

**Certified Reference Material** **Certificate of Analysis**

**Product ID: MBH-31X B19 S**

ISO  
17034:2016

ISO/IEC  
17025:2017

ISO  
9001:2015

**Product Description: Alloyed Brass**

**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> 0.0041 ± 0.0005	<b>Al</b> 0.015 ± 0.002	<b>As</b> 0.0214 ± 0.0006	<b>Bi</b> 0.019 ± 0.001
<b>Cd</b> 0.0110 ± 0.0004	<b>Co</b> 0.0007 ± 0.0002	<b>Cr</b> 0.0012 ± 0.0002	<b>Cu</b> 59.7 ± 0.2
<b>Fe</b> 0.357 ± 0.004	<b>Mn</b> 0.0194 ± 0.0004	<b>Ni</b> 0.0249 ± 0.0007	<b>P</b> 0.016 ± 0.001
<b>Pb</b> 2.36 ± 0.05	<b>Sb</b> 0.036 ± 0.002	<b>Se</b> 0.0010 ± 0.0003	<b>Si</b> 0.015 ± 0.002
<b>Sn</b> 0.0556 ± 0.0009	<b>Te</b> 0.0012 ± 0.0002	<b>Zn</b> 37.3 ± 0.2	

**Indicative Values listed in ppm**

B (<3) S (30)

**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.

$$1. N_{MIN} = \max(10, \sqrt[3]{N_{PROD}})$$

$$2. U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$$

**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
- Dirats Laboratories - Westfield, MA
- Laboratory Testing, Inc. - Hatfield, PA
- Universal Scientific Laboratory - Revesby, Australia
- Connecticut Metallurgical, Inc. - East Hartford, CT
- NSL Analytical Services - Cleveland, OH
- TEC Eurolab - Campogalliano, Italy
- IMR Test Labs - Lansing, NY
- SGS MSI - Melrose Park, IL
- Scrooby's Laboratory Service - Rynfield, South Africa
- EAG Laboratories - Liverpool, NY
- AnchorCert Analytical - Birmingham, UK
- TCR Engineering Services - Maharashtra, India
- Institute of Non-Ferrous Metals - Gliwice, Poland
- Applied Technical Services - Marietta, GA
- Sheffield Assay Office - Sheffield, England

**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.

  
**Kimberly Halkotis, Global Product Manager**

**November 5, 2021**  
**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	B	Bi	Cd	Co	Cr	Cu	Fe	Mn	Ni	P
1	0.0020	0.0104	0.0190	0.0001	0.0161	0.0094	0.0001	0.0008	58.962	0.3440	0.0181	0.0230	0.0130
2	0.0029	0.0120	0.0199	0.0003	0.0164	0.0100	0.0001	0.0009	59.270	0.3492	0.0183	0.0233	0.0130
3	0.0030	0.0124	0.0200		0.0170	0.0100	0.0004	0.0009	59.409	0.3500	0.0185	0.0234	0.0132
4	0.0034	0.0127	0.0200		0.0172	0.0103	0.0005	0.0010	59.500	0.3510	0.0188	0.0238	0.0136
5	0.0037	0.0130	0.0202		0.0180	0.0104	0.0007	0.0011	59.560	0.3517	0.0189	0.0239	0.0150
6	0.0039	0.0130	0.0203		0.0180	0.0105	0.0008	0.0011	59.610	0.3520	0.0190	0.0240	0.0150
7	0.0041	0.0133	0.0209		0.0180	0.0106	0.0008	0.0013	59.620	0.3520	0.0190	0.0240	0.0152
8	0.0041	0.0134	0.0210		0.0184	0.0110	0.0008	0.0014	59.690	0.3523	0.0190	0.0240	0.0159
9	0.0042	0.0135	0.0215		0.0187	0.0110	0.0008	0.0015	59.720	0.3530	0.0190	0.0242	0.0160
10	0.0044	0.0143	0.0216		0.0189	0.0110	0.0009	0.0016	59.750	0.3540	0.0190	0.0247	0.0160
11	0.0045	0.0146	0.0219		0.0190	0.0110	0.0009	<0.0005	59.805	0.3575	0.0191	0.0248	0.0164
12	0.0045	0.0156	0.0220		0.0190	0.0112	0.0011	<0.001	59.830	0.3580	0.0191	0.0250	0.0168
13	0.0047	0.0157	0.0220		0.0192	0.0112	<0.0005	<0.001	59.856	0.3620	0.0197	0.0251	0.0170
14	0.0048	0.0180	0.0220		0.0198	0.0113	<0.001	<0.002	60.003	0.3637	0.0198	0.0251	0.0174
15	0.0050	0.0183	0.0220		0.0210	0.0120	<0.002	<0.002	60.077	0.3640	0.0200	0.0260	0.0177
16	0.0051	0.0205	0.0221		0.0217	0.0120	<0.002	<0.005	60.137	0.3650	0.0201	0.0260	0.0180
17	0.0060	0.0210	0.0222		0.0220	0.0120	<0.005		60.464	0.3668	0.0202	0.0265	0.0180
18		0.0210	0.0225		0.0240	0.0123				0.3710	0.0208	0.0280	0.0184
19		0.0210	0.0229			<0.005					0.0210	0.0285	0.0187
20			0.0242								0.0210		0.0190
21													0.0196
Mean	0.0041	0.0155	0.0214	0.0002	0.0190	0.0110	0.0007	0.0012	59.721	0.3565	0.0194	0.0249	0.0163
STDV	0.0009	0.0034	0.0012	0.0001	0.0021	0.0008	0.0003	0.0003	0.3486	0.0073	0.0009	0.0015	0.0020
<b>Certified</b>	<b>0.0041</b>	<b>0.015</b>	<b>0.0214</b>	<b>(&lt;0.0003)</b>	<b>0.019</b>	<b>0.0110</b>	<b>0.0007</b>	<b>0.0012</b>	<b>59.7</b>	<b>0.357</b>	<b>0.0194</b>	<b>0.0249</b>	<b>0.016</b>
U <sub>CRM</sub>	<b>0.0005</b>	<b>0.002</b>	<b>0.0006</b>		<b>0.001</b>	<b>0.0004</b>	<b>0.0002</b>	<b>0.0002</b>	<b>0.2</b>	<b>0.004</b>	<b>0.0004</b>	<b>0.0007</b>	<b>0.001</b>
Methods	O,IM,I,X,A	O,IM,I,X	O,I,IM,X	I,O	O,IM,I,X	O,I,IM,X,A	O,IM,I,X,A	O,I,IM,X,A	W,O,I,X	O,I,IM,X,A	O,I,IM,X,A	O,I,IM,X	W,O,I,IM,X

	Pb	S	Sb	Se	Si	Sn	Te	Zn
1	2.1800	0.0003	0.0271	0.0003	0.0091	0.0520	0.0010	36.680
2	2.1867	0.0011	0.0280	0.0005	0.0120	0.0530	0.0010	36.751
3	2.2510	0.0015	0.0294	0.0010	0.0123	0.0530	0.0010	37.023
4	2.2840	0.0017	0.0300	0.0010	0.0130	0.0531	0.0010	37.077
5	2.2910	0.0019	0.0315	0.0010	0.0130	0.0537	0.0011	37.160
6	2.3080	0.0020	0.0330	0.0013	0.0131	0.0550	0.0012	37.170
7	2.3090	0.0021	0.0361	0.0014	0.0144	0.0550	0.0015	37.180
8	2.3187	0.0025	0.0370	0.0014	0.0144	0.0560	0.0017	37.180
9	2.3200	0.0029	0.0375	<0.0005	0.0150	0.0560	<0.002	37.220
10	2.3424	0.0050	0.0377	<0.0005	0.0160	0.0560	<0.002	37.340
11	2.3430	0.0053	0.0385	<0.001	0.0160	0.0560	<0.002	37.350
12	2.3470	0.0060	0.0385	<0.002	0.0170	0.0560	<0.005	37.379
13	2.3700	<0.0005	0.0388	<0.005	0.0175	0.0563	<0.005	37.420
14	2.3870	<0.001	0.0390	<0.005	0.0183	0.0568		37.680
15	2.4000	<0.002	0.0390	<0.005	0.0190	0.0568		37.698
16	2.4440	<0.002	0.0398		0.0193	0.0570		37.730
17	2.4440	<0.002	0.0400		0.0195	0.0577		37.770
18	2.4580	<0.003	0.0410		0.0200	0.0580		
19	2.4870		0.0412			0.0590		
20	2.5642							
21	2.5860							
Mean	2.3629	0.0027	0.0360	0.0010	0.0155	0.0556	0.0012	37.283
STDV	0.1070	0.0018	0.0046	0.0004	0.0031	0.0019	0.0003	0.3175
<b>Certified</b>	<b>2.36</b>	<b>(0.003)</b>	<b>0.036</b>	<b>0.0010</b>	<b>0.015</b>	<b>0.0556</b>	<b>0.0012</b>	<b>37.3</b>
U <sub>CRM</sub>	<b>0.05</b>		<b>0.002</b>	<b>0.0003</b>	<b>0.002</b>	<b>0.0009</b>	<b>0.0002</b>	<b>0.2</b>
Methods	O,I,X,A	O,C,I,X	O,I,IM,X,A	O,I,IM,X,A	W,O,I,IM,X	O,I,IM,X,A	O,IM,I,X,A	W,O,I,X,A

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

