

CERTIFICATE OF ANALYSIS

13X NSB3 (batch G)

Certified Reference Material Information

Type:	NITROGEN STAINLESS STEEL (WROUGHT)
Form and Size:	Disc 42mm Diameter x 15mm Thickness
Manufactured by:	Polycast Ltd
Certified and Supplied by:	MBH Analytical Limited

Assigned Values

Percentage element by weight

Element	C	Si	Mn	Ni	Cr	Mo	N
Value ¹	0.121	0.471	0.632	9.26	15.22	0.630	0.198
Uncertainty ²	0.002	0.009	0.006	0.06	0.09	0.012	0.004

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 19th October 2007

C Eveleigh



Method of Preparation

This reference material was produced from commercial-purity metals and master alloys. The discs are the product of one melt, cast into 70mm diameter billets and hot worked into bars of ~42mm diameter.

Sampling

Milled samples for chemical analysis were taken from several positions within the batch. In addition, at least 10% of all discs were selected for homogeneity checking.

Homogeneity

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

Using the meaned 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).

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

Most of the analytical work performed to assess this material has been carried out by laboratories with proven competence, as indicated by their accreditation to a national authority. It is part of the 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 primary reference materials.

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.

A minimum of five consistent replicate analyses is recommended to provide the necessary sample size. 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.

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 - 2000, using documented standard reference methods and validated by appropriate reference materials.

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

Analytical Data

Sample	<u>Percentage element by weight</u>						
	C	Si	Mn	Ni	Cr	Mo	N
1	0.118	0.447	0.614	9.107	15.02	0.614	0.188
2	0.118	0.454	0.620	9.156	15.02	0.615	0.190
3	0.119	0.460	0.623	9.162	15.08	0.621	0.191
4	0.119	0.461	0.625	9.194	15.08	0.626	0.199
5	0.120	0.464	0.629	9.22	15.19	0.626	0.199
6	0.120	0.464	0.630	9.222	15.22	0.631	0.200
7	0.120	0.470	0.634	9.250	15.22	0.631	0.201
8	0.120	0.471	0.634	9.261	15.24	0.631	0.201
9	0.120	0.475	0.634	9.333	15.25	0.634	0.201
10	0.123	0.480	0.640	9.34	15.30	0.648	0.206
11	0.124	0.482	0.640	9.37	15.38	0.658	0.206
12	0.129	0.493	0.642	9.370	15.40		
13	0.129	0.500	0.650	9.401	15.40		
Mean	0.121	0.471	0.632	9.260	15.22	0.630	0.198
Std Dev	0.004	0.015	0.010	0.094	0.13	0.013	0.006
C (95%)	0.002	0.009	0.006	0.057	0.08	0.009	0.004

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.

Participating Laboratories

ATI AllVac Ltd	Sheffield, England	UKAS accreditation 1385
Bodycote Materials Testing	Middlesbrough, England	UKAS accreditation 0239
Metals Technology (Testing) Ltd	Sheffield, England	UKAS accreditation 0963
Universal Scientific Laboratory Pty Ltd	Milperra, NSW, Australia	NATA accreditation 492
Laboratory Testing Inc	Hatfield, PA, USA	A2LA accreditation 0117
Institute of Iron & Steel Technology	Shanghai, China	CNAL accreditation 0783
Luo Yang Copper Co	Luo Yang, He Nan, China	CNAL accreditation 0173
Quality Inspection Station, Wu Han Steel	WuHan, Hu Bei, China	CNAL accreditation 0271
TCR Engineering Services Ltd	Mumbai, India	NABL accreditation 0367
Sargam Metals Pvt Ltd	Chennai, India	NABL accreditation 0025
Laboratory TUV Nord Czech	Brno, Czech Republic	CAI accreditation 1060
London & Scandinavian Met Co	Rotherham, England	
De Bruyn Spectroscopic Solutions Ltd	Johannesburg, South Africa	
Genitest Inc	Montreal, Canada	

Note: to achieve National Accreditation (eg UKAS, A2LA, NATA, CNAL, NABL, CAI), test houses must demonstrate conformity to the general requirements of EN ISO/IEC 17025.

Analytical Methods Used

ELEMENT	RESULT No. & METHOD		
	ICP-AES	FAAS	OTHER
Carbon	-	-	all combustion (infra-red detection)
Silicon	6, 7, 9, 11	-	1, 2, 4, 5, 8, 12 gravimetric (perchloric acid) 3, 10 photometric (molybdenum blue)
Manganese	1, 2, 4, 5, 8-10	3, 13	13 XRF 7 photometric (periodate) 6, 12 volumetric (ammonium nitrate, FAS, arsenite)
Nickel	2, 7, 9, 10, 12	3, 13	11 XRF 1 photometric (dimethyl glyoxime) 4-6, 8 gravimetric (dimethyl glyoxime)
Chromium	3, 5, 10-12	-	11 XRF 1, 2, 4, 7-9, 13 volumetric (ferrous ammonium sulfate)
Molybdenum	1, 2, 5-8, 10	-	6 XRF 3, 4, 9, 11 photometric (thiocyanate)
Nitrogen	-	-	1 photometric (Nessler reagent, after distillation) 2, 4-9, 11 inert gas fusion (thermal conductivity) 3, 10 volumetric (hydrochloric acid, after distillation)

Notes

This Certified Reference Material has been produced and certified in accordance with the requirements of ISO Guide 34-2000, ISO Guide 31-2000 and ISO Guide 35-1989, taking into account the requirements of the ISO Guide to the Expression of Uncertainty in Measurement (GUM).

This certification is applicable to the whole of the disc. However, in accordance with normal practice, it is appropriate to avoid use of the central portion (approx 8mm diameter) for OES sampling purposes.

This material will remain stable provided adequate precautions are taken to protect it from cross-contamination, extremes of temperature and atmospheric moisture. All production records will be retained for a period of 20 years from the date of this certificate. This certification will therefore expire in October 2027, although we reserve the right to make changes as issue revisions, in the intervening period.

This sample is also available in the form of chippings.

The manufacture, analysis and certification of this product were supervised by C Eveleigh, PhD, Technical Director, MBH Analytical Ltd.

The material to which this certificate of analysis refers is supplied subject to our general conditions of sale.