MBH ANALYTICAL LTD

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CERTIFICATE OF ANALYSIS

54X GS20J2 (batch E)

Certified Reference Material Information

Type:	ALUMINIUM / SILICON (CAST)
Form and Size:	Disc 40-50mm diameter x 15-20mm thick
Manufactured 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
Value [1]	**0.168**	**0.177**	**18.7**	**0.565**	**0.059**	**0.091**	**0.304**
Uncertainty [2]	0.008	0.009	0.5	0.015	0.003	0.004	0.007

Element	Pb	Sn	Ti	Cr	Be	Sr	Ca
Value [1]	**0.066**	**0.075**	**0.082**	**0.066**	**<0.0001**	**<0.0001**	**(<0.001)**
Uncertainty [2]	0.002	0.004	0.002	0.003	-	-	-

Note: values given in parentheses are not certified - they are provided for information only.

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 15th July 2002

MBH ANALYTICAL LIMITED _____

Method of Preparation

This reference material was produced from commercial-purity aluminium and silicon, pure elements and master alloys. The melt was degassed using sodium-free degasser, and was cast into iron chill moulds. Phosphorus treatment was carried out prior to pouring, in order to refine the cast structure. 2mm has been removed from the cast face to minimise any surface effects.

Sampling

Samples for chemical analysis, and discs for homogeneity checks, were taken from various positions within the casting process.

Homogeneity

Samples representative of the batch were checked for uniformity using an optical emission spectrometer. Multiple measurements were taken from each surface under test.

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

For all elements except silicon, using the individual data from each check, standard deviation values were derived for each element. These values were combined with the 95% half-width confidence intervals ($C_{(95\%)}$) obtained from the wet analysis programme, using the square-root of the summed squares, to derive the final uncertainty values.

The same calculation was applied for silicon, except that the portion of the uncertainty attributable to inhomogeneity was derived using the meaned data for each surface.

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.

Usage

Intended use:	With optical emission and X-ray fluorescence spectrometers.
Recommended method of use:	Aluminium and aluminium alloys are generally prepared by machining on 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
1	0.158	0.17	18.20	0.550	0.055	0.084	0.293
2	0.159	0.17	18.2	0.554	0.057	0.089	0.296
3	0.163	0.171	18.4	0.554	0.057	0.090	0.299
4	0.166	0.174	18.70	0.56	0.058	0.090	0.300
5	0.17	0.175	18.92	0.566	0.059	0.0926	0.31
6	0.172	0.175	19.06	0.567	0.060	0.094	0.310
7	0.174	0.179	19.1	0.570	0.060	0.0950	0.311
8	0.175	0.188		0.57	0.0626		0.313
9	0.178	0.188		0.59			
Mean	**0.168**	**0.177**	**18.65**	**0.565**	**0.059**	**0.091**	**0.304**
Std Dev	0.007	0.007	0.39	0.012	0.002	0.004	0.008
$C_{(95\%)}$	0.006	0.005	0.36	0.009	0.002	0.003	0.007

Sample	Pb	Sn	Ti	Cr	Be	Sr	Ca
1	0.063	0.070	0.0776	0.060	0.00006	<0.0001	<0.0001
2	0.063	0.0722	0.0778	0.064	0.0001	<0.0001	<0.001
3	0.065	0.074	0.080	0.065	<0.0001	<0.0001	<0.002
4	0.066	0.0746	0.081	0.067	<0.0001	<0.0001	
5	0.066	0.075	0.083	0.0678	<0.0001	<0.0001	
6	0.0670	0.076	0.0839	0.068	<0.0002	<0.0005	
7	0.069	0.076	0.084	0.068	<0.0005	<0.001	
8	0.0691	0.078	0.085	0.0682	<0.001		
9		0.080	0.085				
10			0.085				
Mean	**0.066**	**0.075**	**0.082**	**0.066**	**<0.0001**	**<0.0001**	**<0.001**
Std Dev	0.002	0.003	0.003	0.003	-	-	-
$C_{(95\%)}$	0.002	0.002	0.002	0.002	-	-	-

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

Bodycote Materials Testing Ltd	Middlesbrough, England	UKAS accreditation 0239
Metals Technology (testing) Ltd	Sheffield, England	UKAS accreditation 0963
Birmingham Assay Office	Birmingham, England	UKAS accreditation 0667
Rotech Laboratories Ltd	Wednesbury, England	UKAS accreditation 0366
Coleshill Laboratories Ltd	Coleshill, England	UKAS accreditation 0121
Universal Scientific Laboratory Pty Ltd	Milperra, NSW, Australia	NATA accreditation 0492
Central Iron & Steel Research Inst	Beijing, China	CNACL accreditation 0435
University Dept of Science and Eng	Shanghai, China	
Anglo-American Research Laboratories Pty	Johannesburg, South Africa	
Tun Abdul Razak Research Laboratories	Hertford, England	

Note: to achieve National Accreditation (eg UKAS, NATA, CNACL), test houses must demonstrate conformity to the general requirements of EN ISO/IEC 17025 and ISO9002.

Analytical Methods Used

ELEMENT	RESULT No. & METHOD			
	ICP-AES	FAAS	OTHER	
Copper:	1, 2, 3, 5, 8	6, 7	4, 9	photometric (BCO)
Magnesium:	1, 3, 5, 7, 8	2, 4, 6, 9		
Silicon:	2, 7	3	1, 4, 5, 6	gravimetric (perchloric acid)
Iron:	2, 6, 7, 9	4, 5, 8	1, 3	photometric (thiocyanate)
Manganese:	2, 5, 6, 7	1, 3, 4	8	photometric (periodate)
Nickel:	1, 3, 6	2, 4	5, 7	photometric (dimethyl glyoxime)
Zinc:	1, 4, 8	2, 3, 5, 6	7	volumetric (EDTA)
Lead:	1, 3, 4, 7	2, 5, 8	6	square-wave polarography
Tin:	2, 3, 5, 6, 8	1, 7, 9	4	photometric (phenylfluorone)
Titanium:	1, 4, 7, 8, 9	3, 5, 10	2, 6	photometric (di-antipyryl methane)
Chromium:	1, 3, 6, 7	2, 4, 5, 8		
Beryllium:	1, 2, 3, 4, 5	6, 7, 8		
Strontium:	1, 2, 3, 4	5, 6, 7		
Calcium:	1	2, 3		

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.

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).

This sample is of hypereutectic composition. Despite the phosphorus treatment and chill casting, it still contains primary silicon at the chill face. For OE analysis, it is therefore necessary to take at least five burns to derive a meaningful result. Furthermore, the above certification is only applicable from the front face of the disc. Material to the rear of the disc, to a depth of ~5mm, 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 this certificate. This certification will therefore expire in July 2022, although we reserve the right to make changes as issue revisions, in the intervening period.

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