

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

**Product ID:** MBH-12X 15260 X



**Product Description:** Low Alloy Steel (Wrought)

**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>Al</b> 0.57 ± 0.01	<b>As</b> 0.044 ± 0.002	<b>C</b> 0.404 ± 0.008	<b>Co</b> 0.085 ± 0.003
<b>Cr</b> 2.48 ± 0.03	<b>Cu</b> 0.119 ± 0.003	<b>Mn</b> 1.67 ± 0.02	<b>Mo</b> 0.093 ± 0.003
<b>Nb</b> 0.183 ± 0.006	<b>Ni</b> 0.499 ± 0.005	<b>P</b> 0.034 ± 0.001	<b>Pb</b> 0.0012 ± 0.0004
<b>S</b> 0.086 ± 0.006	<b>Si</b> 0.390 ± 0.009	<b>Sn</b> 0.0021 ± 0.0004	<b>Ti</b> 0.0064 ± 0.0008
<b>V</b> 0.417 ± 0.003	<b>Zr</b> 0.0054 ± 0.0005		

**Indicative Values listed in ppm**

B (<10)	Ca (<10)	Fe (<94%)	N (<220)	O (<20)	Sb (60)	Ta (140)
W (30)	Zn (<40)					

**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
- Connecticut Metallurgical, Inc. - East Hartford, CT
- NSL Analytical Services - Cleveland, OH
- SGS MSI - Melrose Park, IL
- IMR Test Labs - Lansing, NY
- Laboratory Testing, Inc. - Hatfield, PA
- Cleveland Cliffs - Middletown, OH
- Applied Technical Services - Marietta, GA
- EAG Laboratories - Liverpool, NY
- Sheffield Assay Office - Sheffield, UK
- Scrooby's Laboratory Service - Rynfield, South Africa
- Element Materials Technology - Middlesbrough, UK
- New Hampshire Materials Laboratory - Somersworth, NH
- RSML - Bengaluru, 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

February 7, 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.

Lab	Al	As	B	C	Ca	Co	Cr	Cu	Fe	Mn	Mo	N	Nb	Ni
1	0.5208	0.0396	0.0003	0.3680	0.0002	0.0731	2.3610	0.1070	93.043	1.5370	0.0740	0.0212	0.1580	0.4840
2	0.5230	0.0405	0.0011	0.3805	<0.001	0.0758	2.3640	0.1076	94.850	1.5580	0.0797	0.0220	0.1600	0.4859
3	0.5290	0.0410	<0.001	0.3917		0.0770	2.4000	0.1100		1.6186	0.0820		0.1660	0.4870
4	0.5360	0.0410		0.3920		0.0790	2.4041	0.1150		1.6360	0.0875		0.1670	0.4893
5	0.5410	0.0434		0.4000		0.0810	2.4110	0.1168		1.6370	0.0890		0.1750	0.4910
6	0.5410	0.0435		0.4002		0.0830	2.4280	0.1180		1.6400	0.0890		0.1770	0.4940
7	0.5440	0.0435		0.4010		0.0830	2.4364	0.1187		1.6490	0.0920		0.1782	0.4940
8	0.5548	0.0450		0.4020		0.0836	2.4600	0.1190		1.6490	0.0920		0.1799	0.4958
9	0.5569	0.0450		0.4040		0.0840	2.4733	0.1190		1.6616	0.0921		0.1806	0.4960
10	0.5679	0.0450		0.4040		0.0840	2.4747	0.1196		1.6665	0.0930		0.1830	0.4961
11	0.5695	0.0460		0.4060		0.0849	2.4899	0.1205		1.6669	0.0930		0.1840	0.4990
12	0.5700	0.0460		0.4070		0.0853	2.4900	0.1210		1.6697	0.0940		0.1868	0.5010
13	0.5703	0.0469		0.4070		0.0854	2.4990	0.1211		1.6810	0.0950		0.1870	0.5010
14	0.5740	0.0493		0.4200		0.0866	2.5020	0.1214		1.6833	0.0950		0.1880	0.5025
15	0.5770			0.4210		0.0870	2.5090	0.1220		1.6890	0.0961		0.1890	0.5110
16	0.5797			0.4213		0.0892	2.5108	0.1220		1.6970	0.0967		0.1890	0.5150
17	0.5890			0.4390		0.0910	2.5120	0.1230		1.7120	0.0990		0.1914	0.5177
18	0.5930					0.0944	2.5600	0.1250		1.7143	0.1006		0.1927	0.5190
19	0.5947					0.1000	2.5740	0.1306		1.7240	0.1006		0.1930	
20	0.5960						2.5950	0.1320		1.7420	0.1011		0.2030	
21	0.6085						2.6280			1.7610	0.1014		0.2060	
22	0.6100													
Mean	0.5657	0.0440	0.0007	0.4038	0.0002	0.0846	2.4801	0.1195	93.947	1.6663	0.0925	0.0216	0.1826	0.4988
STDV	0.0269	0.0027	0.0006	0.0164		0.0063	0.0721	0.0063	1.2775	0.0539	0.0072	0.0006	0.0126	0.0107
<b>Certified</b>	<b>0.57</b>	<b>0.044</b>	<b>(&lt;0.001)</b>	<b>0.404</b>	<b>(&lt;0.001)</b>	<b>0.085</b>	<b>2.48</b>	<b>0.119</b>	<b>(&lt;94)</b>	<b>1.67</b>	<b>0.093</b>	<b>(&lt;0.022)</b>	<b>0.183</b>	<b>0.499</b>
U <sub>CRM</sub>	0.01	0.002		0.008		0.003	0.03	0.003		0.02	0.003		0.006	0.005
Methods	I,O,G,X	IM,X,O,I	I,O	C,G,O	O,I	I,O,G,IM,X	I,G,O,X,W	I,O,IM,X	O	I,O,G,X	I,O,IM,X	F	I,O,G,IM,X	O,G,I,X

Lab	O	P	Pb	S	Sb	Si	Sn	Ta	Ti	V	W	Zn	Zr
1	0.0013	0.0290	0.0007	0.0670	0.0004	0.3550	0.0010	0.0015	0.0034	0.4041	0.0003	0.0025	0.0041
2	0.0023	0.0293	0.0010	0.0750	0.0018	0.3580	0.0014	0.0060	0.0040	0.4090	0.0004	0.0036	0.0045
3		0.0310	0.0011	0.0750	0.0018	0.3650	0.0014	0.0108	0.0042	0.4130	0.0008	0.0070	0.0046
4		0.0313	0.0011	0.0767	0.0019	0.3730	0.0016	0.0108	0.0048	0.4130	0.0020		0.0047
5		0.0320	0.0011	0.0790	0.0040	0.3740	0.0018	0.0140	0.0050	0.4144	0.0020		0.0050
6		0.0325	0.0012	0.0800	0.0043	0.3773	0.0018	0.0147	0.0050	0.4150	0.0030		0.0051
7		0.0329	0.0015	0.0811	0.0050	0.3900	0.0020	0.0150	0.0050	0.4160	0.0041		0.0053
8		0.0331	0.0017	0.0823	0.0180	0.3910	0.0020	0.0151	0.0052	0.4170	0.0050		0.0055
9		0.0340	0.0017	0.0830	0.0194	0.3930	0.0023	0.0158	0.0060	0.4180	0.0050		0.0055
10		0.0350	<0.002	0.0835	<0.0005	0.3982	0.0024	0.0185	0.0067	0.4187	0.0060		0.0060
11		0.0350	<0.005	0.0840	<0.0010	0.3982	0.0026	0.0280	0.0068	0.4190	<0.0005		0.0060
12		0.0352		0.0860	<0.002	0.4002	0.0027	<0.0020	0.0070	0.4190	<0.001		0.0060
13		0.0355		0.0900		0.4020	0.0029		0.0070	0.4200	<0.001		0.0065
14		0.0356		0.0953		0.4043	0.0030		0.0073	0.4216	<0.001		0.0067
15		0.0356		0.0960		0.4080	0.0030		0.0080	0.4216	<0.001		<0.005
16		0.0359		0.0990		0.4090	<0.002		0.0080	0.4220	<0.0010		
17		0.0360		0.0990		0.4090	<0.002		0.0080	0.4255	<0.0010		
18		0.0370		0.1080		0.4096	<0.002		0.0080	0.4270	<0.005		
19		0.0380					<0.002		0.0080		<0.010		
20		0.0390					<0.005		0.0097				
21									<0.002				
22									<0.005				
Mean	0.0018	0.0341	0.0012	0.0856	0.0063	0.3897	0.0021	0.0137	0.0064	0.4174	0.0029	0.0044	0.0054
STDV	0.0007	0.0027	0.0003	0.0104	0.0072	0.0182	0.0006	0.0068	0.0017	0.0056	0.0021	0.0023	0.0008
<b>Certified</b>	<b>(&lt;0.002)</b>	<b>0.034</b>	<b>0.0012</b>	<b>0.086</b>	<b>(0.006)</b>	<b>0.390</b>	<b>0.0021</b>	<b>(0.014)</b>	<b>0.0064</b>	<b>0.417</b>	<b>(0.003)</b>	<b>(&lt;0.004)</b>	<b>0.0054</b>
U <sub>CRM</sub>		0.001	0.0004	0.006		0.009	0.0004		0.0008	0.003			0.0005
Methods	F	I,IM,G,O,X	IM,O,I	C,G,I,O,X	IM,X,O,I	I,G,IM,O,W,X	I,IM,O,X	I,IM,O	I,IM,G,O,X	I,G,IM,O,X	IM,I,G,O,X	IM,I	I,IM,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

