ARMI | MBH
ANALYTICAL LTD

Certified Reference Material
Certificate of Analysis

Product ID: MBH-13X 40800 A

ISO 17034:2016   **ISO/IEC 17025:2017**   **ISO 9001:2015**

Product Description: Ferritic Stainless Steel

Revision No.: 000
Revision Date: 03/22/2022

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	0.042	± 0.002	As	0.004	± 0.001	C	0.032	± 0.001	Co	0.033	± 0.003
Cr	12.32	± 0.05	Cu	0.299	± 0.006	Mn	0.804	± 0.009	Mo	0.268	± 0.008
N	0.0054	± 0.0004	Nb	0.020	± 0.002	Ni	0.58	± 0.01	P	0.034	± 0.002
S	0.030	± 0.002	Sb	0.002	± 0.001	Si	0.80	± 0.01	Sn	0.0028	± 0.0006
Ta	0.027	± 0.009	Ti	0.84	± 0.02	V	0.034	± 0.002	W	0.005	± 0.001

Indicative Values listed in ppm

B	(3)	Fe	(83.7%)	O	(18)	Pb	(3)	Zr	(10)

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 calculated 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.

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

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-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
- Dirats Laboratories - Westfield, MA
- IMR Test Labs - Lansing, NY
- Applied Technical Services - Marietta, GA
- Luvak Inc. - Boylston, MA
- Instytut Metalurgii Żelaza - Gliwice, Poland
- NSL Analytical Services - Cleveland, OH
- SGS MSi - Melrose Park, IL
- EAG Laboratories - Liverpool, NY
- New Hampshire Materials Laboratory - Somersworth, NH
- Scrooby's Laboratory Service - Benoni, South Africa
- Raghavendra Spectro Metallurgical Laboratory - Bengaluru, India
- IMR Test Labs - Louisville, KY

Instructions for Use: The test surface is on the opposite side of the labeled surface, which includes the material identification. The entire thickness of the unit is certified. However, the user is cautioned not to measure disks less than 2 mm thick when using X-ray fluorescence spectrometry. 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 Halkiotis

Kimberly Halkiotis, Global Product Manager

March 22, 2022
Certification Date

QLA ACCREDITED

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.

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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	Fe	Mn	Mo	N	Nb	Ni
1	0.0376	0.0031	0.0001	0.0290	0.0210	12.160	0.2760	83.000	0.7700	0.2260	0.0050	0.0120	0.5410
2	0.0385	0.0032	0.0004	0.0290	0.0261	12.200	0.2785	83.490	0.7820	0.2500	0.0050	0.0160	0.5470
3	0.0390	0.0038		0.0308	0.0290	12.207	0.2862	83.890	0.7870	0.2530	0.0052	0.0170	0.5530
4	0.0390	0.0038		0.0310	0.0300	12.222	0.2900	84.000	0.7910	0.2530	0.0053	0.0194	0.5650
5	0.0393	0.0040		0.0312	0.0300	12.240	0.2900	84.130	0.7918	0.2560	0.0058	0.0195	0.5690
6	0.0393	0.0040		0.0314	0.0306	12.250	0.2929		0.7950	0.2580	0.0058	0.0200	0.5700
7	0.0397	0.0041		0.0318	0.0307	12.260	0.2935		0.7970	0.2600	0.0060	0.0203	0.5716
8	0.0400	0.0072		0.0320	0.0319	12.300	0.2970		0.7970	0.2600		0.0212	0.5783
9	0.0400	<0.002		0.0320	0.0320	12.330	0.2970		0.8000	0.2636		0.0212	0.5850
10	0.0400	<0.002		0.0320	0.0320	12.337	0.3000		0.8020	0.2650		0.0220	0.5860
11	0.0408	<0.005		0.0330	0.0325	12.340	0.3005		0.8030	0.2700		0.0230	0.5870
12	0.0412	<0.0050		0.0340	0.0340	12.350	0.3010		0.8030	0.2710		0.0234	0.5900
13	0.0420			0.0343	0.0343	12.353	0.3010		0.8060	0.2726		0.0240	0.5900
14	0.0420			0.0350	0.0360	12.354	0.3040		0.8100	0.2750		0.0250	0.5910
15	0.0430			0.0351	0.0370	12.356	0.3070		0.8131	0.2750			0.5920
16	0.0450			0.0360	0.0372	12.447	0.3080		0.8186	0.2760			0.5970
17	0.0460				0.0390	12.460	0.3100		0.8213	0.2860			0.6068
18	0.0460				0.0460	12.515	0.3100		0.8300	0.2883			0.6093
19	0.0485						0.3130		0.8500	0.2972			0.6170
20	0.0490						0.3263			0.2985			0.6330
Mean	0.0418	0.0042	0.0003	0.0323	0.0327	12.316	0.2991	83.702	0.8036	0.2677	0.0054	0.0203	0.5840
STDV	0.0034	0.0013	0.0002	0.0021	0.0054	0.0958	0.0120	0.4596	0.0181	0.0172	0.0004	0.0035	0.0231
Certified	**0.042**	**0.004**	**(0.0003)**	**0.032**	**0.033**	**12.32**	**0.299**	**(83.7)**	**0.804**	**0.268**	**0.0054**	**0.020**	**0.58**
U$_{CRM}$	0.002	0.001		0.001	0.003	0.05	0.006		0.009	0.008	0.0004	0.002	0.01
Methods	I,IM,O,X,G	I,IM,X	IM,I	C,O,G,I	I,IM,O,X,G	I,O,X,G	I,O,X,G,IM	I,O,X	I,O,X,G	I,O,X,G,IM	F	I,IM,X,O	I,O,X,G

	O	P	Pb	S	Sb	Si	Sn	Ta	Ti	V	W	Zr
1	0.0015	0.0280	0.0001	0.0242	0.0010	0.7450	0.0019	0.0102	0.7710	0.0300	0.0020	0.0004
2	0.0020	0.0300	0.0001	0.0250	0.0010	0.7640	0.0023	0.0152	0.7930	0.0300	0.0029	0.0005
3		0.0310	0.0003	0.0260	0.0010	0.7670	0.0024	0.0167	0.7980	0.0310	0.0038	0.0017
4		0.0310	0.0004	0.0280	0.0024	0.7700	0.0026	0.0180	0.8025	0.0310	0.0041	0.0019
5		0.0317	0.0005	0.0280	0.0030	0.7731	0.0028	0.0193	0.8040	0.0310	0.0048	0.0024
6		0.0320	<0.001	0.0290	0.0030	0.7765	0.0028	0.0290	0.8070	0.0316	0.0050	<0.0010
7		0.0320	<0.0010	0.0292	<0.0010	0.7860	0.0033	0.0400	0.8230	0.0319	0.0050	<0.002
8		0.0330	<0.005	0.0293		0.7950	0.0040	0.0400	0.8340	0.0321	0.0059	<0.002
9		0.0330		0.0298		0.7980	<0.001	0.0412	0.8370	0.0330	0.0062	<0.005
10		0.0331		0.0300		0.7980	<0.002	0.0450	0.8416	0.0340	0.0066	
11		0.0332		0.0300		0.7990	<0.002	<0.002	0.8480	0.0342	0.0070	
12		0.0342		0.0300		0.8005	<0.002		0.8540	0.0350	0.0070	
13		0.0348		0.0300		0.8080	<0.0020		0.8650	0.0350	0.0070	
14		0.0350		0.0310		0.8100	<0.005		0.8660	0.0370	<0.005	
15		0.0352		0.0320		0.8120	<0.01		0.8700	0.0380	<0.01	
16		0.0360		0.0330		0.8190			0.8971	0.0380		
17		0.0380		0.0338		0.8300			0.9000	0.0380		
18		0.0390		0.0351		0.8370			0.9490	0.0382		
19		0.0400		0.0357		0.8440				0.0400		
20		0.0400				0.8580						
Mean	0.0018	0.0340	0.0003	0.0300	0.0019	0.7995	0.0028	0.0275	0.8422	0.0342	0.0052	0.0014
STDV	0.0004	0.0033	0.0002	0.0031	0.0010	0.0291	0.0006	0.0131	0.0447	0.0032	0.0016	0.0009
Certified	**(0.0018)**	**0.034**	**(0.0003)**	**0.030**	**0.002**	**0.80**	**0.0028**	**0.027**	**0.84**	**0.034**	**0.005**	**(0.001)**
U$_{CRM}$		0.002		0.002	0.001	0.01	0.0006	0.009	0.02	0.002	0.001	
Methods	F	I,IM,O,X,G	I,IM,O	C,O,X,I,G	I,IM	I,O,W,X,G	I,IM,O,X	I,IM,O,X	I,O,X,G	I,IM,O,X,G	I,IM,O,X	I,IM,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

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