

CERTIFICATE OF ANALYSIS

518X 905 (batch A)

Certified Reference Material Information

Type: ALUMINIUM ALLOY (PRESSED POWDER)
Form and Size: Disc 45mm diameter x 40mm thick
Produced by: RSP Technology, Holland
Certified and Supplied by: MBH Analytical Limited

Certified Analysis

Percentage element by weight

Element	Cu	Mg	Si	Fe	Mn	Ni	Zn	Pb
Value ¹	2.51	0.645	0.10	2.54	0.994	4.98	0.0052	(0.0006)
Uncertainty ²	0.04	0.013	0.01	0.03	0.017	0.06	0.0005	-

Element	Sn	Ti	Cr	Co	V	Zr	Mo	Ca
Value ¹	(0.0024)	0.587	0.0090	0.0033	0.0186	0.77	0.807	(0.0007)
Uncertainty ²	-	0.006	0.0005	0.0003	0.0010	0.02	0.012	-

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:

MBH ANALYTICAL LIMITED _____

on 23rd May 2006

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 molten metal stream was forced onto a cold rotating disc and chill-solidified at 10^6 degrees per second ('melt-spinning'). The resultant flakes were pressed into an ingot, which was extruded to the final dimension.

Sampling

Samples for chemical analysis, and discs for homogeneity checks, were taken from several positions throughout the batch. At least 10% of all discs were incorporated into the schedule for non-destructive homogeneity checking.

Homogeneity

The discs were checked for sample and batch 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.

Using the individual data from each check, 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 four 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
1	2.426	0.616	0.0855	2.513	0.961	4.894	0.0046	0.0005
2	2.45	0.630	0.0898	2.520	0.965	4.900	0.0049	0.0005
3	2.480	0.632	0.0958	2.520	0.970	4.964	0.0052	0.0006
4	2.485	0.633	0.0967	2.54	0.984	4.98	0.0052	0.0006
5	2.487	0.639	0.0990	2.54	0.992	5.00	0.0053	<0.001
6	2.51	0.654	0.0999	2.549	0.995	5.005	0.006	<0.002
7	2.514	0.656	0.104	2.550	0.996	5.040		
8	2.52	0.656	0.1045	2.566	1.006	5.05		
9	2.520	0.667	0.105	2.589	1.008			
10	2.567	0.671	0.116		1.010			
11	2.618		0.116		1.048			
Mean	2.507	0.645	0.101	2.543	0.994	4.979	0.0052	(0.0006)
Std Dev	0.053	0.018	0.010	0.024	0.025	0.058	0.0005	-
C_(95%)	0.035	0.013	0.006	0.019	0.017	0.049	0.0005	-

Sample	Sn	Ti	Cr	Co	V	Zr	Mo	Ca
1	0.0017	0.575	0.0084	0.0027	0.0162	0.761	0.791	0.0005
2	0.0021	0.578	0.0084	0.003	0.0170	0.768	0.798	0.00058
3	0.0025	0.580	0.0085	0.0031	0.0176	0.771	0.801	0.0007
4	0.0025	0.582	0.0088	0.0033	0.0179	0.777	0.804	0.0007
5	0.003	0.583	0.0093	0.0033	0.0185	0.793	0.807	0.0008
6		0.585	0.0094	0.0034	0.0186		0.824	<0.001
7		0.595	0.0095	0.0034	0.019		0.827	<0.001
8		0.595	0.0100	0.0035	0.0198			
9		0.596		0.0042	0.0200			
10		0.597			0.0210			
Mean	(0.0024)	0.587	0.0090	0.0033	0.0186	0.774	0.807	(0.0007)
Std Dev	-	0.008	0.0006	0.0004	0.0015	0.012	0.013	-
C_(95%)	-	0.006	0.0005	0.0003	0.0010	0.015	0.012	-

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
Sheffield Assay Office	Sheffield, England	UKAS accreditation 0012
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
Luo Yang Copper Co	Luo Yang, He Nan, China	CNAL accreditation 0173
Sargam Metals Pvt Ltd	Chennai, India	NABL accreditation 0025
TCR Engineering Services Ltd	Mumbai, India	NABL accreditation 0367
Fu Shun Aluminium Smelter	Fu Shun District, China	
Colehill Laboratories Ltd	Birmingham, England	
De Bruyn Spectroscopic Solutions Ltd	Johannesburg, South Africa	

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

Analytical Methods Used

ELEMENT	RESULT No. & METHOD		
	ICP-AES	FAAS	OTHER
Copper	1-3, 9, 11	4, 5, 8	6, 10 7 photometric (neocuprone, BCO) volumetric (thiosulfate)
Magnesium	1, 3, 4, 6, 7, 10	2, 5, 8, 9	
Silicon	1, 2, 4, 7, 10	-	3, 5, 6, 9 8, 11 photometric (molybdenum yellow) gravimetric (perchloric acid)
Iron	2, 6, 8	3, 5	1, 4, 7, 9 photometric (orthophenanthroline)
Manganese	1, 2, 8-10	4, 6	3, 5, 7, 11 photometric (periodate)
Nickel	2, 5	1, 3, 6, 7, 8	4 photometric (DMGO, α -fural dioxime)
Zinc	5	1-4, 6	
Lead	1, 4, 6	2, 3, 5	
Tin	1, 4	2, 5	3 photometric (phenylfluorone)
Titanium	2, 3, 8, 10	6, 9	1, 4, 5, 7 photometric (peroxide, DAP)
Chromium	1, 2, 4, 5, 7	3, 6, 8	
Cobalt	1, 5, 8, 9	2-4, 6, 7	
Vanadium	1-6, 8	7, 9, 10	5 photometric (N-benzoyl-p-h)
Zirconium	1-4	-	5 photometric (xylenol orange)
Molybdenum	1, 3, 5-7	2, 4	
Calcium	3-5, 7	1, 2, 6	

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 and the ISO Guide to the Expression of Uncertainty in Measurement (GUM).

This certification is applicable to the whole of the disc.

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 analysis. This certification will therefore expire in May 2026, 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.