MBH ANALYTICAL LTD

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CERTIFICATE OF ANALYSIS

56X G2000J3 (batch C)

Certified Reference Material Information

Type:	ALUMINIUM/COPPER (CAST)
Form and Size:	Disc 40-50mm diameter x 15-20mm thick
Produced by:	Coleshill Laboratories Limited
Certified and Supplied by:	MBH Analytical Limited

Certified Analysis

Percentage element by weight

Element	Cu	Mg	Si	Fe	Mn	Ni	Zn	Pb	Ti
Value [1]	**4.78**	**1.018**	**0.773**	**0.382**	**0.589**	**0.091**	**0.114**	**0.375**	**0.196**
Uncertainty [2]	0.06	0.015	0.012	0.007	0.009	0.003	0.002	0.009	0.006

Element	Sn	Cr	Co	V	Zr	Bi	Be	Ag	Li
Value [1]	**0.0157**	**0.0573**	**0.108**	**0.0099**	**0.0268**	**0.152**	**0.0039**	**0.0105**	**0.0019**
Uncertainty [2]	0.0013	0.0013	0.002	0.0003	0.0013	0.010	0.0004	0.0005	0.0002

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:

on 28th September 2004

MBH ANALYTICAL LIMITED _____

C Eveleigh

Method of Preparation

This reference material was produced from commercial-purity aluminium, with the major and trace elements added as master alloys or pure elements. The melt was degassed using sodium-free flux, and sequentially cast into iron chill moulds. 2mm has been removed from the cast face of each disc, to minimise any surface effects.

Sampling

Samples for chemical analysis were taken from various positions throughout the casting process. 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. One disc was also checked for vertical uniformity.

For each of the surfaces checked, the differences between the averaged result and the overall mean value were evaluated to ensure that the homogeneity of the material comprising the batch satisfied the definition given in ISO guide 30 - 1992.

Using the combined data for 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 mostly 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 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

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: Aluminium alloys are generally prepared by machining on a mill or a lathe. 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 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.

Analytical Data

Percentage element by weight

Sample	Cu	Mg	Si	Fe	Mn	Ni	Zn	Pb	Ti
1	4.71	0.973	0.740	0.367	0.567	0.0862	0.110	0.362	0.191
2	4.726	0.996	0.760	0.369	0.570	0.0868	0.113	0.369	0.191
3	4.744	0.999	0.761	0.372	0.579	0.088	0.113	0.371	0.192
4	4.752	1.004	0.770	0.376	0.584	0.0881	0.113	0.372	0.194
5	4.76	1.015	0.77	0.376	0.590	0.0912	0.113	0.377	0.194
6	4.76	1.02	0.772	0.380	0.592	0.0918	0.114	0.378	0.195
7	4.78	1.03	0.784	0.383	0.594	0.0920	0.114	0.381	0.196
8	4.812	1.031	0.785	0.384	0.600	0.093	0.117	0.383	0.205
9	4.86	1.039	0.792	0.391	0.600	0.0964	0.119	0.384	0.206
10	4.860	1.04	0.796	0.392	0.601	0.0981			
11		1.049		0.394	0.602				
12				0.394					
Mean	**4.776**	**1.018**	**0.773**	**0.382**	**0.589**	**0.0912**	**0.114**	**0.375**	**0.196**
Std Dev	0.052	0.023	0.017	0.010	0.012	0.0040	0.003	0.007	0.006
$C_{(95\%)}$	0.037	0.015	0.012	0.006	0.008	0.0029	0.002	0.006	0.004

Sample	Sn	Cr	Co	V	Zr	Bi	Be	Ag	Li
1	0.0136	0.0533	0.105	0.0092	0.0232	0.140	0.0029	0.0100	0.0016
2	0.0142	0.0557	0.106	0.0095	0.0258	0.145	0.0035	0.010	0.0017
3	0.0142	0.0564	0.106	0.0097	0.0261	0.147	0.0036	0.0101	0.0017
4	0.0143	0.0568	0.107	0.0097	0.0263	0.150	0.0039	0.0102	0.0017
5	0.0155	0.0578	0.107	0.0098	0.0264	0.151	0.0039	0.0106	0.0019
6	0.017	0.0580	0.108	0.0099	0.0267	0.153	0.0040	0.0107	0.0020
7	0.0172	0.0583	0.110	0.0100	0.0269	0.164	0.0042	0.0113	0.0021
8	0.0173	0.0588	0.111	0.0104	0.0280	0.168	0.0044	0.0113	0.0022
9	0.0178	0.059	0.112	0.0107	0.0280		0.0046		0.0024
10		0.059			0.0302				
Mean	**0.0157**	**0.0573**	**0.108**	**0.0099**	**0.0268**	**0.152**	**0.0039**	**0.0105**	**0.0019**
Std Dev	0.0017	0.0018	0.002	0.0005	0.0018	0.009	0.0005	0.0005	0.0003
$C_{(95\%)}$	0.0013	0.0013	0.002	0.0003	0.0013	0.008	0.0004	0.0005	0.0002

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

Zurich Certification Ltd	West Bromwich, England	UKAS accreditation 0584
Coleshill Laboratories Ltd	Birmingham, England	UKAS accreditation 0121
Bodycote Materials Testing Ltd	Middlesbrough, England	UKAS accreditation 0239
Universal Scientific Laboratory Pty	Milperra, NSW, Australia	NATA accreditation 492
Laboratory Testing Inc	Hatfield, PA, USA	A2LA accreditation 0117
Central Iron & Steel Research Inst	Beijing, China	CNAL accreditation 0435
Institute of Iron & Steel Technology	Shanghai, China	CNAL accreditation 0783
RWTUV Laboratory	Brno, Czech Republic	CIA accreditation 1060
Maristas-Azterlan S.L.	Saibigain, Durango, Spain	ENAC accreditation 0059
Fu Shun Aluminium Smelter	Fu Shun District, China	
Advanced Analytical Centre, Cook University	Townsville, Qld, Australia	
Spectroscopic Solutions Ltd	Johannesburg, South Africa	
Europa Fachhochschule Fresenius	Idstein, Germany	

Note: to achieve National Accreditation (eg UKAS, A2LA, NATA, CNAL, CIA, ENAC), test houses are required to demonstrate conformity to the general requirements of EN ISO/IEC 17025 and ISO9002.

Analytical Methods Used

ELEMENT	RESULT No. & METHOD				
	ICP-AES	ICP-MS	FAAS	OTHER	
Copper	2, 3, 6-9	-	1	4, 5, 10	photometric (BCO, neocuprone)
Magnesium	1-6, 8-10	-	7, 11		
Silicon	1, 2, 5, 6, 8	-	-	3, 4, 7, 10	gravimetric (perchloric acid)
				9	photometric (molybdenum blue)
Iron	1, 2, 4, 5, 7-9, 11, 12	-	6	3, 10	photometric (orthophenanthroline)
Manganese	1, 2, 4, 5, 9-11	-	3	7	volumetric (arsenite)
				6, 8	photometric (periodate)
Nickel	1, 2, 4, 5, 7-9	-	3, 6	10	photometric (dimethyl glyoxime)
Zinc	1, 2, 5, 7-9	6	3, 4		
Lead	1-3, 4, 5, 8, 9	-	4, 7		
Titanium	2, 3, 5-7	1	4	8, 9	photometric (di-antipyryl methane)
Tin	1, 4, 5, 7-9	2	6	3	photometric (phenylfluorone)
Chromium	2-4, 6, 7, 10	5	9	1, 8	photometric (1, 2 diphenyl hydrazine)
Cobalt	2, 3, 5-7, 9	4	1, 8		
Vanadium	2, 4-6, 8	7	1	9	volumetric (ferrous ammonium sulfate)
				3	photometric (N-benzoyl-p-h)
Zirconium	1-7, 9	8	-	10	photometric (xylenol orange)
Bismuth	1, 3, 6-8	2, 4	5		
Beryllium	1, 3, 5, 6, 9	8	7	4	photometric (eriochrome cyanine-R)
Silver	2-4, 6-8	5	1		
Lithium	1, 3, 4, 6-9	5	2		

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 ASTM E1724, ASTM E1831 and the ISO Guide to the Expression of Uncertainty in Measurement (GUM).

The combination of alloying elements used in a complex material of this type, coupled with the unidirectional solidification effects associated with chill casting, may lead to the formation of inhomogeneous segregates in the rear portion of the disc. The above certification is therefore only applicable from the front face of the disc. Material to the rear of the disc, to a depth of ~5-8mm, is not certified.

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 original analysis. This certification will therefore expire in September 2024, 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.