

**Certified Reference Material**

**Certificate of Analysis**

**Product ID: MBH-71X SR3 G**

ISO  
17034:2016

ISO/IEC  
17025:2017

ISO  
9001:2015

Revision No.: 000  
Revision Date: 05/10/2022

**Product Description: Tin with Impurities**

**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.

**Certified Values listed in wt.% with associated uncertainties**

<b>Ag</b> 0.065 ±0.003	<b>Al</b> 0.0011 ±0.0005	<b>As</b> 0.033 ±0.003	<b>Au</b> 0.015 ± 0.002
<b>Bi</b> 0.105 ±0.003	<b>Cd</b> 0.102 ±0.004	<b>Co</b> 0.0021 ±0.0003	<b>Cu</b> 0.128 ± 0.005
<b>Fe</b> 0.0111 ±0.0008	<b>Ga</b> 0.056 ±0.003	<b>Ge</b> 0.053 ±0.002	<b>Hg</b> 0.09 ± 0.01
<b>In</b> 0.098 ±0.005	<b>Ni</b> 0.039 ±0.003	<b>Pb</b> 0.31 ±0.01	<b>Sb</b> 0.16 ± 0.02
<b>Se</b> 0.0018 ±0.0007	<b>Te</b> 0.056 ±0.009	<b>Zn</b> 0.023 ±0.002	

**Indicative Values listed in ppm**

Cr (0.15)	P (20)	S (10)	Sn (98.71%)	Tl (0.3)
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**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 calculate 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% CI, and  $n$ = number of observations.

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

**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-recognized 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
- Connecticut Metallurgical, Inc. - East Hartford, CT
- Dirats Laboratories - Westfield, MA
- NSL Analytical Services - Cleveland, OH
- SGS MSI - Melrose Park, IL
- IMR Test Labs - Lansing, NY
- Scrooby's Laboratory Services - Benoni, South Africa
- Universal Scientific Laboratory - Revesby, Australia
- Applied Technical Services - Marietta, GA
- Northern Analytical Laboratory, Inc. - Londonderry, NH
- EAG Laboratories - Liverpool, NY
- Sheffield Analytical Services - Sheffield, UK
- Instytut Metali Nieżelaznych - Gliwice, Poland
- Inppamet Ltda. - Calama, Chile
- Alpha Assembly Solutions - Altoona, PA

**Instructions for Use:** The test surface is on the opposite side of the labeled surface, which includes the material identification. This material is individually chill cast per piece. This manner of casting can cause the formation of inhomogeneous segregates in the upper, engraved portion of the disk. Therefore, the certification information above is not applicable to within 3mm of the engraved surface. 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.

*Chuck Goudreau*

**Chuck Goudreau, Certifying Officer**

1 May 2022  
**Certification Date**



ISO 17034 Accredited: Reference Materials  
Producer, Certificate # 2848.02  
ISO/IEC 17025 Accredited: Chemical Testing,  
Certificate # 2848.01

**Conditions of Sale and Supply:** All CRMs & RMs sold are subject to applicable LGC Standard Terms and Conditions of Sale.



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

	Ag	Al	As	Au	Bi	Cd	Co	Cr	Cu	Fe	Ga	Ge	Hg
1	0.0590	0.0004	0.0250	0.0096	0.0980	0.0840	0.0008	0.00001	0.1080	0.0086	0.0446	0.0494	0.0670
2	0.0595	0.0006	0.0305	0.0137	0.0995	0.0933	0.0010	0.00002	0.1100	0.0096	0.0510	0.0499	0.0700
3	0.0601	0.0009	0.0308	0.0143	0.1000	0.0990	0.0016	<0.0010	0.1183	0.0100	0.0538	0.0500	0.0819
4	0.0603	0.0011	0.0316	0.0146	0.1010	0.0991	0.0019	<0.005	0.1190	0.0103	0.0539	0.0530	0.0851
5	0.0603	0.0015	0.0316	0.0147	0.1012	0.1003	0.0020		0.1210	0.0106	0.0548	0.0530	0.0856
6	0.0610	0.0016	0.0320	0.0148	0.1014	0.1010	0.0020		0.1230	0.0106	0.0550	0.0531	0.0946
7	0.0614	0.0020	0.0324	0.0161	0.1051	0.1025	0.0020		0.1240	0.0107	0.0556	0.0553	0.0960
8	0.0630	<0.0010	0.0329	0.0184	0.1059	0.1027	0.0021		0.1250	0.0110	0.0566	0.0555	0.0967
9	0.0630		0.0340	<0.0050	0.1060	0.1040	0.0022		0.1257	0.0112	0.0584	0.0560	0.1080
10	0.0646		0.0348		0.1060	0.1050	0.0022		0.1270	0.0116	0.0602		
11	0.0648		0.0359		0.1065	0.1060	0.0022		0.1280	0.0117	0.0608		
12	0.0660		0.0384		0.1080	0.1079	0.0022		0.1286	0.0119	0.0638		
13	0.0678		0.0438		0.1087	0.1090	0.0027		0.1307	0.0121			
14	0.0680				0.1100	0.1130	0.0030		0.1310	0.0122			
15	0.0698				0.1140		0.0031		0.1390	0.0130			
16	0.0750				0.1160		<0.002		0.1420	0.0130			
17	0.0775						<0.002		0.1437				
18							<0.003		0.1450				
19							<0.005		0.1460				
Mean	0.0648	0.0011	0.0334	0.0145	0.1055	0.1019	0.0021	0.00002	0.1282	0.0111	0.0557	0.0528	0.0872
STDV	0.0054	0.0006	0.0044	0.0025	0.0052	0.0071	0.0006	0.000001	0.0110	0.0012	0.0050	0.0025	0.0132
Certified	0.065	0.0011	0.033	0.015	0.105	0.102	0.0021	(0.000015)	0.128	0.0111	0.056	0.053	0.09
U <sub>CRM</sub>	0.003	0.0005	0.003	0.002	0.003	0.004	0.0003		0.005	0.0008	0.003	0.002	0.01
Methods	I,G,A,IM,X,O	I,IM,G,O	I,IM,O	I,G,IM,O	I,IM,X,O	I,IM,O	I,IM,G,A,X,O	G,I,IM	I,A,G,IM,X,O	I,IM,G,A,X,O	I,G,IM	I,IM,X,O	I,G,IM,A,X,O

	In	Ni	P	Pb	S	Sb	Se	Sn	Te	Tl	Zn
1	0.0880	0.0246	0.00001	0.2670	0.0001	0.0969	0.0009	98.680	0.0421	0.00003	0.0170
2	0.0890	0.0300	0.00001	0.2820	0.0002	0.1216	0.0010	98.740	0.0508	0.00004	0.0190
3	0.0917	0.0300	0.00004	0.2900	0.0018	0.1300	0.0012		0.0508	<0.0010	0.0190
4	0.0952	0.0320	0.0002	0.2920	0.0023	0.1390	0.0012		0.0517		0.0205
5	0.0955	0.0370	0.0009	0.2940	0.0028	0.1450	0.0013		0.0544		0.0212
6	0.0956	0.0370	0.0017	0.3022	<0.0005	0.1460	0.0015		0.0546		0.0222
7	0.0971	0.0378	0.0060	0.3070	<0.001	0.1477	0.0019		0.0716		0.0229
8	0.0984	0.0386	0.0066	0.3100	<0.0010	0.1500	0.0020		0.0730		0.0229
9	0.0988	0.0390	<0.002	0.3110	<0.0010	0.1507	0.0024				0.0230
10	0.1048	0.0391	<0.002	0.3155		0.1520	0.0042				0.0230
11	0.1078	0.0393	<0.005	0.3180		0.1540	<0.005				0.0234
12	0.1130	0.0406	<0.0050	0.3180		0.1580	<0.005				0.0234
13		0.0407		0.3190		0.1610					0.0238
14		0.0416		0.3200		0.1682					0.0240
15		0.0417		0.3220		0.1790					0.0244
16		0.0423		0.3319		0.1825					0.0252
17		0.0428		0.3338		0.2100					0.0300
18		0.0441		0.3352		0.2140					0.0300
19		0.0468		0.3460		0.2154					
20		0.0470				0.2310					
21		0.0470									
Mean	0.0979	0.0390	0.0019	0.3113	0.0014	0.1626	0.0018	98.710	0.0561	0.00003	0.0231
STDV	0.0074	0.0059	0.0028	0.0199	0.0012	0.0340	0.0010	0.0424	0.0107	0.00001	0.0033
Certified	0.098	0.039	(0.002)	0.31	(0.001)	0.16	0.0018	(98.71)	0.056	(0.00003)	0.023
U <sub>CRM</sub>	0.005	0.003		0.01		0.02	0.0007		0.009		0.002
Methods	I,IM,O	I,G,A,IM,X,O	I,G,IM,X	I,A,G,IM,X	C,G,I	I,A,G,IM,X,O	I,IM,G	I	I,IM	G,IM	I,IM,A,G,X,O

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

The following data was analyzed by GDMS and is intended for informational purposes only. All values listed in ppm.

	B	Ba	Be	Br	Ca	Ce	Cl	Cs	Dy	Er	Eu	F	Gd	Hf	Ho	I
1	0.006	0.05	<0.005	<0.05	<0.01	0.02	0.04	<0.05	<0.005	<0.005	<0.005	<0.05	<0.01	<0.005	<0.005	<0.05
2	<0.01	<0.05	<0.01	<1	<0.01	<0.05	<0.01	<0.05	<0.05	<0.05	<0.05	<1	<0.05	<0.05	<0.05	<0.05

	Ir	K	La	Li	Lu	Mg	Mn	Mo	Na	Nb	Nd	Os	Pd	Pr	Pt	Rb	Re
1	<0.01	0.055	0.05	<0.005	<0.005	<0.01	0.01	0.03	0.065	0.006	0.02	<0.01	0.1	0.02	<0.01	<0.005	0.02
2	<0.1	0.06	<0.05	<0.1	<0.05	<0.05	<0.05	<0.1	<0.01	<0.05	<0.05	<0.1	19	<0.05	<0.1	<0.05	<0.05

	Rh	Ru	Sc	Si	Sm	Sr	Ta	Tb	Th	Ti	Tm	U	V	W	Y	Yb	Zr
1	12	0.1	<0.001	2	0.033	<0.005	<0.01	<0.005	<0.005	0.03	<0.005	<0.005	0.002	<0.1	<0.005	<0.005	<0.005
2	<1	0.53	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.01	<0.05	<0.05	<0.01	<5	<0.05	<0.05	<0.05

