cu	0.197	± 0.005	Fe	0.315	± 0.008	Ga	0.0057	± 0.0005	Mg	1.10	± 0.02
Mn	1.07	± 0.02	Ni	0.043	± 0.002	Pb	0.011	± 0.002	Sb	0.004	± 0.001
Si	0.23	± 0.01	Sn	0.031	± 0.005	Sr	0.0040	± 0.0002	Ti	0.059	± 0.003
٧	0.037	± 0.002	Zn	0.098	± 0.004	Zr	0.008	± 0.001			
					Indicative Va	lues list	ed in ppm				
	۸~ (حE)	A1 /	06 00/ \	٨٥	(40) D	(10)	Co /	حر (70)	(-2)	No	(~EO)

(<5) (96.8%) (<50) Αg (<50)(<10)

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 may also be 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 eguation 2, where H=U_{hom}, S= Standard deviation, t= t-value at 95% CI, and n= number of observations.

1.
$$N_{MIN} = \max(10, \sqrt[3]{N_{PROD}})$$
 2. $U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$

Certification Laboratories: Much of the analytical work performed to assess this material has been carried out by laboratories with proven competence, as indicated by their accreditation to ISO 17025. It is an implicit requirement for this accreditation that analytical work should be performed with due traceability, via an unbroken chain of comparisons, each with stated uncertainty, to primary standards such as the mole, or to nationally- or internationally-recognised reference materials. Of the individual results herein, some have traceability (to the mole) via primary analytical methods. Some are traceable to substances of known stoichiometry. Most have traceability via commercial solutions. Furthermore, some results have additional traceability to NIST standards, as part of the analytical calibration or process control.

- LGC Standards Manchester, NH
- RSML Bengaluru, India
- NSL Analytical Services Cleveland, OH
- Laboratory Testing, Inc. Hatfield, PA
- Connecticut Metallurgical, Inc. East Hartford, CT
- IMR Test Labs Lansing NY
- SGS MSi Melrose Park, IL
- Scrooby's Laboratory Service Rynfield, South Africa
- Applied Technical Services Marietta, GA
- FAG Laboratories Liverpool NY
- AnchorCert Analytical Birmingham, UK
- Luvak Inc. Boviston, MA

Instructions for Use: The test surface is on the opposite side of the labeled surface, which includes the material identification. 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 recommended for gas analysis.

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

October 7, 2021



ISO 17034 Accredited: Reference Materials Producer Certificate # 2848 02 ISO/IEC 17025 Accredited: Chemical Testing, Certificate # 2848.01



The following data represents all pertinent information reported as it applies to the chemical characterization of this material.

	Ag	Al	As	В	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Mg
1	0.0003	96.635	0.0003	0.0006	0.0004	0.0060	0.0015	0.0049	0.0003	0.0210	0.1860	0.2780	0.0050	1.0300
2	<0.0001	96.710	0.0050	0.0007	0.0004	0.0062	0.0060	0.0050	0.0003	0.0211	0.1860	0.2950	0.0050	1.0607
3	<0.0001	96.800	0.0050	0.0007	0.0006	0.0080	<0.005	0.0050	0.0004	0.0220	0.1870	0.3030	0.0051	1.0620
4	< 0.0005	96.900	0.0055	0.0018	0.0006	0.0083		0.0050	< 0.0001	0.0220	0.1887	0.3090	0.0051	1.0739
5	< 0.0005	96.960	<0.001	0.0022	0.0006	0.0087		0.0052	< 0.0005	0.0226	0.1903	0.3122	0.0053	1.0770
6	< 0.001		<0.001	<0.0001	0.0006	0.0090		0.0053	<0.0005	0.0234	0.1917	0.3190	0.0058	1.0917
7	< 0.001		< 0.005	<0.0001	<0.001	0.0091		0.0053	<0.001	0.0236	0.1945	0.3190	0.0059	1.1000
8				< 0.001	<0.001	0.0097		0.0055	<0.001	0.0240	0.1962	0.3200	0.0060	1.1005
9						0.0103		0.0055		0.0240	0.1980	0.3200	0.0061	1.1020
10						0.0109		0.0055		0.0241	0.1990	0.3200	0.0073	1.1100
11						0.0110		0.0056		0.0250	0.2000	0.3211	<0.001	1.1110
12						0.0120		0.0060		0.0251	0.2050	0.3229	<0.005	1.1120
13						0.0129				0.0264	0.2070	0.3237		1.1140
14										0.0265	0.2095	0.3271		1.1300
15										0.0269	0.2133	0.3418		1.1400
16														1.1587
17														
18														
19														
20														
Mean	0.0003	96.801	0.0040	0.0012	0.0005	0.0094	0.0038	0.0053	0.0003	0.0238	0.1968	0.3155	0.0057	1.0983
STDV		0.1331	0.0024	0.0007	0.0001	0.0020	0.0032	0.0003	0.0001	0.0019	0.0088	0.0149	0.0007	0.0323
Certified	(<0.0005)	(96.8)	(0.004)	(0.0012)	0.0005	0.009	(<0.007)	0.0053	(<0.0003)	0.024	0.197	0.315	0.0057	1.10
1.1														
UCRM					0.0001	0.001		0.0002		0.001	0.005	0.008	0.0005	0.02
U _{CRM} Methods	O,IM,I	1,0	O,IM,I	O,IM,I	0.0001 O,IM,I	0.001 O,I,IM,X	O,IM	0.0002 O,I,IM,X	O,IM,I	0.001 O,I,IM,X	0.005 O,I,X	0.008 O,I,IM,X	0.0005 O,IM,I,X	0.02 O,I,X
		,			O,IM,I	O,I,IM,X	,	O,I,IM,X	, ,	O,I,IM,X	O,I,X	O,I,IM,X	O,IM,I,X	O,I,X
Methods	Mn	Na	Ni	Р	O,IM,I Pb	O,I,IM,X	Sb	O,I,IM,X Si	Sn	O,I,IM,X Sr	O,I,X Ti	O,I,IM,X	O,IM,I,X Zn	O,I,X Zr
Methods 1	Mn 1.0000	Na 0.0018	Ni 0.0350	P 0.0019	O,IM,I Pb 0.0069	O,I,IM,X S 0.0009	Sb 0.0010	O,I,IM,X Si 0.2106	Sn 0.0160	O,I,IM,X Sr 0.0036	O,I,X Ti 0.0500	V 0.0300	O,IM,I,X Zn 0.0810	O,I,X Zr 0.0040
Methods 1 2	Mn 1.0000 1.0100	Na 0.0018 <0.001	Ni 0.0350 0.0380	P 0.0019 <0.0001	O,IM,I Pb 0.0069 0.0080	S 0.0009 0.0015	Sb 0.0010 0.0029	O,I,IM,X Si 0.2106 0.2150	Sn 0.0160 0.0235	O,I,IM,X Sr 0.0036 0.0037	O,I,X Ti 0.0500 0.0500	V 0.0300 0.0303	O,IM,I,X Zn 0.0810 0.0850	O,I,X Zr 0.0040 0.0049
Methods 1 2 3	Mn 1.0000 1.0100 1.0530	Na 0.0018	Ni 0.0350 0.0380 0.0409	P 0.0019	Pb 0.0069 0.0080 0.0083	S 0.0009 0.0015 <0.0001	Sb 0.0010 0.0029 0.0034	O,I,IM,X Si 0.2106 0.2150 0.2160	Sn 0.0160 0.0235 0.0280	Sr 0.0036 0.0037 0.0038	O,I,X Ti 0.0500 0.0500 0.0530	V 0.0300 0.0303 0.0306	Zn 0.0810 0.0850 0.0870	O,I,X Zr 0.0040 0.0049 0.0070
Methods 1 2 3 4	Mn 1.0000 1.0100 1.0530 1.0598	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410	P 0.0019 <0.0001	O,IM,I Pb 0.0069 0.0080 0.0083 0.0088	S 0.0009 0.0015	Sb 0.0010 0.0029 0.0034 0.0039	O,I,IM,X Si 0.2106 0.2150 0.2160 0.2167	Sn 0.0160 0.0235 0.0280 0.0280	Sr 0.0036 0.0037 0.0038 0.0040	O,I,X Ti 0.0500 0.0500 0.0530 0.0545	V 0.0300 0.0303 0.0306 0.0340	Zn 0.0810 0.0850 0.0870 0.0920	O,I,X Zr 0.0040 0.0049 0.0070 0.0073
Methods 1 2 3 4 5	Mn 1.0000 1.0100 1.0530 1.0598 1.0600	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410	P 0.0019 <0.0001	O,IM,I Pb 0.0069 0.0080 0.0083 0.0088 0.0089	S 0.0009 0.0015 <0.0001	Sb 0.0010 0.0029 0.0034 0.0039 0.0040	O,I,IM,X Si 0.2106 0.2150 0.2160 0.2167 0.2185	Sn 0.0160 0.0235 0.0280 0.0280 0.0300	Sr 0.0036 0.0037 0.0038 0.0040 0.0040	O,I,X Ti 0.0500 0.0500 0.0530 0.0545 0.0560	V 0.0300 0.0303 0.0306 0.0340 0.0340	O,IM,I,X Zn 0.0810 0.0850 0.0870 0.0920 0.0940	O,I,X Zr 0.0040 0.0049 0.0070 0.0073 0.0075
Methods 1 2 3 4 5 6	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094	S 0.0009 0.0015 <0.0001	Sb 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040	O,I,IM,X Si 0.2106 0.2150 0.2160 0.2167 0.2185 0.2200	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0040	Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358	O,IM,I,X Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959	Zr 0.0040 0.0049 0.0070 0.0073 0.0075
Methods 1 2 3 4 5 6 7	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0650	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414 0.0424	P 0.0019 <0.0001	O,IM,I Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094 0.0100	S 0.0009 0.0015 <0.0001	\$b 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040	Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0040 0.0041	Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0570	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358 0.0364	Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978	Zr 0.0040 0.0049 0.0070 0.0073 0.0075 0.0075 0.0080
Methods 1 2 3 4 5 6 7 8	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0650 1.0656	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414 0.0424 0.0428	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094 0.0100 0.0103	S 0.0009 0.0015 <0.0001	\$b 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0040 0.0050	O,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305 0.0310	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042	Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0570 0.0578	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358 0.0364 0.0368	Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0983	Zr 0.0040 0.0049 0.0070 0.0073 0.0075 0.0075 0.0080 0.0080
Methods 1 2 3 4 5 6 7 8 9	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0650 1.0656 1.0680	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414 0.0424 0.0428 0.0429	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094 0.0100 0.0103 0.0110	S 0.0009 0.0015 <0.0001	Sb 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0040 0.0050	0,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287 0.2320	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305 0.0310 0.0311	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042 0.0043	Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0570 0.0578	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358 0.0364 0.0368 0.0370	Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0983 0.0986	Zr 0.0040 0.0049 0.0070 0.0073 0.0075 0.0075 0.0080 0.0080
Methods 1 2 3 4 5 6 7 8 9 10	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0650 1.0656 1.0680 1.0760	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414 0.0424 0.0428 0.0429 0.0431	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094 0.0100 0.0103 0.0110 0.0120	S 0.0009 0.0015 <0.0001	\$b 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0050 0.0050 0.0050	0,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287 0.2320 0.2343	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305 0.0310 0.0311 0.0314	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042 0.0043 0.0044	Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0570 0.0578 0.0580 0.0582	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358 0.0364 0.0368 0.0370 0.0372	Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0983 0.0986 0.0994	7r 0.0040 0.0049 0.0070 0.0073 0.0075 0.0075 0.0080 0.0080 0.0080
Methods 1 2 3 4 5 6 7 8 9 10 11	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0650 1.0656 1.0680 1.0777	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0414 0.0424 0.0428 0.0429 0.0431 0.0434	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0100 0.0103 0.0110 0.0120 0.0120	S 0.0009 0.0015 <0.0001	Sb 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0040 0.0050	0,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287 0.2320 0.2343 0.2360	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305 0.0310 0.0311 0.0314 0.0332	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042 0.0043	Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0570 0.0578 0.0580 0.0582 0.0591	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358 0.0364 0.0368 0.0370 0.0372	Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0983 0.0986 0.0994 0.1000	Zr 0.0040 0.0049 0.0070 0.0073 0.0075 0.0080 0.0080 0.0080 0.0080 0.0080
Methods 1 2 3 4 5 6 7 8 9 10 11 12	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0650 1.0656 1.0680 1.0777 1.0780	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414 0.0424 0.0428 0.0429 0.0431 0.0434	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094 0.0100 0.0103 0.0110 0.0120 0.0120 0.0121	S 0.0009 0.0015 <0.0001	\$b 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0050 0.0050 0.0050	0,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287 0.2320 0.2343 0.2360 0.2460	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305 0.0310 0.0311 0.0314 0.0332 0.0342	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042 0.0043 0.0044	Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0570 0.0578 0.0580 0.0582 0.0591	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358 0.0364 0.0368 0.0370 0.0372 0.0374	Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0983 0.0986 0.0994 0.1000 0.1000	7r 0.0040 0.0049 0.0070 0.0073 0.0075 0.0075 0.0080 0.0080 0.0080 0.0080 0.0082
Methods 1 2 3 4 5 6 7 8 9 10 11 12 13	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0650 1.0656 1.0680 1.0777 1.0780 1.0900	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414 0.0424 0.0428 0.0429 0.0431 0.0434 0.0438	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.00100 0.0103 0.0110 0.0120 0.0121 0.0138	S 0.0009 0.0015 <0.0001	\$b 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0050 0.0050 0.0050	0,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287 0.2320 0.2343 0.2360	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305 0.0310 0.0311 0.0314 0.0332	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042 0.0043 0.0044	O,I,X Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0570 0.0578 0.0580 0.0582 0.0591 0.0610 0.0619	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358 0.0364 0.0368 0.0370 0.0372 0.0374 0.0390 0.0407	7n 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0983 0.0986 0.0994 0.1000 0.1000	Zr 0.0040 0.0049 0.0070 0.0073 0.0075 0.0080 0.0080 0.0080 0.0080 0.0080
Methods 1 2 3 4 5 6 7 8 9 10 11 12 13 14	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0656 1.0680 1.0777 1.0780 1.0900 1.0930	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414 0.0424 0.0428 0.0429 0.0431 0.0434 0.0438 0.0440 0.0452	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094 0.0100 0.0110 0.0120 0.0120 0.0121 0.0138 0.0142	S 0.0009 0.0015 <0.0001	\$b 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0050 0.0050 0.0050	0,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287 0.2320 0.2343 0.2360 0.2460	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305 0.0310 0.0311 0.0314 0.0332 0.0342	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042 0.0043 0.0044	O,I,X Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0578 0.0580 0.0582 0.0591 0.0619 0.0627	V 0.0300 0.0303 0.0306 0.0340 0.0358 0.0364 0.0364 0.0370 0.0372 0.0374 0.0390 0.0407	O,IM,I,X Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0986 0.0994 0.1000 0.1000 0.1004 0.1010	7r 0.0040 0.0049 0.0070 0.0073 0.0075 0.0075 0.0080 0.0080 0.0080 0.0080 0.0082 0.0094
Methods 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0656 1.0680 1.0760 1.0777 1.0780 1.0900 1.0930 1.1125	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414 0.0424 0.0428 0.0429 0.0431 0.0434 0.0438 0.0440 0.0452	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094 0.0100 0.0103 0.0110 0.0120 0.0120 0.0121 0.0138 0.0142 0.0159	S 0.0009 0.0015 <0.0001	\$b 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0050 0.0050 0.0050	0,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287 0.2320 0.2343 0.2360 0.2460	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305 0.0310 0.0311 0.0314 0.0332 0.0342	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042 0.0043 0.0044	0,1,X Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0570 0.0578 0.0580 0.0582 0.0591 0.0610 0.0619 0.0627 0.0630	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358 0.0364 0.0368 0.0370 0.0372 0.0374 0.0390 0.0407	O,IM,I,X Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0986 0.0994 0.1000 0.1000 0.1004 0.1010 0.1020	7r 0.0040 0.0049 0.0070 0.0073 0.0075 0.0075 0.0080 0.0080 0.0080 0.0080 0.0082 0.0094
Methods 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0656 1.0680 1.0777 1.0780 1.0900 1.0930	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414 0.0424 0.0428 0.0429 0.0431 0.0434 0.0438 0.0440 0.0452	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094 0.0100 0.0110 0.0120 0.0120 0.0121 0.0138 0.0142	S 0.0009 0.0015 <0.0001	\$b 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0050 0.0050 0.0050	0,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287 0.2320 0.2343 0.2360 0.2460	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305 0.0310 0.0311 0.0314 0.0332 0.0342	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042 0.0043 0.0044	0,1,X Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0578 0.0580 0.0582 0.0591 0.0619 0.0627 0.0630 0.0659	V 0.0300 0.0303 0.0306 0.0340 0.0358 0.0364 0.0364 0.0370 0.0372 0.0374 0.0390 0.0407	O,IM,I,X Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0986 0.0994 0.1000 0.1000 0.1004 0.1010 0.1020 0.1048	Zr 0.0040 0.0049 0.0070 0.0073 0.0075 0.0075 0.0080 0.0080 0.0080 0.0080 0.0082 0.0094
Methods 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0656 1.0680 1.0760 1.0777 1.0780 1.0900 1.0930 1.1125	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414 0.0424 0.0428 0.0429 0.0431 0.0434 0.0438 0.0440 0.0452	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094 0.0100 0.0103 0.0110 0.0120 0.0120 0.0121 0.0138 0.0142 0.0159	S 0.0009 0.0015 <0.0001	\$b 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0050 0.0050 0.0050	0,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287 0.2320 0.2343 0.2360 0.2460	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305 0.0310 0.0311 0.0314 0.0332 0.0342	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042 0.0043 0.0044	0,1,X Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0570 0.0578 0.0580 0.0582 0.0591 0.0610 0.0619 0.0627 0.0630	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358 0.0364 0.0368 0.0370 0.0372 0.0374 0.0390 0.0407	O,IM,I,X Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0983 0.0986 0.0994 0.1000 0.1000 0.1004 0.1010 0.1020 0.1048 0.1050	Zr 0.0040 0.0049 0.0070 0.0073 0.0075 0.0075 0.0080 0.0080 0.0080 0.0080 0.0082 0.0094
Methods 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0656 1.0680 1.0760 1.0777 1.0780 1.0900 1.0930 1.1125	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414 0.0424 0.0428 0.0429 0.0431 0.0434 0.0438 0.0440 0.0452	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094 0.0100 0.0103 0.0110 0.0120 0.0120 0.0121 0.0138 0.0142 0.0159	S 0.0009 0.0015 <0.0001	\$b 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0050 0.0050 0.0050	0,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287 0.2320 0.2343 0.2360 0.2460	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305 0.0310 0.0311 0.0314 0.0332 0.0342	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042 0.0043 0.0044	0,1,X Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0578 0.0580 0.0582 0.0591 0.0619 0.0627 0.0630 0.0659	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358 0.0364 0.0368 0.0370 0.0372 0.0374 0.0390 0.0407	O,IM,I,X Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0986 0.0994 0.1000 0.1000 0.1004 0.1010 0.1020 0.1048	Zr 0.0040 0.0049 0.0070 0.0073 0.0075 0.0075 0.0080 0.0080 0.0080 0.0080 0.0082 0.0094
Methods 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0656 1.0680 1.0760 1.0777 1.0780 1.0900 1.0930 1.1125	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414 0.0424 0.0428 0.0429 0.0431 0.0434 0.0438 0.0440 0.0452	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094 0.0100 0.0103 0.0110 0.0120 0.0120 0.0121 0.0138 0.0142 0.0159	S 0.0009 0.0015 <0.0001	\$b 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0050 0.0050 0.0050	0,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287 0.2320 0.2343 0.2360 0.2460	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305 0.0310 0.0311 0.0314 0.0332 0.0342	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042 0.0043 0.0044	0,1,X Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0578 0.0580 0.0582 0.0591 0.0619 0.0627 0.0630 0.0659	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358 0.0364 0.0368 0.0370 0.0372 0.0374 0.0390 0.0407	O,IM,I,X Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0983 0.0986 0.0994 0.1000 0.1000 0.1004 0.1010 0.1020 0.1048 0.1050	7r 0.0040 0.0049 0.0070 0.0073 0.0075 0.0075 0.0080 0.0080 0.0080 0.0080 0.0082 0.0094
Methods 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0650 1.0656 1.0680 1.0777 1.0780 1.0930 1.1125 1.1217	Na 0.0018 <0.001 <0.005	Ni 0.0350 0.0380 0.0409 0.0410 0.0414 0.0424 0.0428 0.0429 0.0431 0.0434 0.0438 0.0440 0.0452 0.0456 0.0513	P 0.0019 <0.0001 <0.005	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094 0.0100 0.0103 0.0110 0.0120 0.0120 0.0121 0.0138 0.0142 0.0159 <0.002	S 0.0009 0.0015 <0.0001 <0.0005	\$b 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0050 0.0050 0.0065 <0.002	0,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287 0.2320 0.2343 0.2360 0.2460 0.2730	\$n 0.0160 0.0235 0.0280 0.0300 0.0302 0.0305 0.0310 0.0311 0.0314 0.0332 0.0342	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042 0.0043 0.0044 <0.01	0,1,X Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0578 0.0582 0.0591 0.0610 0.0619 0.0627 0.0630 0.0659 0.0718	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358 0.0364 0.0368 0.0370 0.0372 0.0374 0.0390 0.0407 0.0420 0.0450	O,IM,I,X Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0986 0.0994 0.1000 0.1000 0.1004 0.1010 0.1020 0.1048 0.1050 0.1171	7r 0.0040 0.0049 0.0070 0.0075 0.0075 0.0080 0.0080 0.0080 0.0080 0.0082 0.0094 0.0101
Methods 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	Mn 1.0000 1.0100 1.0530 1.0598 1.0600 1.0620 1.0656 1.0680 1.0760 1.0777 1.0780 1.0900 1.0930 1.1125	Na 0.0018 <0.001	Ni 0.0350 0.0380 0.0409 0.0410 0.0410 0.0414 0.0424 0.0428 0.0429 0.0431 0.0434 0.0438 0.0440 0.0452	P 0.0019 <0.0001	Pb 0.0069 0.0080 0.0083 0.0088 0.0089 0.0094 0.0100 0.0103 0.0110 0.0120 0.0120 0.0121 0.0138 0.0142 0.0159	S 0.0009 0.0015 <0.0001	\$b 0.0010 0.0029 0.0034 0.0039 0.0040 0.0040 0.0050 0.0050 0.0050	0,I,IM,X Si 0.2106 0.2150 0.2167 0.2185 0.2200 0.2217 0.2287 0.2320 0.2343 0.2360 0.2460	\$n 0.0160 0.0235 0.0280 0.0280 0.0300 0.0302 0.0305 0.0310 0.0311 0.0314 0.0332 0.0342	Sr 0.0036 0.0037 0.0038 0.0040 0.0040 0.0041 0.0042 0.0043 0.0044	0,1,X Ti 0.0500 0.0500 0.0530 0.0545 0.0560 0.0569 0.0578 0.0580 0.0582 0.0591 0.0619 0.0627 0.0630 0.0659	V 0.0300 0.0303 0.0306 0.0340 0.0340 0.0358 0.0364 0.0368 0.0370 0.0372 0.0374 0.0390 0.0407	O,IM,I,X Zn 0.0810 0.0850 0.0870 0.0920 0.0940 0.0959 0.0978 0.0983 0.0986 0.0994 0.1000 0.1000 0.1004 0.1010 0.1020 0.1048 0.1050	Zr 0.0040 0.0049 0.0070 0.0073 0.0075 0.0075 0.0080 0.0080 0.0080 0.0080 0.0082 0.0094

Legend: W = Classical, C = Combustion, F = Fusion, A = AA or GFAA, I = ICP or DCP, IM=ICP-MS, D = DC Arc, O = AES, X = XRF, G = GDAES or GDMS, H = Hollow Cathode AES

0.004

0.001

O,IM,X,I

0.23

0.01

O,I,IM,X

0.031

0.005

O,I,IM,X

0.0040

0.0002

O,IM,I,X

0.059

0.003

O,I,IM,X

0.037

0.002

O,I,IM,X

(<0.001)

O,C

0.011

0.002

O,I,IM,X



0.098

0.004

O,I,IM,X

0.008

0.001

O,IM,I,X

Certified

Methods

(<0.005)

O,IM

1.07

0.02

O,I,X

0.043

0.002

O,I,IM,X

(<0.005)

O,IM