MBH ANALYTICAL LTD

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CERTIFICATE OF ANALYSIS

41X 4380Zn5 (batch C)

Certified Reference Material Information

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

Certified Analysis

Percentage element by weight

Element	Pb	Mg	Al	Cd	Fe	Sn	Cu
Value [1]	**0.140**	**0.00165**	**0.0215**	**0.0571**	**0.0120**	**0.0101**	**0.071**
Uncertainty [2]	0.005	0.00011	0.0013	0.0011	0.0011	0.0011	0.003

Element	Mn	Ti	Ni	Cr	Bi	Sb
Value [1]	**0.035**	**0.339**	**0.00147**	**0.0075**	**0.0308**	**0.0061**
Uncertainty [2]	0.002	0.013	0.00011	0.0003	0.0014	0.0006

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 18th August 2004

MBH ANALYTICAL LIMITED _____

C Eveleigh

Method of Preparation

This reference material was produced from commercial-purity zinc, pure elements and master alloys. 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 approximately 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 additional disc was checked for vertical uniformity using the same method.

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 meaned data for each surface, standard deviation values were derived for each element. These values were combined with the 95% half-width confidence intervals ($C_{(95\%)}$) obtained from the wet analysis programme, using the square-root of the summed squares, to derive the final uncertainty values.

The vertical uniformity check showed that this material is of satisfactory homogeneity for at least the first 15 mm of depth from the original chilled face.

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.

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 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	Pb	Mg	Al	Cd	Fe	Sn	Cu
1	0.132	0.0015	0.0180	0.0553	0.010	0.0076	0.0674
2	0.133	0.0015	0.0192	0.0558	0.0107	0.0088	0.0684
3	0.135	0.00152	0.0202	0.056	0.0112	0.009	0.0691
4	0.136	0.00159	0.0210	0.0566	0.0116	0.0091	0.0691
5	0.139	0.0016	0.0210	0.0567	0.0119	0.0100	0.0700
6	0.139	0.0017	0.021	0.0567	0.0120	0.0105	0.0703
7	0.140	0.0018	0.0221	0.0569	0.0121	0.0107	0.0706
8	0.140	0.0018	0.0222	0.0575	0.0121	0.0111	0.0720
9	0.141	0.00185	0.0230	0.0581	0.0124	0.0120	0.0736
10	0.145		0.024	0.0592	0.0128	0.0122	0.0738
11	0.147		0.0247	0.0595	0.0132		0.074
12	0.149				0.0139		0.0744
Mean	**0.140**	**0.00165**	**0.0215**	**0.0571**	**0.0120**	**0.0101**	**0.0711**
Std Dev	0.005	0.00014	0.0020	0.0013	0.0011	0.0015	0.0024
$C_{(95\%)}$	0.003	0.00011	0.0013	0.0009	0.0007	0.0011	0.0015

Sample	Mn	Ti	Ni	Cr	Bi	Sb
1	0.0339	0.32	0.00134	0.00721	0.029	0.0053
2	0.0340	0.330	0.0014	0.00726	0.0296	0.0055
3	0.034	0.330	0.0014	0.0073	0.0297	0.0056
4	0.0342	0.332	0.0014	0.0073	0.0300	0.0057
5	0.0345	0.334	0.00144	0.0073	0.0304	0.00601
6	0.0350	0.338	0.00149	0.0074	0.0304	0.0067
7	0.0352	0.338	0.00150	0.0076	0.0312	0.00696
8	0.0355	0.342	0.0016	0.0077	0.0315	0.0071
9	0.0357	0.346	0.0017	0.0077	0.0318	
10	0.0360	0.348		0.00788	0.0322	
11	0.0364	0.348			0.0325	
12	0.0379	0.361				
Mean	**0.0352**	**0.339**	**0.00147**	**0.00747**	**0.0308**	**0.00611**
Std Dev	0.0012	0.011	0.00011	0.00023	0.0012	0.00071
$C_{(95\%)}$	0.0008	0.007	0.00009	0.00017	0.0008	0.00059

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
Laboratory Testing Inc	Hatfield, PA, USA	A2LA accreditation 0117
Universal Scientific Laboratory Pty Ltd	Milperra, NSW, Australia	NATA accreditation 492
Central Iron & Steel Research Inst	Beijing, China	CNAL accreditation 0435
Luo Yang Copper	Luo Yang, He Nan, China	CNAL accreditation 0173
Institute of Iron & Steel Technology	Shanghai, China	CNAL accreditation 0783
RWTUV Laboratory	Brno, Czech Republic	CIA accreditation 1060
Maristas-Azterlan S.L.	Saibigain, Durango, Spain	ENAC accreditation 0059
Institute of Non-Ferrous Metals	Gliwice, Poland	PCA accreditation AB274
Spectroscopic Solutions Ltd	Johannesburg, South Africa	
Advanced Analytical Centre, Cook University	Townsville, Qld, Australia	
Coleshill Laboratories Ltd	Coleshill, England	

Note: to achieve National Accreditation (eg UKAS, NATA, A2LA, CNAL, CIA, ENAC, PCA), test houses must demonstrate conformity to the general requirements of EN ISO/IEC 17025 and ISO9002.

Analytical Methods Used

ELEMENT	RESULT No. & METHOD				
	ICP-AES	ICP-MS	FAAS	OTHER	
Lead	1, 2, 4, 6-8, 10-12	9	3, 5		
Magnesium	1, 2, 4, 5, 6, 8, 9	3	7		
Aluminium	1-3, 6-9	11	4, 5	10	photometric (chrome azurol-S)
Cadmium	1, 2, 4, 6, 8, 9, 11	10	3, 5, 7		
Iron	2-8, 11	12	9, 10	1	photometric (orthophenanthroline)
Tin	1, 2, 6-8, 10	9	3	4, 5	photometric (phenyl fluorone)
Copper	1, 3-8, 10	-	2, 9, 11, 12		
Manganese	1, 3, 5-7, 10, 12	8	4, 11	2, 9	photometric (periodate)
Titanium	3, 5-8, 10, 12	11	2, 4	1	photometric (peroxide)
				9	photometric (di antipyryl methane)
Nickel	1, 4, 6-9	5	2, 3		
Chromium	1, 4, 5, 7-9	10	2, 3, 6		
Bismuth	2-7, 10	9	8, 11	1	photometric (iodide)
Antimony	1, 4-8	-	2, 3		

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, ASTM E1831 and the ISO Guide to the Expression of Uncertainty in Measurement (GUM).

The combination of alloying elements used in a complex material of this type, coupled with the unidirectional solidification effects associated with semi-chill casting, may lead 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. 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 July 2024, 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.