

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

**Product ID:** MBH-31X BIB4 D



**Product Description:** Bismuth Brass Alloy

**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.

<b>Certified Values listed in wt.% with associated uncertainties</b>											
<b>Ag</b>	<b>0.0014</b>	± 0.0002	<b>Al</b>	<b>0.435</b>	± 0.009	<b>As</b>	<b>0.0095</b>	± 0.0008	<b>B</b>	<b>0.0019</b>	± 0.0001
<b>Bi</b>	<b>0.80</b>	± 0.02	<b>Cd</b>	<b>0.0022</b>	± 0.0002	<b>Co</b>	<b>0.0108</b>	± 0.0003	<b>Cr</b>	<b>0.0006</b>	± 0.0003
<b>Cu</b>	<b>62.9</b>	± 0.1	<b>Fe</b>	<b>0.094</b>	± 0.002	<b>Mn</b>	<b>0.00082</b>	± 0.00008	<b>Ni</b>	<b>0.211</b>	± 0.005
<b>P</b>	<b>0.039</b>	± 0.001	<b>Pb</b>	<b>0.096</b>	± 0.003	<b>Sb</b>	<b>0.022</b>	± 0.001	<b>Se</b>	<b>0.0011</b>	± 0.0004
<b>Si</b>	<b>0.060</b>	± 0.002	<b>Sn</b>	<b>0.58</b>	± 0.01	<b>Zn</b>	<b>34.8</b>	± 0.1			

**Indicative Values listed in ppm**  
S (50)

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

**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	0.0010	0.4000	0.0054	0.0015	0.7100	0.0013	0.0092	0.0001	62.560	0.0859	0.0006	0.1940	0.0334
2	0.0010	0.4000	0.0070	0.0015	0.7400	0.0014	0.0100	0.0001	62.580	0.0881	0.0007	0.1970	0.0354
3	0.0010	0.4040	0.0080	0.0016	0.7500	0.0020	0.0101	0.0001	62.750	0.0900	0.0007	0.2030	0.0359
4	0.0012	0.4200	0.0081	0.0016	0.7660	0.0020	0.0103	0.0005	62.760	0.0900	0.0008	0.2055	0.0364
5	0.0012	0.4273	0.0085	0.0017	0.7680	0.0020	0.0103	0.0006	62.760	0.0910	0.0008	0.2057	0.0365
6	0.0013	0.4310	0.0088	0.0018	0.7890	0.0020	0.0105	0.0010	62.773	0.0910	0.0008	0.2060	0.0380
7	0.0014	0.4315	0.0090	0.0019	0.7900	0.0021	0.0106	0.0010	62.800	0.0911	0.0009	0.2067	0.0380
8	0.0015	0.4357	0.0095	0.0019	0.7908	0.0022	0.0106	0.0010	62.831	0.0915	0.0009	0.2080	0.0383
9	0.0015	0.4358	0.0095	0.0019	0.7950	0.0023	0.0110	0.0010	62.996	0.0916	0.0009	0.2080	0.0385
10	0.0015	0.4360	0.0095	0.0020	0.7980	0.0024	0.0110	<0.00005	63.100	0.0920	0.0009	0.2090	0.0390
11	0.0020	0.4360	0.0100	0.0020	0.8060	0.0024	0.0110	<0.0005	63.100	0.0920	0.0010	0.2092	0.0390
12	0.0020	0.4367	0.0100	0.0020	0.8143	0.0024	0.0110	<0.0005	63.111	0.0924	<0.0005	0.2104	0.0390
13	0.0022	0.4380	0.0100	0.0022	0.8150	0.0025	0.0110	<0.001	63.170	0.0950	<0.001	0.2110	0.0397
14	<0.002	0.4400	0.0100	0.0024	0.8160	0.0026	0.0110	<0.0010	63.430	0.0961	<0.0010	0.2117	0.0398
15	<0.005	0.4460	0.0100	<0.005	0.8196	0.0026	0.0110	<0.0010		0.0970	<0.002	0.2136	0.0398
16		0.4480	0.0104		0.8200	0.0029	0.0110	<0.002		0.0970	<0.002	0.2140	0.0400
17		0.4510	0.0109		0.8222	0.0030	0.0115	<0.002		0.0982	<0.002	0.2170	0.0409
18		0.4511	0.0111		0.8232	<0.002	0.0120	<0.005		0.1000	<0.005	0.2260	0.0420
19		0.4540	0.0140		0.8250	<0.002	0.0120			0.1020		0.2300	0.0430
20		0.4720			0.8290	<0.005				0.1026		0.2350	0.0451
21					0.8310								
22					0.8318								
Mean	0.0014	0.4347	0.0095	0.0019	0.7977	0.0022	0.0108	0.0006	62.909	0.0937	0.0008	0.2110	0.0389
STDV	0.0004	0.0182	0.0018	0.0003	0.0328	0.0005	0.0007	0.0004	0.2476	0.0046	0.0001	0.0100	0.0027
<b>Certified</b>	<b>0.0014</b>	<b>0.435</b>	<b>0.0095</b>	<b>0.0019</b>	<b>0.80</b>	<b>0.0022</b>	<b>0.0108</b>	<b>0.0006</b>	<b>62.9</b>	<b>0.094</b>	<b>0.00082</b>	<b>0.211</b>	<b>0.039</b>
U <sub>CRM</sub>	<b>0.0002</b>	<b>0.009</b>	<b>0.0008</b>	<b>0.0001</b>	<b>0.02</b>	<b>0.0002</b>	<b>0.0003</b>	<b>0.0003</b>	<b>0.1</b>	<b>0.002</b>	<b>0.00008</b>	<b>0.005</b>	<b>0.001</b>
Methods	O,I,IM,X,A	O,I,X,IM	O,I,IM,X	O,I,IM,A	O,X,I,A	O,I,IM,X,A	O,I,IM,X,A	O,I,IM,X	X,O,W,I	O,I,X,IM,A	O,I,IM,X,A	O,I,X,IM,A	O,I,X,IM,W

	Pb	S	Sb	Se	Si	Sn	Zn
1	0.0864	0.0002	0.0160	0.0006	0.0540	0.5200	34.423
2	0.0866	0.0010	0.0176	0.0007	0.0540	0.5330	34.500
3	0.0903	0.0015	0.0178	0.0008	0.0550	0.5470	34.565
4	0.0923	0.0018	0.0179	0.0009	0.0552	0.5500	34.600
5	0.0926	0.0024	0.0180	0.0010	0.0560	0.5520	34.610
6	0.0930	0.0025	0.0190	0.0010	0.0566	0.5580	34.629
7	0.0940	0.0031	0.0200	0.0010	0.0580	0.5600	34.747
8	0.0950	0.0045	0.0210	0.0012	0.0593	0.5610	34.798
9	0.0970	0.0048	0.0221	0.0017	0.0600	0.5687	34.800
10	0.0977	0.0120	0.0227	0.0022	0.0613	0.5746	34.810
11	0.0980	0.0140	0.0230	<0.0005	0.0626	0.5818	34.830
12	0.0980	0.0140	0.0230	<0.001	0.0629	0.5857	34.830
13	0.0990	<0.0001	0.0232	<0.002	0.0635	0.5859	34.890
14	0.0992	<0.0005	0.0234	<0.005	0.0640	0.5860	34.897
15	0.1000	<0.001	0.0236	<0.005	0.0640	0.5880	35.180
16	0.1010	<0.001	0.0236	<0.0050	0.0643	0.5880	35.271
17	0.1012	<0.0010	0.0240		0.0661	0.5900	35.290
18	0.1022	<0.003	0.0240		0.0700	0.5920	35.400
19	0.1080		0.0241			0.5960	
20			0.0244			0.6040	
21			0.0252			0.6202	
22						0.6300	
Mean	0.0964	0.0052	0.0216	0.0011	0.0604	0.5760	34.837
STDV	0.0054	0.0051	0.0028	0.0005	0.0046	0.0268	0.2824
<b>Certified</b>	<b>0.096</b>	<b>(0.005)</b>	<b>0.022</b>	<b>0.0011</b>	<b>0.060</b>	<b>0.58</b>	<b>34.8</b>
U <sub>CRM</sub>	<b>0.003</b>		<b>0.001</b>	<b>0.0004</b>	<b>0.002</b>	<b>0.01</b>	<b>0.1</b>
Methods	O,I,X,IM,A	O,C,I,X	O,I,X,IM,A	O,I,X,IM	O,I,X,IM,W	O,X,I	X,O,I,A,W

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

