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CERTIFICATE OF ANALYSIS

Reference Material Type NICKEL BASE NIMONIC TYPE (CAST)

Catalogue Section: 22 X Sample No: 903 Batch No: C

Certified Values

ELEMENT	C	Si	Mn	Cu	Fe	Cr	Mo	Co	Ti	Al	Mg
%	0.08	1.09	0.25	0.01	0.83	19.84	0.07	17.60	1.86	1.67	0.002

Form and Size: Disc 40mm diameter x 15mm thickness

Supplied by: MBH Analytical Limited

Produced by: Willan Metals Limited

Date of Certification: 28 September 1992

Intended Use: With Optical Emission and X-Ray Fluorescence Spectrometers.

Recommended Method of Use: Nickel Base Alloys are generally prepared by linishing (avoiding contamination with abrasives), milling or turning on a lathe (avoiding the use of lubricants) or lapping (using a suitable polishing media). 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 O.E. 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 difference in metallurgical history and be aware of possible inter-element effect.

MBH ANALYTICAL LIMITED CERT. No. 0524

Registered in England. Registered No. 1875653 V.A.T. Registered No. 421 3295 82
Directors: D. Moore D.J. Willis
Registered Office: Regency House, 33 Wood Street, Barnet, Herts, EN5 4BE

ISO9002:BS5750 Pt 2:EN29002

Method of Preparation: This Reference Material was produced from pure metals and master alloy. 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 surface of the discs to minimise surface effect.

Sampling: Samples were taken relative to the top and the bottom of the mould. Two discs were used for chemical analysis and were checked for homogeneity

Chemical Analysis Data:

Sample	C	Si	Mn	Cu	Fe	Cr	Mo	Co	Ti	Al	Mg
1	0.08	1.06	0.26	0.01	0.87	19.84	0.07	17.70	1.87	1.64	0.002
2	-	1.13	0.24	0.004	0.81	19.93	0.066	17.60	1.84	1.69	0.0022
3	0.077	-	-	-	-	-	-	-	-	-	-
4	0.072	1.07	-	-	0.80	19.74	-	17.49	1.87	1.68	-
Mean:	0.076	1.087	0.25	0.007	0.827	19.837	0.068	17.597	1.86	1.67	0.002
Stand. Deviation:	0.004	0.037	0.014	-	0.037	0.095	0.002	0.105	0.015	0.026	-

Homogeneity: Two discs were taken relative to the top and bottom of the composite mould and each disc was checked on the face and back using an Optical Emission Spectrometer

Multiple sparkings were made on each surface averaged and reported.

The mean value of this materials was then calculated from these averages.

The difference between the reported average for each face and the overall mean value is tabulated below in % concentration for each element.

Disc from Top of Mould

Position	C	Si	Mn	Cu	Fe	Cr	Mo	Co	Ti	Al	Mg
Face	0.00	0.00	+0.01	0.00	+0.03	-0.03	-0.01	+0.01	-0.04	+0.01	-0.001
Back	0.00	+0.02	-0.01	+0.01	+0.01	-0.05	0.00	-0.01	+0.04	+0.02	+0.001
Average	0.00	+0.01	0.00	0.00	+0.02	-0.04	0.00	0.00	0.00	+0.02	0.000

Disc from Bottom of Mould

Position	C	Si	Mn	Cu	Fe	Cr	Mo	Co	Ti	Al	Mg
Face	0.00	-0.02	+0.01	0.00	-0.03	+0.06	0.00	-0.03	+0.03	-0.02	+0.001
Back	0.00	0.00	-0.01	0.00	-0.01	+0.02	0.00	+0.03	-0.02	-0.01	-0.001
Average	0.00	-0.01	0.00	0.00	-0.02	+0.04	0.00	0.00	0.00	-0.02	0.000

Participating Laboratories:

Willan Metals Limited	Rotherham, England	NAMAS Approval 0014
Metals Tech. (Testing) Ltd	Sheffield, England	NAMAS Approval 0963
Ross & Catherall Ltd	Killamarsh, England	NAMAS Approval 0178
Special Melted Products Ltd	Sheffield, England	NAMAS Approval 0638

Analytical Methods Used:

Carbon	(a)		Combustion (IRD)
Silicon	(a)	(b)	Atomic Absorption
Manganese	(a)	(b)	Atomic Absorption
Copper	(a)	(b)	Atomic Absorption
Iron	(a)	(b)	Atomic Absorption
Chromium	(a)	(b)	Volumetric
Molybdenum	(a)	(b)	Atomic Absorption
Cobalt	(a)	(b)	Atomic Absorption
Titanium	(a)	(b)	Colorimetric
Aluminium	(a)	(b)	Atomic Absorption
Magnesium			Atomic Absorption

NOTE:

1. Some cast materials may exhibit shrinkage cavities on the back engraved surface of the disc. This does not effect the certified portion.

2. (a) Overchecked by OES
   (b) Overchecked by XRF