

CERTIFICATE OF ANALYSIS

27X 14387 (batch E)

Certified Reference Material Information

Type: NICKEL/CHROME/MOLY/COBALT (CAST)
Form and Size: Disc 40mm Diameter x 15mm Thickness
Supplied by: MBH Analytical Limited
Produced by: Willan Metals Limited

Certified Analysis

Percentage element by weight

Element	Si	Mn	Cu	Fe	Cr	Mo	Co	Ti	Al	Ni
%	0.28	0.27	<0.005	1.11	20.2	10.8	10.0	<0.005	<0.005	(REM)

Usage

Intended use: With optical emission and X-ray fluorescence spectrometers.

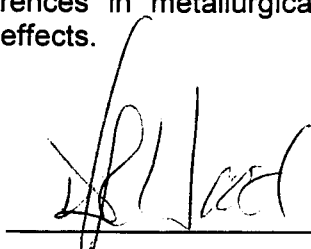
Recommended method of use: Nickel base alloys are generally prepared by finishing, milling, turning or polishing, avoiding contamination with abrasives or lubricants. However, users are recommended to follow the calibration and sample preparation procedures specified by the relevant instrument manufacturer.

Preparation should be the same for reference materials and the samples for test.

When using OE, a minimum of three consistent replicate analyses is recommended to optimise precision and accuracy. 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.

Certified by:

MBH ANALYTICAL LIMITED



on 30 April 1997



Method of Preparation

This reference material was produced from pure metals and master alloys. The discs are the product of one melt poured into a single mould with a feeding system designed to ensure sound discs. Metal was removed from the cast faces of the discs to minimise surface effects.

Sampling

Samples for chemical analysis, and discs for homogeneity checks, were each taken from the top and bottom of the mould.

Chemical Analysis Data

Element	<u>Percentage element by weight</u>								
	Si	Mn	Cu	Fe	Cr	Mo	Co	Ti	Al
Sample 1	0.27	0.29	<0.005	1.14	20.19	10.76	9.91	0.005	<0.005
Sample 2	0.30	0.25	<0.005	1.09	20.18	10.83	10.17	<0.005	<0.005
Sample 3	0.30	0.29	<0.005	1.08	20.3	10.8	10.0	<0.005	<0.005
Sample 4	0.26	0.25	<0.05	1.12	20.30	-	9.81	<0.05	<0.005
Mean	0.283	0.270	<0.005	1.108	20.243	10.80	9.973	<0.005	<0.005
Std Dev	0.021	0.023	-	0.028	0.067	0.035	0.153	-	-

Confidence Limits

These are the upper and lower values between which the actual measurements will fall, with the stated probabilities, assuming a Gaussian distribution.

68.3% of the results will fall within ± 1 x Standard Deviation of the mean.

95.4% of the results will fall within ± 2 x Standard Deviation of the mean.

99.7% of the results will fall within ± 3 x Standard Deviation of the mean.

Homogeneity

Discs from the top and bottom of the mould were checked on the face and back using an optical emission spectrometer.

Multiple measurements were taken from each surface, and averaged.

The mean value of the material was then calculated from these averages.

For each of the four surfaces checked, the differences between the averaged result for each surface and the overall mean value are tabulated below. Results are in % concentration for each element:

Disc from top of mould

	Si	Mn	Cu	Fe	Cr	Mo	Co	Ti	Al
Face 1	0.00	-0.01	0.00	-0.01	+0.05	0.00	+0.01	0.00	0.00
Face 2	-0.01	+0.01	0.00	+0.01	-0.03	-0.01	-0.03	0.00	0.00
Ave	-0.01	0.00	0.00	0.00	+0.01	-0.01	-0.01	0.00	0.00

Disc from bottom of mould

	Si	Mn	Cu	Fe	Cr	Mo	Co	Ti	Al
Face 1	0.00	0.00	0.00	0.00	-0.05	+0.01	0.00	0.00	0.00
Face 2	+0.01	0.00	0.00	0.00	+0.03	0.00	+0.02	0.00	0.00
Ave	+0.01	0.00	0.00	0.00	-0.01	+0.01	+0.01	0.00	0.00

Participating Laboratories

Willan Metals Ltd	Rotherham, England	NAMAS Approval 0014
Metals Technology (Testing) Ltd	Sheffield, England	NAMAS Approval 0963
JB Elds Ltd	Stoke, England	NAMAS Approval 1173
London and Scandinavian Metallurgical Ltd	Rotherham, England	NAMAS Approval 1091

Analytical Methods Used

Silicon:	Atomic absorption	XRF
Manganese:	Atomic absorption	XRF
Copper:	Atomic absorption	XRF
Iron:	Atomic absorption	XRF
Chromium:	Volumetric	XRF
Molybdenum:	Atomic absorption	XRF
Cobalt:	Atomic absorption	XRF
Titanium:	Atomic absorption	XRF
Aluminium:	Atomic absorption	XRF

Notes

Some cast materials may exhibit shrinkage cavities on the rear (engraved) surface of the disc. The above certification is applicable to the front face of the disc and to the first 10mm of depth.

This certificate of analysis is prepared in accordance with the guidelines given in ISO Guide 31-1981.

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