

CERTIFICATE OF ANALYSIS

13X 18001 (batch B)

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	0.207	0.203	0.0786	0.0090	0.463	6.13	15.92
Uncertainty ²	0.004	0.004	0.0013	0.0008	0.003	0.03	0.07

Element	Mo	Cu	Co	Nb	V	Al	N
Value ¹	0.816	0.149	0.0231	0.612	0.0996	0.0157	0.0347
Uncertainty ²	0.005	0.003	0.0009	0.008	0.0014	0.0007	0.0005

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:

MBH ANALYTICAL LIMITED _____

on 4th October 2015

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 within the batch. Approximately 10% 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 finishing, 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	0.1996	0.1955	0.0759	0.0069	0.458	6.100	15.76
2	0.2000	0.1963	0.0762	0.0071	0.459	6.100	15.85
3	0.2000	0.1972	0.0765	0.0075	0.460	6.102	15.90
4	0.2020	0.1988	0.0768	0.0076	0.460	6.102	15.91
5	0.2040	0.1999	0.0781	0.0080	0.460	6.110	15.91
6	0.2071	0.2030	0.0794	0.0091	0.464	6.114	15.92
7	0.2090	0.2036	0.0796	0.0092	0.465	6.143	15.93
8	0.2097	0.2050	0.0804	0.0095	0.465	6.154	15.93
9	0.2110	0.2060	0.0805	0.0097	0.467	6.159	15.97
10	0.2113	0.2097	0.0806	0.0100	0.471	6.161	16.01
11	0.2117	0.2113	0.0806	0.0101		6.164	16.05
12	0.2150	0.2155		0.0105		6.166	
13	0.2156			0.0112			
Mean	0.2074	0.2034	0.0786	0.0090	0.463	6.131	15.92
Std Dev	0.0057	0.0063	0.0019	0.0014	0.004	0.029	0.08
C (95%)	0.0034	0.0040	0.0013	0.0008	0.003	0.018	0.05

Sample	Mo	Cu	Co	Nb	V	Al	N
1	0.807	0.1405	0.0218	0.596	0.0959	0.0145	0.0336
2	0.809	0.1450	0.0219	0.601	0.0968	0.0145	0.0344
3	0.813	0.1461	0.0221	0.602	0.0972	0.0150	0.0345
4	0.814	0.1465	0.0222	0.605	0.0977	0.0150	0.0345
5	0.815	0.1468	0.0224	0.607	0.0980	0.0151	0.0347
6	0.815	0.1474	0.0225	0.610	0.0985	0.0158	0.0351
7	0.816	0.1498	0.0227	0.619	0.1010	0.0159	0.0352
8	0.817	0.1501	0.0229	0.621	0.1010	0.0160	0.0355
9	0.818	0.1513	0.0235	0.622	0.1013	0.0162	
10	0.821	0.1518	0.0235	0.624	0.1013	0.0172	
11	0.824	0.1520	0.0238	0.625	0.1013	0.0174	
12	0.825	0.1540	0.0240		0.1018		
13		0.1549	0.0249		0.1025		
14		0.1550	0.0250				
Mean	0.816	0.1494	0.0231	0.612	0.0996	0.0157	0.0347
Std Dev	0.005	0.0042	0.0011	0.010	0.0022	0.0010	0.0006
C (95%)	0.003	0.0024	0.0006	0.007	0.0014	0.0007	0.0005

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.