MBH ANALYTICAL LTD

HOLLAND HOUSE • QUEENS ROAD • BARNET • EN5 4DJ • ENGLAND • TEL: +44 (0)20 8441 2024 • FAX: +44 (0)20 8449 0810

email: info@mbh.co.uk web: www.mbh.co.uk

CERTIFICATE OF ANALYSIS

22 X 904 (batch C)

Certified Reference Material Information

Type:	NIMONIC TYPE ALLOY (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	C	Si	Mn	Cu	Fe	Cr
%	0.08	0.52	0.50	0.10	0.25	19.9

Element	Mo	Co	Ti	Al	Mg	Ni
%	0.21	16.9	2.26	1.29	0.005	58.0

Usage

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

Recommended method of use: Nickel base alloys are generally prepared by linishing, 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:

on 30 April 1997

MBH ANALYTICAL LIMITED _____

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

Percentage element by weight

Element	C	Si	Mn	Cu	Fe	Cr
Sample 1	0.083	0.50	0.49	0.10	0.26	19.81
Sample 2	0.082	0.53	0.48	0.10	0.26	19.7
Sample 3	0.081	-	0.51	0.08	0.22	20.0
Sample 4	0.077	0.54	0.52	0.11	0.25	19.98
Mean	0.081	0.523	0.500	0.098	0.248	19.87
Std Deviation	0.003	0.021	0.018	0.013	0.019	0.14

Element	Mo	Co	Ti	Al	Mg	Ni
Sample 1	0.21	17.01	2.25	1.34	0.005	-
Sample 2	0.19	17.0	-	1.33	0.005	-
Sample 3	0.19	16.73	2.25	1.25	0.005	58.2
Sample 4	0.23	16.80	2.29	1.22	0.003	57.8
Mean	0.205	16.89	2.263	1.285	0.0045	58.0
Std Deviation	0.019	0.14	0.023	0.059	0.001	0.282

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

	C	Si	Mn	Cu	Fe	Cr	Mo	Co	Ti	Al	Mg
Face 1	-0.001	+0.01	0.00	0.00	+0.01	+0.07	0.00	+0.03	-0.02	-0.01	+0.001
Face 2	+0.001	0.00	0.00	0.00	-0.01	-0.07	0.00	-0.03	0.00	0.00	-0.001
Ave	0.000	+0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	0.000

Disc from bottom of mould

	C	Si	Mn	Cu	Fe	Cr	Mo	Co	Ti	Al	Mg
Face 1	0.000	-0.01	0.00	0.00	0.00	+0.02	0.00	0.00	+0.01	+0.02	0.000
Face 2	0.000	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	+0.01	-0.01	0.000
Ave	0.000	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	+0.01	+0.01	0.000

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

Carbon:	Combustion (IRD)	
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
Magnesium:	Atomic absorption	

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.

Figures shown in brackets are not certified; they are provided for information only.

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.