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Certificate of Analysis
MBH 13X NSC7 B

High Nitrogen Stainless Steel Alloy

Certified Reference Material

Certified Values listed in wt.% with associated uncertainties

Al	**0.204** $\pm$ 0.009	**C**	**0.397** $\pm$ 0.003	**Co**	**0.297** $\pm$ 0.006	**Cr**	**23.9** $\pm$ 0.1
Cu	**0.220** $\pm$ 0.005	**Mn**	**3.55** $\pm$ 0.03	**Mo**	**0.435** $\pm$ 0.005	**N**	**0.429** $\pm$ 0.004
Nb	**0.826** $\pm$ 0.018	**Ni**	**7.50** $\pm$ 0.03	**P**	**0.019** $\pm$ 0.001	**S**	**0.0098** $\pm$ 0.0009
Si	**0.88** $\pm$ 0.02	**V**	**0.167** $\pm$ 0.005	**W**	**0.041** $\pm$ 0.002		

Description and Intended Use

This Certified Reference Material has been produced and certified, wherever possible, in accordance with the requirements of ISO 17034 and the associated Guides, taking into account the requirements of the ISO Guide to the Expression of Uncertainty in Measurement (GUM). 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.

Instructions for Use

1. 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.
2. 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.
3. The material should be stored in a cool, dry location when not in use.
4. Chips are not recommended for gas analysis.

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The following data represents all pertinent information reported as it applies to the chemical characterization of this material.

	Al	C	Co	Cr	Cu	Mn	Mo	N	Nb	Ni	P	S	Si	V	W
1	0.2347	0.4045	0.3110	24.138	0.2350	3.658	0.4480	0.4350	0.8510	7.619	0.0231	0.0127	0.9450	0.1842	0.0446
2	0.2340	0.4044	0.3109	24.124	0.2287	3.631	0.4472	0.4348	0.8482	7.570	0.0215	0.0127	0.9080	0.1831	0.0437
3	0.2180	0.4030	0.3080	24.053	0.2280	3.618	0.4450	0.4340	0.8423	7.564	0.0199	0.0127	0.9019	0.1785	0.0437
4	0.2099	0.4015	0.3076	24.030	0.2274	3.584	0.4417	0.4321	0.8325	7.553	0.0199	0.0107	0.9000	0.1680	0.0429
5	0.2086	0.4006	0.3068	24.020	0.2270	3.580	0.4402	0.4318	0.8325	7.549	0.0198	0.0106	0.8990	0.1668	0.0427
6	0.2080	0.4000	0.3060	23.950	0.2240	3.572	0.4375	0.4278	0.8323	7.543	0.0197	0.0105	0.8962	0.1660	0.0421
7	0.2047	0.3990	0.3010	23.930	0.2211	3.552	0.4340	0.4257	0.8166	7.535	0.0195	0.0103	0.8890	0.1660	0.0420
8	0.2028	0.3980	0.2972	23.930	0.2210	3.535	0.4320	0.4222	0.8130	7.497	0.0193	0.0099	0.8860	0.1660	0.0409
9	0.2010	0.3954	0.2950	23.895	0.2195	3.527	0.4303	0.4220	0.8093	7.494	0.0192	0.0096	0.8794	0.1653	0.0405
10	0.1995	0.3950	0.2932	23.850	0.2180	3.519	0.4302		0.8090	7.485	0.0185	0.0091	0.8788	0.1652	0.0400
11	0.1991	0.3933	0.2915	23.777	0.2166	3.513	0.4280		0.7974	7.484	0.0183	0.0090	0.8630	0.1630	0.0391
12	0.1990	0.3920	0.2900	23.610	0.2120	3.512	0.4280			7.470	0.0171	0.0090	0.8624	0.1624	0.0388
13	0.1965	0.3913	0.2890	23.508	0.2110	3.482	0.4276			7.468	0.0170	0.0085	0.8350	0.1600	0.0366
14	0.1950	0.3904	0.2865		0.2107	3.481	0.4208			7.441	0.0169	0.0084	0.8260	0.1560	0.0350
15	0.1858	0.3895	0.2842		0.2050	3.454				7.402	0.0152	0.0082	0.8158	0.1544	
16	0.1680		0.2729							7.381	0.0150	0.0079			
17												0.0064			
18															
19															
20															
Mean	0.2040	0.3972	0.2969	23.909	0.2203	3.548	0.4350	0.4295	0.8258	7.503	0.0187	0.0098	0.8790	0.1670	0.0409
STDV.	0.0162	0.0051	0.0111	0.187	0.0083	0.059	0.0083	0.0052	0.0177	0.064	0.0021	0.0018	0.0341	0.0087	0.0028
Certified	**0.204**	**0.397**	**0.297**	**23.9**	**0.220**	**3.55**	**0.435**	**0.429**	**0.826**	**7.50**	**0.019**	**0.0098**	**0.88**	**0.167**	**0.041**
U$_{CRM}$	0.009	0.003	0.006	0.1	0.005	0.03	0.005	0.004	0.018	0.03	0.001	0.0009	0.02	0.005	0.002
Methods	I,W,A	C	I,W,A	I,W	I,W,A	I,W,A	I,W,A	F	I,W,A	I,W,A	I,W	C	I,W	I,W,A	I,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

Certification Laboratories

Sheffield Analytical Services	Sheffield, England	Element Ltd	Middlesbrough, England
TUV Nord-Czech	Brno, Czech Republic	Metals Technology (Testing) Ltd	Sheffield, England
AMG Superalloys UK Ltd	Rotherham, England	Laboratory Testing, Inc	Hatfield, PA
Mineral & Metallurgical Laboratories	Bangalore, India	Tec-Eurolab	Campogalliano, Italy
Instytut Metalurgii Zelaza	Gliwice, Poland	Universal Scientific Laboratory Pty Ltd	Sydney, Australia
Luo Yang Copper Co	Luo Yang, He Nan, China	Genitest Inc	Montreal, Canada
Anchorcert Analytical	Birmingham, England	Shanghai Jinyi Test Tech Co	Shanghai, China
Raghavendra SpectroMet Laboratory	Bangalore, India	Analyticka Laborator Lithea sro	Brno, Czech Republic
TCR Engineering Services Ltd	Mumbai, India	Scrooby's Laboratory Services	Benoni, South Africa

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.
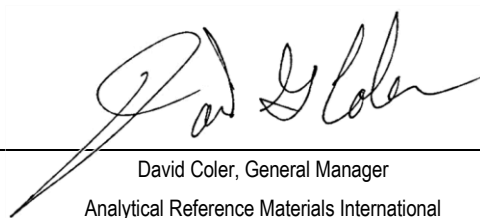
Homogeneity and Uncertainty

"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 spark OES 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 spark OES. 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.

$$1. \quad N_{min} = \max(10, \sqrt[3]{N_{prod}})$$

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

Expiration

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.

David Coler, General Manager

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