

CERTIFICATE OF ANALYSIS

55X G02DY (batch A)

Certified Reference Material Information

Type: ALUMINIUM/SILICON/COPPER
(PRESSED POWDER)

Form and Size: Disc, 65mm diameter x 30mm thick

Produced by: RSP Technologies, Delfzijl, Holland

Certified and Supplied by: MBH Analytical Ltd

Assigned Values

Percentage element by weight

Element	Cu	Mg	Si	Fe	Mn	Ni	Zn
Value ¹	3.67	0.309	11.31	0.591	0.107	0.109	0.153
Uncertainty ²	0.05	0.006	0.11	0.008	0.002	0.002	0.005

Element	Pb	Sn	Ti	Cr	Co	V	Cd
Value ¹	0.0620	0.0747	0.0687	0.063	0.0195	0.0250	0.0032
Uncertainty ²	0.0010	0.0009	0.0011	0.003	0.0005	0.0017	0.0001

Element	Zr	Sb	Be	Bi	Ag	Ca	P
Value ¹	0.0218	0.0199	0.0012	0.0100	0.0102	(0.0011)	(0.01)
Uncertainty ²	0.0011	0.0007	0.0001	0.0007	0.0004	-	-

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 19th May 2017

MBH ANALYTICAL LIMITED _____

C Eveleigh

Method of Preparation

This reference material was produced using commercial-grade aluminium and master alloys. The melt was rapid-quenched, and the resultant ribbon was milled into powder. The bulk powder was sieved, homogenised, then pressed into a billet which was extruded to bar of the final diameter.

Sampling

Samples for chemical analysis were taken from various positions within the bar. 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.

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 as follows:

$$C_{(95\%)} = (t \times SD) / \sqrt{n}$$

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.

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.

A minimum of three 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
1	3.551	0.294	11.02	0.562	0.102	0.106	0.146
2	3.57	0.300	11.07	0.570	0.102	0.107	0.146
3	3.609	0.301	11.08	0.575	0.103	0.108	0.147
4	3.642	0.304	11.11	0.588	0.105	0.108	0.149
5	3.65	0.305	11.24	0.591	0.105	0.109	0.149
6	3.68	0.305	11.34	0.592	0.106	0.109	0.150
7	3.693	0.306	11.35	0.598	0.107	0.110	0.153
8	3.700	0.310	11.39	0.599	0.108	0.110	0.153
9	3.73	0.310	11.42	0.599	0.109	0.112	0.155
10	3.766	0.313	11.43	0.600	0.110	0.112	0.167
11	3.814	0.318	11.48	0.601	0.111	0.113	0.170
12		0.320	11.51	0.604	0.111		
13		0.334	11.53	0.605	0.112		
Mean	3.673	0.309	11.31	0.591	0.107	0.109	0.153
Std Dev	0.080	0.010	0.18	0.014	0.003	0.002	0.008
C_(95%)	0.054	0.006	0.11	0.008	0.002	0.002	0.005

Sample	Pb	Sn	Ti	Cr	Co	V	Cd
1	0.0596	0.0732	0.0662	0.0572	0.0182	0.0209	0.0029
2	0.0610	0.0734	0.0673	0.0605	0.0183	0.0210	0.0029
3	0.0614	0.0735	0.0675	0.0608	0.0192	0.0221	0.0031
4	0.0615	0.074	0.0678	0.0608	0.0194	0.0250	0.0031
5	0.0616	0.0748	0.0680	0.0616	0.0197	0.0252	0.0031
6	0.0620	0.075	0.069	0.0623	0.0199	0.0253	0.0032
7	0.062	0.0750	0.0692	0.063	0.0201	0.0259	0.0032
8	0.0630	0.0752	0.070	0.0632	0.0201	0.0267	0.0032
9	0.0633	0.0766	0.0705	0.0682	0.0201	0.0270	0.0032
10	0.0645	0.0767	0.0710	0.0685	0.0204	0.0272	0.0032
11				0.0695		0.0282	0.0033
12							0.0035
Mean	0.0620	0.0747	0.0687	0.0632	0.0195	0.0250	0.0032
Std Dev	0.0014	0.0012	0.0015	0.0037	0.0008	0.0025	0.0002
C_(95%)	0.0010	0.0009	0.0011	0.0025	0.0005	0.0017	0.0001

Sample	Zr	Sb	Be	Bi	Ag	Ca	P
1	0.0193	0.0189	0.0010	0.0083	0.0096	0.0007	0.0093
2	0.0200	0.0191	0.0011	0.0090	0.0098	0.0008	0.0093
3	0.0200	0.0192	0.0011	0.0092	0.0100	0.0009	0.0095
4	0.0207	0.0192	0.0012	0.0093	0.0101	0.0010	0.0096
5	0.0220	0.0197	0.0013	0.0095	0.0102	0.0015	0.0100
6	0.0221	0.0200	0.0013	0.0106	0.0102	0.0015	0.0101
7	0.0222	0.0200	0.0013	0.0107	0.0105		0.0103
8	0.0222	0.0210	0.0013	0.0110	0.0105		0.0122
9	0.0230	0.0216	0.0013	0.0110	0.0113		
10	0.0240		0.0015	0.0110			
11	0.0241						
Mean	0.0218	0.0199	0.0012	0.0100	0.0102	0.0011	0.0100
Std Dev	0.0016	0.0009	0.0001	0.0010	0.0005	0.0004	0.0010
C_(95%)	0.0011	0.0007	0.0001	0.0007	0.0004	0.0004	0.0008

Participating Laboratories

Bodycote Materials Testing Ltd	Middlesbrough, England	UKAS accreditation 0239
Sheffield Assay Office	Sheffield, England	UKAS accreditation 0012
Universal Scientific Laboratory Pty	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	Chonquin, SiChuan, China	CNAL accreditation 0007
TCR Engineering Services Ltd	Mumbai, India	NABL accreditation 0367
Sargam Metals Pvt Ltd	Chennai, India	NABL accreditation 0025
Institute of Non-Ferrous Metals	Gliwice, Poland	PCA accreditation AB274
London & Scandinavian Met Co Ltd	Rotherham, England	
De Bruyn Spectroscopic Solutions Ltd	Johannesburg, South Africa	

Note: to achieve National Accreditation (eg UKAS, NATA, A2LA, PRI, CNAL, NABL, PCA), 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	ICP-MS	FAAS	OTHER	
Copper	2-4, 6, 7, 9	-	1, 5, 8, 10, 11		
Magnesium	1, 3, 4, 6-8, 10, 12	-	2, 5, 9, 11, 13		
Silicon	1, 5, 13	-	-	3, 4, 7-12 2, 6	gravimetric (perchloric acid) photometric (molybdenum blue)
Iron	3, 5-8, 10, 11	-	1, 4, 9, 12, 13	2	photometric (orthophenanthroline)
Manganese	6-8, 10-13	-	1, 3, 4, 9	2, 5	photometric (periodate)
Nickel	1, 3, 4, 6, 7, 10, 11	-	2, 5, 8, 9		
Zinc	2, 4-8	-	1, 3, 9-11		
Lead	1, 2, 4, 6-8, 10	-	3, 5, 9		
Tin	3, 4, 7-10	5	6	1, 2	photometric (phenylfluorone)
Titanium	1-3, 6, 9, 10	4	8	5, 7	photometric (di-antipyryl methane)
Chromium	1-3, 5, 7, 10, 11	-	4, 6, 8, 9		
Cobalt	3-5, 8-10	-	1, 2, 6, 7		
Vanadium	1, 5-9, 11	4	2, 3	10	photometric (N benzoyl-N-p.h.)
Cadmium	3, 4, 7-12	-	1, 2, 5, 6		
Zirconium	1-6, 8, 11	7	-	9, 10	photometric (xylenol orange)
Antimony	1, 3, 4, 6, 9	-	2, 7, 8	5	photometric (iodide)
Beryllium	2-4, 7-10	6	1	5	photometric (eriochrome cyanine R)
Bismuth	1, 4-6, 9, 10	-	3, 7, 8	2	photometric (brucine)
Silver	1, 2, 7-9	-	3, 4, 5, 6		
Calcium	1-3, 5, 6	-	4		
Phosphorus	2, 6-8	5	-	1, 3, 4	photometric (molybdenum yellow)

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

This certification is applicable to the whole of the disc although, in accordance with normal practice for OES use, it is appropriate to avoid using the central area, of approximately 12mm diameter.

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 May 2028, 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.

This certificate was up-issued to enable downgrading of the value for phosphorus to 'uncertified'. Long-term studies have shown the phosphorus in this sample to be unevenly distributed.

The specification, preparation, 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.