MBH ANALYTICAL LTD

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CERTIFICATE OF ANALYSIS

511X G6026 (batch A)

Certified Reference Material Information

Type:	ALUMINIUM/MAGNESIUM (WROUGHT)
Form and Size:	Disc, ~50mm diameter
Produced by:	Eural, Italy
Certified and Supplied by:	MBH Analytical Ltd

Assigned Values

Percentage element by weight

Element	Cu	Mg	Si	Fe	Mn	Ni	Zn	Pb
Value [1]	**0.413**	**0.692**	**0.898**	**0.470**	**0.703**	**0.0075**	**0.0775**	**0.277**
Uncertainty [2]	0.005	0.005	0.008	0.006	0.006	0.0004	0.0014	0.005

Element	Sn	Ti	Cr	Bi	Zr	V	B	Ga
Value [1]	**0.0043**	**0.0255**	**0.0706**	**0.498**	**0.0030**	**0.0066**	**0.0017**	**0.0092**
Uncertainty [2]	0.0006	0.0006	0.0011	0.007	0.0002	0.0005	0.0002	0.0008

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 17th June 2017

MBH ANALYTICAL LIMITED _____

C Eveleigh

Method of Preparation

This reference material was produced by slicing commercial barstock to alloy designation EN AW 6026, UNS A96026 into discs of 20mm length. The bar was extruded, but otherwise the detailed metallurgical history is unknown.

Sampling

Samples for chemical analysis were taken from various positions throughout the bar. At least 5% of all discs were selected for non-destructive homogeneity testing.

Homogeneity

Samples representative of the batch were checked for uniformity using an optical emission spectrometer. The testing procedure was in accordance with ASTM E826 and the material found acceptable.

From this test data, through-batch variation values were derived for each element as an indicator of any minor compositional variation (as determined for the specific sample size and other limitations of 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 - 2005, 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

Much of the analytical work performed to assess this material has been carried out by laboratories with proven competence, as indicated by their accreditation to ISO 17025. It is an implicit 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 reference materials.

Of the individual results herein, some have traceability (to the mole) via primary analytical methods. Some are traceable to substances of known stoichiometry. Most have traceability via commercial solutions. Furthermore, some results have additional traceability to NIST standards, as part of the analytical calibration or process control.

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 provide the necessary sample size. 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
1	0.3989	0.6820	0.8743	0.4530	0.6910	0.0062	0.0742	0.2648
2	0.3990	0.6831	0.8867	0.4580	0.6922	0.0070	0.0747	0.2670
3	0.4040	0.6850	0.8900	0.4605	0.6928	0.0072	0.0760	0.2685
4	0.4045	0.6867	0.8960	0.4620	0.6930	0.0072	0.0760	0.2686
5	0.4061	0.6870	0.8970	0.4627	0.6940	0.0073	0.0763	0.2719
6	0.4102	0.6903	0.8990	0.4631	0.6968	0.0074	0.0766	0.2726
7	0.4131	0.6930	0.9009	0.4660	0.6991	0.0074	0.0770	0.2730
8	0.4162	0.6932	0.9030	0.4680	0.7013	0.0075	0.0771	0.2744
9	0.4168	0.6937	0.9050	0.4712	0.7028	0.0075	0.0782	0.2764
10	0.4180	0.6960	0.9095	0.4724	0.7040	0.0076	0.0789	0.2780
11	0.4190	0.6961	0.9180	0.4745	0.7060	0.0078	0.0802	0.2799
12	0.4198	0.6961		0.4770	0.7083	0.0080	0.0808	0.2880
13	0.4198	0.6992		0.4815	0.7174	0.0088	0.0813	0.2880
14	0.4230	0.7010		0.4820	0.7180			0.2898
15	0.4240			0.4870	0.7208			0.2900
16				0.4886				
Mean	**0.4128**	**0.6916**	**0.8981**	**0.4704**	**0.7025**	**0.0075**	**0.0775**	**0.2767**
Std Dev	0.0085	0.0060	0.0117	0.0106	0.0099	0.0006	0.0023	0.0086
$C_{(95\%)}$	0.0047	0.0035	0.0079	0.0057	0.0057	0.0004	0.0014	0.0048

Sample	Sn	Ti	Cr	Bi	Zr	V	B	Ga
1	0.0033	0.0233	0.0679	0.4785	0.0024	0.0050	0.0014	0.0074
2	0.0036	0.0241	0.0693	0.4881	0.0026	0.0055	0.0015	0.0076
3	0.0041	0.0245	0.0694	0.4910	0.0027	0.0060	0.0015	0.0079
4	0.0044	0.0248	0.0696	0.4940	0.0029	0.0062	0.0015	0.0080
5	0.0046	0.0249	0.0698	0.4973	0.0030	0.0063	0.0016	0.0085
6	0.0046	0.0250	0.0703	0.4975	0.0030	0.0063	0.0016	0.0086
7	0.0048	0.0255	0.0703	0.4980	0.0031	0.0064	0.0017	0.0099
8	0.0051	0.0257	0.0705	0.5040	0.0031	0.0065	0.0017	0.0100
9		0.0257	0.0706	0.5042	0.0032	0.0068	0.0019	0.0102
10		0.0259	0.0706	0.5102	0.0032	0.0069	0.0020	0.0102
11		0.0259	0.0709	0.5164	0.0032	0.0071	0.0022	0.0108
12		0.0261	0.0710		0.0034	0.0072		0.0113
13		0.0264	0.0716		0.0035	0.0073		
14		0.0267	0.0732			0.0078		
15		0.0274	0.0746			0.0081		
Mean	**0.0043**	**0.0255**	**0.0706**	**0.4981**	**0.0030**	**0.0066**	**0.0017**	**0.0092**
Std Dev	0.0006	0.0011	0.0016	0.0105	0.0003	0.0008	0.0002	0.0013
$C_{(95\%)}$	0.0006	0.0006	0.0009	0.0071	0.0002	0.0005	0.0002	0.0008

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

Exova Ltd	Middlesbrough, England	UKAS accreditation 0239
Sheffield Assay Office	Sheffield, England	UKAS accreditation 0012
Universal Scientific Laboratory Pty Ltd	Milperra, NSW, Australia	NATA accreditation 0492
Shanghai Jinyi Test Technology Co	Shanghai, China	CNAL accreditation 0783
Luo Yang Copper Co	Luo Yang, HeNan, China	CNAS accreditation 0173
Shandong Metallurgical & Science Research	Jinan, Shandong, China	CNAS accreditation 1461
Genitest, Inc	Montreal, Canada	PRI accreditation 123077
Raghavendra Spectromet Laboratory	Bangalore, India	NABL accreditation 0371
Institute of Non-Ferrous Metals	Gliwice, Poland	PCA accreditation AB274
INCDMNR-IMNR	Pantelimon, Romania	RENAR accreditation 1056
Tec-Eurolab	Campogalliano, Italy	ACCREDIA accreditation 52
Mineral & Metallurgical Laboratories	Bangalore, India	
AMG Superalloys UK Ltd	Rotherham, England	
Coleshill Laboratories Ltd	Birmingham, England	
Analyticka Laborator Lithea sro	Brno, Czech Republic	

Note: to achieve the above accreditation (UKAS, NATA, etc), test houses must demonstrate conformity to the general requirements of EN ISO/IEC 17025.

Analytical Methods Used

ELEMENT	RESULT No. & METHOD			
	ICP-AES	FAAS		OTHER
Copper	1, 4, 5, 7-9, 12-15	2, 6, 10	3	volumetric (iodine)
			11	photometric (EDTA)
Magnesium	1, 2, 4-6, 8-10, 12, 13	3, 7, 11	14	gravimetric (oxine)
Silicon	2, 5, 7, 8	-	1, 3, 4, 6, 9, 11	gravimetric (perchloric acid)
			10	photometric (molybdenum blue)
Iron	1, 4-9, 11, 13, 15, 16	2, 10, 12	3	photometric (orthophenanthroline)
			14	volumetric (redox)
Manganese	3-9, 12-15	2	1, 10	photometric (periodate)
			11	volumetric (bismuthate)
Nickel	1-7, 9-11, 13	8, 12		
Zinc	1, 3-7, 11-13	2, 9, 10	8	gravimetric (oxide)
Lead	4-6, 8-14	1, 2, 15	7	photometric (sulfide)
Tin	1-7	8		
Titanium	1-6, 9, 10, 12, 15	7, 11	8, 13, 14	photometric (di-antipyryl methane)
Chromium	1-8, 12-14	10, 11, 15	9	volumetric (persulfate)
Bismuth	1, 2, 5, 6, 8-10	3, 4, 11	7	gravimetric (dimethyl glyoxime)
Zirconium	1-7, 9, 11-13	10	8	photometric (xylenol orange)
Vanadium	1-8, 11-14	9, 15	10	photometric (N-benzoyl Nph)
Boron	1-4, 6-11	5		
Gallium	1, 3-10, 12	2	11	photometric (butyl rhodamine B)

Notes

This Certified Reference Material has been tested and certified, wherever possible, in accordance with the requirements of ISO Guide 34, ISO Guide 31 and ISO Guide 35, taking into account the requirements of the ISO Guide to the Expression of Uncertainty in Measurement (GUM).

This certification is applicable to the whole of the disc. However, in accordance with normal practice for OES, it is appropriate to avoid usage of the central portion of approx 8mm diameter.

This material will remain stable indefinitely, 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. Technical support for this certification will therefore expire in June 2037, 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 testing, 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.