MBH ANALYTICAL LTD

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CERTIFICATE OF ANALYSIS

41X GLV3 (batch B)

Certified Reference Material Information

Type:	ZINC GALVANIZING ALLOY (CAST)
Form and Size:	Disc 50mm Diameter x 20mm Thickness
Produced by:	J Watson
Certified and supplied by:	MBH Analytical Limited

Assigned Values

Percentage element by weight

Element	Pb	Mg	Al	Cd	Fe	Sn	Cu
Value [1]	**0.0091**	**0.00145**	**0.334**	**0.0188**	**0.0031**	**0.0060**	**0.0260**
Uncertainty [2]	0.0009	0.00017	0.006	0.0006	0.0003	0.0004	0.0014

Element	Ni	Mn	Bi	Sb	Cr	As	Co
Value [1]	**0.0300**	**0.0111**	**0.0016**	**0.058**	**0.00084**	**(0.0007)**	**0.00150**
Uncertainty [2]	0.0016	0.0005	0.0002	0.003	0.00010	-	0.00017

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 29th May 2007

MBH ANALYTICAL LIMITED _____

C Eveleigh

Method of Preparation

This reference material was produced from commercial-purity zinc, with the traces added as pure elements. The metal was cast from the bulk melt by sequential transfer of aliquots into individual iron chill moulds. At least 1mm was machined from the upper and lower surfaces of each disc, to minimise surface effects.

Sampling

Samples for chemical analysis were taken from throughout the casting process. In addition, at least 10% of all discs, chosen at random from the complete cast, were checked for homogeneity.

Homogeneity

The discs were checked for sample and batch uniformity using an optical emission spectrometer. One disc was checked for vertical uniformity using the same method.

Using the meaned data from 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 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:	Zinc and zinc alloys are generally prepared by machining on a mill or 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.
	For OES the sample should be of sufficient mass to prevent excess heating during sparking, and the discharge chamber should be regularly cleaned as directed by the instrument manufacturer.
	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	Pb	Mg	Al	Cd	Fe	Sn	Cu
1	0.0071	0.0010	0.325	0.0171	0.0025	0.0047	0.0222
2	0.0077	0.0011	0.328	0.0172	0.0025	0.0055	0.0234
3	0.0081	0.0012	0.328	0.0179	0.0026	0.0056	0.0240
4	0.0082	0.00131	0.330	0.0180	0.0027	0.0057	0.0241
5	0.0087	0.00142	0.332	0.0186	0.0027	0.0058	0.0256
6	0.0094	0.00152	0.336	0.0189	0.0031	0.0062	0.0261
7	0.0096	0.0015	0.340	0.0192	0.0032	0.0062	0.0269
8	0.0096	0.0015	0.342	0.0194	0.0032	0.0063	0.0269
9	0.0099	0.0016	0.349	0.0194	0.0033	0.0064	0.0270
10	0.0106	0.0016		0.0194	0.0034	0.0064	0.0271
11	0.0116	0.0018		0.0195	0.0037	0.0066	0.0281
12		0.0019		0.0197	0.0039	0.0071	0.0304
13				0.0200			
Mean	**0.0091**	**0.00145**	**0.334**	**0.0188**	**0.0031**	**0.0060**	**0.0260**
Std Dev	0.0013	0.00027	0.008	0.0010	0.0005	0.0006	0.0023
$C_{(95\%)}$	0.0009	0.00017	0.006	0.0006	0.0003	0.0004	0.0014

Sample	Ni	Mn	Bi	Sb	Cr	As	Co
1	0.0262	0.0100	0.0011	0.0499	0.00064	0.00046	0.0010
2	0.0262	0.0100	0.0012	0.0504	0.0007	0.0006	0.0012
3	0.0270	0.0101	0.0013	0.055	0.0007	0.0006	0.0013
4	0.0287	0.0103	0.0015	0.0561	0.0008	0.0007	0.00136
5	0.0305	0.0109	0.0015	0.0568	0.00084	0.0009	0.0014
6	0.0306	0.0109	0.00151	0.0568	0.00090	0.00100	0.0015
7	0.0308	0.0114	0.0016	0.0605	0.0009		0.00151
8	0.0308	0.0114	0.00175	0.0611	0.0009		0.00156
9	0.0313	0.0117	0.0019	0.0613	0.0009		0.0017
10	0.0319	0.0120	0.0019	0.0631	0.0011		0.0017
11	0.0321	0.0122	0.00207	0.0634			0.0019
12	0.0341	0.0122					0.0019
Mean	**0.0300**	**0.0111**	**0.00158**	**0.0577**	**0.00084**	**0.0007**	**0.00150**
Std Dev	0.0025	0.0008	0.00031	0.0047	0.00013	0.0002	0.00027
$C_{(95\%)}$	0.0016	0.0005	0.00021	0.0031	0.00010	0.0002	0.00017

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	Middlesbrough, England	UKAS accreditation 0239
Sheffield Assay Office	Sheffield, England	UKAS accreditation 0012
Universal Scientific Laboratory Pty Ltd	Milperra, NSW, Australia	NATA accreditation 492
Laboratory Testing, Inc	Hatfield, PA, USA	A2LA accreditation 0117
Luo Yang Copper	Luo Yang, He Nan, China	CNAL accreditation 0173
Institute of Iron & Steel Technology	Shanghai, China	CNAL accreditation 0783
Institute of Non-Ferrous Metals	Gliwice, Poland	PCA accreditation AB274
Laboratory TUV Nord Czech	Brno, Czech Republic	CAI accreditation 1060
TCR Engineering Services Ltd	Mumbai, India	NABL accreditation 0367
Sargam Metals Pvt Ltd	Chennai, India	NABL accreditation 0025
De Bruyn Spectroscopic Solutions Ltd	Johannesburg, South Africa	
Coleshill Laboratories Ltd	Coleshill, England	
Genitest Inc	Montreal, Canada	

Note: to achieve National Accreditation (eg UKAS, NATA, A2LA, CNAL, PCA, CAI, NABL), 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	
Lead	1-6, 8	7, 9, 10, 11		
Magnesium	2-4, 7, 8, 10-12	1, 5, 6	9	ICP-MS
Aluminium	2, 4-6, 8, 9	1, 7	3	photometric (chrome azurol S)
Cadmium	1, 3-5, 7, 10-13	2, 6, 8, 9		
Iron	2, 3, 6, 8-12	1, 4, 5, 7		
Tin	1-4, 7, 8, 10-12	6	5	ICP-MS
			9	photometric (phenyl fluorone)
Copper	2-5, 8-12	1, 6, 7		
Nickel	2-6, 9-11	1, 7, 8, 12		
Manganese	2, 3, 6-12	1, 4, 5		
Bismuth	1, 3, 4, 7-11	5, 6	2	ICP-MS
Antimony	1-5, 7, 10, 11	6, 7, 9		
Chromium	1-3, 5, 8-10	4, 6	7	ICP-MS
Arsenic	2-4, 6	1	5	ICP-MS
Cobalt	1, 2, 4, 6, 7, 9-11	5, 8, 12	3	ICP-MS

Notes

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

The unidirectional solidification effects associated with this method of casting have led to the formation of inhomogeneous segregates in the rear portion of the disc. However, testing has shown that the above certification is applicable from the front face of the disc to a depth of at least 15mm. 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 original analysis. This certification will therefore expire in May 2027, 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.