

Certified Reference Material

Certificate of Analysis

Product ID: MBH-12X 15254-21

Product Description: Low-Alloy Steel

ISO
17034:2016

ISO/IEC
17025:2017

ISO
9001:2015

Revision No.: 000
Revision Date: 11/15/2022

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

Al	0.96 ± 0.02	Cu	0.292 ± 0.004	Ni	0.373 ± 0.007	Ti	0.319 ± 0.008
As	0.0066 ± 0.0009	Mn	0.84 ± 0.01	P	0.049 ± 0.002	V	0.401 ± 0.007
C	0.230 ± 0.006	Mo	0.77 ± 0.01	S	0.025 ± 0.001	W	0.313 ± 0.009
Co	0.512 ± 0.007	N	0.014 ± 0.001	Si	0.621 ± 0.009	Zr	0.017 ± 0.001
Cr	1.95 ± 0.03	Nb	0.37 ± 0.01	Sn	0.062 ± 0.002		

Indicative Values listed in ppm

B (37) Fe (Bal) Pb (25)

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.

- AnchorCert Analytical - Birmingham, England
- Applied Technical Services - Marietta, GA
- Cleveland Cliffs - West Chester, OH
- Connecticut Metallurgical, Inc. - East Hartford, CT
- Ditrat Laboratories - Westfield, MA
- Eurofins EAG Laboratories - Liverpool, NY
- IMR Test Labs - Lansing, NY
- LGC Standards - Manchester, NH
- Lihea S.R.O. - Brno, Czech Republic
- Luvak Inc - Boylston, MA
- New Hampshire Materials Laboratory - Somersworth, NH
- NSL Analytical Services - Cleveland, OH
- Scrooby's Laboratory Service - Benoni, South Africa
- SGS MSI - Melrose Park, IL
- TCR Engineering Services Pvt Ltd - Navi Mumbai, 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.

Chuck Goudreau

Chuck Goudreau, Certifying Officer

15 November 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.

	Al	As	B	C	Co	Cr	Cu	Mn	Mo	N	Nb
1	0.8300	0.0043	0.0030	0.2160	0.4690	1.806	0.2730	0.7910	0.7190	0.0130	0.3250
2	0.8948	0.0050	0.0037	0.2160	0.4860	1.831	0.2810	0.7950	0.7200	0.0130	0.3390
3	0.8950	0.0050	0.0045	0.2167	0.4901	1.847	0.2810	0.7980	0.7240	0.0132	0.3500
4	0.9160	0.0050		0.2197	0.4920	1.850	0.2820	0.8010	0.7280	0.0140	0.3500
5	0.9200	0.0050		0.2230	0.5020	1.910	0.2830	0.8020	0.7290	0.0142	0.3502
6	0.9242	0.0052		0.2260	0.5060	1.920	0.2830	0.8200	0.7300	0.0150	0.3520
7	0.9292	0.0056		0.2290	0.5064	1.929	0.2840	0.8340	0.7426	0.0160	0.3680
8	0.9430	0.0060		0.2297	0.5070	1.940	0.2860	0.8359	0.7440		0.3700
9	0.9480	0.0066		0.2300	0.5090	1.947	0.2860	0.8390	0.7500		0.3705
10	0.9480	0.0069		0.2300	0.5100	1.950	0.2896	0.8493	0.7510		0.3710
11	0.9664	0.0077		0.2310	0.5110	1.957	0.2900	0.8500	0.7600		0.3740
12	0.9690	0.0080		0.2316	0.5150	1.970	0.2918	0.8510	0.7628		0.3801
13	0.9730	0.0080		0.2332	0.5160	1.970	0.2928	0.8544	0.7630		0.3810
14	0.9740	0.0089		0.2360	0.5160	1.973	0.2930	0.8560	0.7790		0.3860
15	0.9840	0.0091		0.2380	0.5160	1.977	0.2960	0.8600	0.7838		0.3960
16	0.9840	0.0094		0.2510	0.5200	1.978	0.2971	0.8600	0.7839		0.4026
17	0.9850	<0.0001		0.2560	0.5201	1.979	0.2990	0.8610	0.7880		0.4060
18	0.9970	<0.0007			0.5241	1.981	0.3000	0.8611	0.7930		0.4260
19	1.0040	<0.01			0.5250	2.002	0.3000	0.8614	0.7960		
20	1.0100	<0.01			0.5270	2.009	0.3000	0.8640	0.8012		
21	1.0301				0.5300	2.010	0.3003	0.8700	0.8070		
22	1.0345				0.5325	2.020	0.3080	0.8717	0.8260		
23	1.0600				0.5360	2.026	0.3100	0.8720	0.8280		
24						2.070					
Mean	0.9617	0.0066	0.0037	0.2302	0.5116	1.952	0.2916	0.8416	0.7656	0.0141	0.3721
STDV	0.0523	0.0017	0.0008	0.0111	0.0160	0.065	0.0094	0.0269	0.0337	0.0011	0.0255
Certified	0.96	0.0066	(0.0037)	0.230	0.512	1.95	0.292	0.84	0.77	0.014	0.37
U _{CRM}	0.02	0.0009		0.006	0.007	0.03	0.004	0.01	0.01	0.001	0.01
Methods	I,O,X	I,G,IM,O,A,X	I,O	C,I,G,O	I,G,O,X	I,G,O,X	I,IM,O,X	I,G,O,X	I,G,O,X	C,O,F,I	I,G,O,X

	Ni	P	Pb	S	Si	Sn	Ti	V	W	Zr
1	0.3410	0.0410	0.0004	0.0210	0.5800	0.0560	0.2920	0.3740	0.2850	0.0133
2	0.3520	0.0420	0.0004	0.0214	0.5990	0.0560	0.2990	0.3780	0.2860	0.0133
3	0.3530	0.0440	0.0010	0.0230	0.5990	0.0560	0.3000	0.3800	0.2950	0.0140
4	0.3540	0.0462	0.0010	0.0234	0.6040	0.0564	0.3000	0.3820	0.2960	0.0150
5	0.3550	0.0469	0.0020	0.0240	0.6044	0.0580	0.3012	0.3897	0.2970	0.0150
6	0.3630	0.0470	0.0022	0.0240	0.6088	0.0588	0.3020	0.3900	0.2980	0.0160
7	0.3662	0.0470	0.0030	0.0243	0.6110	0.0594	0.3070	0.3910	0.3050	0.0170
8	0.3670	0.0471	0.0030	0.0245	0.6120	0.0609	0.3100	0.3915	0.3080	0.0170
9	0.3690	0.0487	0.0036	0.0246	0.6133	0.0620	0.3120	0.3920	0.3100	0.0170
10	0.3700	0.0490	0.0040	0.0250	0.6200	0.0620	0.3131	0.3954	0.3100	0.0180
11	0.3700	0.0490	0.0044	0.0250	0.6230	0.0620	0.3188	0.3990	0.3153	0.0180
12	0.3710	0.0490	0.0051	0.0259	0.6270	0.0624	0.3200	0.4000	0.3170	0.0180
13	0.3730	0.0490	<0.0001	0.0262	0.6300	0.0640	0.3200	0.4000	0.3210	0.0185
14	0.3730	0.0496	<0.0010	0.0262	0.6340	0.0650	0.3202	0.4010	0.3240	0.0188
15	0.3790	0.0497	<0.005	0.0270	0.6350	0.0660	0.3210	0.4040	0.3283	0.0190
16	0.3792	0.0498	<0.005	0.0270	0.6360	0.0670	0.3262	0.4070	0.3290	0.0200
17	0.3800	0.0502	<0.005	0.0290	0.6390	0.0680	0.3310	0.4080	0.3372	0.0200
18	0.3800	0.0507	<0.01	0.0293	0.6406	0.0690	0.3350	0.4161	0.3400	0.0210
19	0.3822	0.0510	<0.01	0.0293	0.6450	0.0694	0.3360	0.4170	0.3480	0.0216
20	0.3827	0.0528			0.6500	0.0710	0.3380	0.4200		
21	0.3900	0.0530					0.3500	0.4200		
22	0.3960	0.0531					0.3550	0.4290		
23	0.4018	0.0550						0.4380		
24	0.4070	0.0569								
Mean	0.3731	0.0491	0.0025	0.0253	0.6206	0.0625	0.3185	0.4010	0.3131	0.0174
STDV	0.0161	0.0037	0.0016	0.0024	0.0184	0.0048	0.0171	0.0166	0.0182	0.0025
Certified	0.373	0.049	(0.0025)	0.025	0.621	0.062	0.319	0.401	0.313	0.017
U _{CRM}	0.007	0.002		0.001	0.009	0.002	0.008	0.007	0.009	0.001
Methods	I,G,IM,O,X	I,G,IM,O,X	I,G,IM,O,A,X	C,I,G,O,X	I,G,O,X	I,IM,O,A,X	I,G,IM,O,X	I,G,IM,O,X	I,G,IM,X,O	I,G,IM,O,X

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