

CERTIFICATE OF ANALYSIS

56X G2011 (batch A)

Certified Reference Material Information

Type: ALUMINIUM / COPPER (WROUGHT)
Form and Size: Disc, ~50mm diameter
Produced by: Stock bar
Certified and Supplied by: MBH Analytical Ltd

Assigned Values

Percentage element by weight

Element	Cu	Mg	Si	Fe	Mn	Ni
Value ¹	5.70	0.0102	0.089	0.632	0.0183	0.0044
Uncertainty ²	0.06	0.0006	0.004	0.007	0.0005	0.0003

Element	Zn	Pb	Sn	Bi	Ti	Cr
Value ¹	0.0188	0.332	0.0037	0.527	0.0121	0.0031
Uncertainty ²	0.0016	0.004	0.0004	0.006	0.0006	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:

MBH ANALYTICAL LIMITED _____

On 3rd November 2011

C Eveleigh



Method of Preparation

This reference material was produced by slicing a single length of commercial barstock to alloy designation 2011, into discs of 20mm length. 2011 is a free-machining alloy; this sample has been wrought and subjected to T3 heat-treatment.

Sampling

Samples for chemical analysis were taken from various positions throughout the bar. Approximately 8% 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.

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 - 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. In addition, some of the results derived as part of this testing programme have 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
1	5.610	0.0090	0.0794	0.621	0.0172	0.0035
2	5.610	0.0091	0.0799	0.625	0.0174	0.0037
3	5.650	0.0093	0.0808	0.625	0.0174	0.0040
4	5.658	0.0093	0.0854	0.626	0.0177	0.0041
5	5.663	0.0095	0.0890	0.628	0.0180	0.0042
6	5.697	0.0099	0.0891	0.628	0.0180	0.0042
7	5.726	0.0101	0.0892	0.630	0.0181	0.0043
8	5.729	0.0102	0.0901	0.631	0.0183	0.0043
9	5.760	0.0103	0.0910	0.633	0.0186	0.0047
10	5.770	0.0110	0.0970	0.634	0.0189	0.0048
11	5.782	0.0114	0.0973	0.634	0.0191	0.0048
12	5.789	0.0117	0.0988	0.641	0.0193	0.0052
13		0.0119		0.647	0.0193	0.0054
14				0.650		
Mean	5.704	0.0102	0.0889	0.632	0.0183	0.0044
Std Dev	0.065	0.0010	0.0067	0.008	0.0007	0.0006
C_(95%)	0.041	0.0006	0.0042	0.005	0.0004	0.0003

Sample	Zn	Pb	Sn	Bi	Ti	Cr
1	0.0154	0.320	0.0031	0.518	0.0100	0.0027
2	0.0168	0.321	0.0032	0.520	0.0110	0.0028
3	0.0170	0.325	0.0032	0.521	0.0112	0.0028
4	0.0171	0.326	0.0035	0.521	0.0113	0.0029
5	0.0173	0.328	0.0036	0.522	0.0116	0.0030
6	0.0173	0.331	0.0038	0.523	0.0118	0.0032
7	0.0175	0.332	0.0039	0.524	0.0120	0.0032
8	0.0180	0.334	0.0043	0.525	0.0122	0.0032
9	0.0193	0.335	0.0044	0.525	0.0123	0.0032
10	0.0197	0.335		0.526	0.0123	0.0033
11	0.0222	0.336		0.527	0.0128	0.0034
12	0.0232	0.337		0.531	0.0128	0.0035
13	0.0233	0.337		0.538	0.0138	
14		0.339		0.539	0.0140	
15		0.339		0.539		
Mean	0.0188	0.332	0.0037	0.527	0.0121	0.0031
Std Dev	0.0026	0.006	0.0005	0.007	0.0011	0.0003
C_(95%)	0.0016	0.003	0.0004	0.004	0.0006	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

Exova Ltd	Middlesbrough, England	UKAS accreditation 0239
Universal Scientific Laboratory Pty Ltd	Milperra, NSW, Australia	NATA accreditation 0492
Laboratory Testing, Inc	Hatfield, PA, USA	A2LA accreditation 0117
Genitest, Inc	Montreal, Canada	PRI accreditation 123077
Institute of Iron & Steel Technology	Shanghai, China	CNAL accreditation 0783
Luo Yang Copper	Luo Yang, He Nan, China	CNAL accreditation 0173
South-West Aluminium Group	Jiulong Puo, Sichuan, China	CNAL accreditation T007
Sargam Metals Pvt Ltd	Chennai, India	NABL accreditation 0025
Shriram Institute for Industrial Research	Delhi, India	NABL accreditation 0045
Raghavendra Spectromet Laboratory	Bangalore, India	NABL accreditation 0371
Institute of Non-Ferrous Metals	Gliwice, Poland	PCA accreditation AB274
London & Scandinavian Met Co	Rotherham, England	
De Bruyn Spectroscopic Solutions Ltd	Johannesburg, South Africa	
Coleshill Laboratories Ltd	Birmingham, England	

Note: to achieve the above accreditation (eg 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, 2, 4, 6-9, 11	3, 5, 10, 12	
Magnesium	4, 6, 8-13	1-3, 5, 7	
Silicon	2-4, 10	-	1, 5, 8, 11 gravimetric (perchloric acid) 6, 7, 9, 12 photometric (molybdenum blue)
Iron	3, 4, 6-8, 10, 13, 14	2, 5, 11, 12	1, 9 photometric (orthophenanthroline)
Manganese	1-3, 7, 9-13	4, 5	6, 8 photometric (periodate)
Nickel	1-4, 6-9, 13	5, 10-12	
Zinc	3-10, 12	1, 2, 11, 13	
Lead	1-3, 5-9, 11-13	4, 10, 14, 15	
Tin	1, 3, 5, 7, 8	6, 9	2, 4 photometric (phenylfluorone)
Bismuth	1-4, 7, 9, 11, 13-15	5, 6, 10, 12	8 photometric (Brucine)
Titanium	1-4, 7, 10-13	5, 14	6, 8, 9 photometric (di-antipyryl methane)
Chromium	1, 3-7, 11, 12	2, 8-10	

Notes

This Certified Reference Material has been tested and certified in accordance with the requirements of ISO Guide 34-2009, ISO Guide 31-2000 and ISO Guide 35-2006, 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 is liable to superficial oxidation. However, it will otherwise 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 November 2031, 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.