MBH ANALYTICAL LTD

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CERTIFICATE OF ANALYSIS

13X 18003 (batch C)

Certified Reference Material Information

Type:	STAINLESS STEEL (WROUGHT)
Form and Size:	Disc 38-43mm diameter
Manufactured by:	Instytut Metalurgii Zelaza, Poland
Certified and Supplied by:	MBH Analytical Ltd

Assigned Values

Percentage element by weight

Element	C	Si	S	P	Mn	Ni	Cr
Value [1]	**0.113**	**0.805**	**0.0245**	**0.0545**	**1.000**	**10.08**	**19.56**
Uncertainty [2]	0.002	0.009	0.0008	0.0014	0.014	0.07	0.08

Element	Mo	Cu	Co	Nb	V	Al	N
Value [1]	**0.401**	**0.0433**	**0.100**	**1.042**	**0.0750**	**0.0292**	**0.090**
Uncertainty [2]	0.005	0.0012	0.003	0.005	0.0008	0.0010	0.002

Definitions

[1] The certified values are the present best estimates of the true content for each element. Each value is a panel consensus, based on the averaged results of an interlaboratory testing programme, detailed on page 3.

[2] The uncertainty values are generated from the 95% confidence interval derived from the wet analysis results, in combination with a statistical assessment of the homogeneity data, as described on page 2.

Certified by:

on 14th October 2015

MBH ANALYTICAL LIMITED _____

C Eveleigh

Method of Preparation

This reference material was produced by vacuum induction melting and ingot casting, followed by hot forging.

Sampling

Samples for chemical analysis were taken from various positions throughout the casting process. At least 15% of all discs were selected for non-destructive homogeneity testing.

Homogeneity

The discs were checked for sample and batch uniformity using an optical emission spectrometer.

Using the combined data from each surface, standard deviation values were derived for each element as an indicator of any non-homogeneity (as determined for the specific sample size taken by the spectrometer).

Chemical Analysis

Analysis was carried out on millings taken from samples representative of the product. It was performed by a panel of laboratories operating within the terms of EN ISO/IEC 17025 - 2005, using documented standard reference methods and validated by appropriate reference materials.

The individual values listed overpage are the average of each analyst's results.

Estimation of Uncertainties

Each element certified has been analysed by several laboratories, and 95% half-width confidence intervals ($C_{(95\%)}$) for the resultant mean values have been derived by the method shown on page 3.

As a separate exercise, the degree of non-homogeneity of the batch for each element has been quantified by a programme of non-destructive application testing, discussed above.

The final certified uncertainty for each element has been derived by combining these two factors, using the square-root of the summed squares.

Traceability

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. In addition, some of the results derived as part of this testing programme have traceability to NIST standards, as part of the analytical calibration or process control.

Usage

Intended use:	With optical emission and X-ray fluorescence spectrometers.
Recommended method of use:	Steels are generally prepared by linishing, grinding, turning or milling. However, users are recommended to follow the calibration and sample preparation procedures specified by the relevant instrument manufacturer. Preparation should be the same for reference materials and the samples for test.

The recommended sample size is at least five replicate analyses. Users are advised to check against possible bias between reference materials and production samples due to differences in metallurgical history, and be aware of possible inter-element effects.

Analytical Data

Percentage element by weight

Sample	C	Si	S	P	Mn	Ni	Cr
1	0.110	0.7800	0.0224	0.0515	0.956	9.99	19.42
2	0.110	0.7929	0.0236	0.0520	0.974	10.00	19.51
3	0.110	0.7972	0.0236	0.0531	0.976	10.03	19.52
4	0.110	0.7980	0.0238	0.0541	0.980	10.03	19.54
5	0.111	0.8090	0.0238	0.0542	0.989	10.03	19.56
6	0.112	0.8105	0.0244	0.0550	0.995	10.08	19.56
7	0.112	0.8114	0.0245	0.0551	0.997	10.11	19.57
8	0.112	0.8114	0.0245	0.0552	1.002	10.14	19.67
9	0.114	0.8130	0.0246	0.0553	1.006	10.18	19.71
10	0.115	0.8130	0.0250	0.0559	1.008	10.21	
11	0.115	0.8170	0.0251	0.0563	1.020		
12	0.116		0.0253	0.0567	1.025		
13	0.116		0.0259		1.032		
14	0.118		0.0260		1.038		
Mean	**0.113**	**0.8049**	**0.0245**	**0.0545**	**1.000**	**10.08**	**19.56**
Std Dev	0.003	0.0113	0.0010	0.0016	0.024	0.08	0.09
C (95%)	0.002	0.0076	0.0006	0.0010	0.014	0.06	0.07

Sample	Mo	Cu	Co	Nb	V	Al	N
1	0.3938	0.0416	0.0963	1.030	0.0724	0.0265	0.0850
2	0.3940	0.0421	0.0972	1.034	0.0735	0.0274	0.0874
3	0.3944	0.0423	0.0975	1.035	0.0738	0.0283	0.0893
4	0.4000	0.0426	0.0981	1.037	0.0744	0.0286	0.0895
5	0.4001	0.0430	0.0981	1.037	0.0745	0.0288	0.0900
6	0.4004	0.0433	0.0984	1.039	0.0746	0.0292	0.0916
7	0.4013	0.0434	0.0996	1.044	0.0748	0.0300	0.0916
8	0.4019	0.0437	0.1003	1.047	0.0750	0.0303	0.0923
9	0.4042	0.0442	0.1008	1.049	0.0754	0.0304	0.0928
10	0.4047	0.0449	0.1020	1.051	0.0756	0.0310	
11	0.4085	0.0449	0.1030	1.052	0.0757	0.0310	
12	0.4100		0.1037	1.052	0.0762		
13			0.1047		0.0763		
14			0.1050		0.0782		
Mean	**0.4011**	**0.0433**	**0.1003**	**1.042**	**0.0750**	**0.0292**	**0.0899**
Std Dev	0.0053	0.0011	0.0029	0.008	0.0014	0.0015	0.0025
C (95%)	0.0034	0.0007	0.0017	0.005	0.0008	0.0010	0.0019

Note: $C_{(95\%)}$ is the 95% half-width confidence interval derived from the equation:

$$C_{(95\%)} = (t \times SD)/\sqrt{n}$$

where n is the number of available values, t is the Student's t value for n-1 degrees of freedom, and SD is the standard deviation of the test results.