MBH ANALYTICAL LTD

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CERTIFICATE OF ANALYSIS

41X GLV9 (batch A)

Certified Reference Material Information

Type:	ZINC GALVANIZING ALLOY (CAST)
Form and Size:	Disc ~50mm diameter
Produced by:	MBH Analytical Ltd
Certified and supplied by:	MBH Analytical Ltd

Assigned Values

Percentage element by weight

Element	Pb	Mg	Al	Cd	Fe	Sn
Value [1]	**0.0043**	**0.0014**	**0.547**	**0.0028**	**0.0039**	**0.0028**
Uncertainty [2]	0.0002	0.0002	0.008	0.0002	0.0004	0.0001

Element	Cu	Ni	Mn	Co	Bi	Sb
Value [1]	**0.0037**	**0.0009**	**0.0027**	**0.0005**	**0.0019**	**0.0048**
Uncertainty [2]	0.0002	0.0001	0.0002	0.0001	0.0002	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:

on 9th August 2011

MBH ANALYTICAL LIMITED _____

C Eveleigh

Method of Preparation

This certified reference material was produced from commercial zinc, with the major alloys and traces added as pure elements or master alloys, targeting the nominal composition indicated for UNS Z80610. The metal was cast from the bulk melt by sequential transfer of aliquots into individual iron chill moulds. At least 1mm has been machined from the working face 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 batch, were selected for non-destructive homogeneity testing.

Homogeneity

The discs were checked for sample and batch uniformity using an optical emission spectrometer.

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 - 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:	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
1	0.0037	0.0011	0.5283	0.0025	0.0033	0.0025
2	0.0037	0.0011	0.5373	0.0027	0.0034	0.0025
3	0.0038	0.0013	0.5377	0.0027	0.0034	0.0026
4	0.0040	0.0013	0.5380	0.0027	0.0035	0.0027
5	0.0041	0.0013	0.5390	0.0027	0.0036	0.0027
6	0.0042	0.0013	0.5452	0.0028	0.0036	0.0028
7	0.0042	0.0014	0.5457	0.0028	0.0038	0.0029
8	0.0044	0.0014	0.5480	0.0028	0.0039	0.0030
9	0.0045	0.0014	0.5488	0.0028	0.0040	0.0030
10	0.0046	0.0014	0.5505	0.0028	0.0041	0.0030
11	0.0046	0.0014	0.5530	0.0028	0.0042	0.0030
12	0.0047	0.0015	0.5549	0.0028	0.0043	0.0030
13	0.0047	0.0016	0.5568	0.0028	0.0044	0.0032
14	0.0047	0.0016	0.5630	0.0029	0.0044	
15		0.0017	0.5653	0.0029	0.0046	
16				0.0030		
Mean	**0.0043**	**0.0014**	**0.5474**	**0.0028**	**0.0039**	**0.0028**
Std Dev	0.0004	0.0002	0.0103	0.0001	0.0004	0.0002
$C_{(95\%)}$	0.0002	0.0001	0.0057	0.0001	0.0002	0.0001

Sample	Cu	Ni	Mn	Co	Bi	Sb
1	0.0031	0.0006	0.0022	0.0003	0.0015	0.0044
2	0.0032	0.0008	0.0023	0.0004	0.0017	0.0045
3	0.0034	0.0008	0.0024	0.0004	0.0017	0.0046
4	0.0036	0.0008	0.0024	0.0004	0.0017	0.0047
5	0.0036	0.0008	0.0024	0.0004	0.0018	0.0048
6	0.0036	0.0008	0.0027	0.00045	0.0019	0.0048
7	0.0037	0.0009	0.0027	0.00046	0.0019	0.0048
8	0.0037	0.0009	0.0027	0.00050	0.0019	0.0048
9	0.0037	0.0009	0.0028	0.0005	0.0019	0.0048
10	0.0037	0.0010	0.0028	0.0005	0.0020	0.0051
11	0.0038	0.0010	0.0029	0.0005	0.0021	0.0052
12	0.0038	0.0010	0.0029	0.0005	0.0022	0.0052
13	0.0038	0.0010	0.0029	0.00054	0.0022	0.0053
14	0.0040	0.0010	0.0029	0.0007	0.0022	
15	0.0041	0.0010	0.0029		0.0023	
16		0.0011	0.0031			
Mean	**0.0037**	**0.0009**	**0.0027**	**0.00046**	**0.0019**	**0.0048**
Std Dev	0.0003	0.0001	0.0003	0.00009	0.0002	0.0003
$C_{(95\%)}$	0.0001	0.0001	0.0001	0.00005	0.0001	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 Materials Testing Ltd	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
Genitest, Inc	Montreal, Canada	PRI accreditation 123077
Luo Yang Copper	Luo Yang, He Nan, China	CNAL accreditation 0173
Institute of Iron & Steel Technology	Shanghai, China	CNAL accreditation 0783
South-West Aluminium Group	Jiulong Puo, Sichuan, China	CNAL accreditation T007
TCR Engineering Services Ltd	Mumbai, India	NABL accreditation 0367
Sargam Metals Pvt Ltd	Chennai, India	NABL accreditation 0025
Raghavendra SpectroMet Laboratory	Bangalore, India	NABL accreditation T371
Institute of Non-Ferrous Metals	Gliwice, Poland	PCA accreditation AB274
London & Scandinavian Met Co	Rotherham, England	
Coleshill Laboratories Ltd	Birmingham, England	
Nyrstar Hobart Pty Ltd	Hobart, Tas, Australia	
Sun Metals Corp	Townsville, Qld, Australia	
Votorantim Metais	Lima, Peru	

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	
Lead	1-3, 5-7, 10-12	4, 8, 9, 13, 14		
Magnesium	1, 2, 4-6, 8-11, 13, 15	3, 7, 12, 14		
Aluminium	1-4, 6, 9, 12-15	5, 7	11	volumetric (EDTA)
			8, 10	photometric (chrome azurol S)
Cadmium	1, 4, 5, 7-16	2, 3, 6-8		
Iron	1, 3, 5, 6, 9-15	4, 7, 8	2	photometric (orthophenanthroline)
Tin	2, 4-7, 9-13	1	3, 8	photometric (phenyl fluorone)
Copper	1, 3-5, 8-12, 15	2, 6, 7, 13, 14		
Nickel	1-6, 9-13	7, 14-16	8	ICP-MS
Manganese	1, 3-6, 11-16	7, 9, 10	2, 8	photometric (periodate)
Cobalt	1, 3-5, 7, 10-13	6, 8, 14	2	ICP-MS
			9	photometric (nitroso-R)
Bismuth	1, 3, 4, 7-10, 12-15	2, 5, 11	6	photometric (Brucine)
Antimony	1-4, 7-10, 12, 13	5, 6, 11		

Notes

This Certified Reference Material has been produced 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).

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. The above certification is therefore only applicable from the front face of the disc, to a depth of 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 August 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 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.