MBH ANALYTICAL LTD

HOLLAND HOUSE • QUEENS ROAD • BARNET • EN5 4DJ • ENGLAND • TEL: +44 (0)20 8441 2024 • FAX: +44 (0)20 8449 0810

email: info@mbh.co.uk web: www.mbh.co.uk

CERTIFICATE OF ANALYSIS

41X GLV13 (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	Al	Cd	Fe	Sn	Cu	Ag
Value [1]	**0.0029**	**0.219**	**0.0011**	**0.0052**	**0.0010**	**0.0049**	**0.0011**
Uncertainty [2]	0.0002	0.003	0.0001	0.0002	0.0002	0.0002	0.0001

Element	Ni	Mn	Co	Bi	Sb	Mg
Value [1]	**0.0028**	**0.0008**	**0.0011**	**0.0009**	**<0.001**	**0.0012**
Uncertainty [2]	0.0002	0.0001	0.0001	0.0001	-	0.0001

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 24th June 2019

MBH ANALYTICAL LIMITED _____

C Eveleigh

Method of Preparation

This reference material was produced from commercial-purity zinc, with the major alloys and traces added as pure elements or master alloys. 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 lower surface 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 batch, were selected for non-destructive homogeneity testing.

Homogeneity

Samples representative of the batch were checked for uniformity using an optical emission spectrometer. Multiple determinations were taken from each surface.

From these test data, through-batch variation values were derived for each element as an indicator of any minor compositional variation (as determined for the specific sample size and other limitations of 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, 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 compositional variation of the batch for each element has been quantified by a programme of non-destructive application testing, described 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.

Of the individual results herein, some have traceability (to the mole) via primary analytical methods. Some are traceable to substances of known stoichiometry. Most have traceability via commercial solutions. Furthermore, some results have additional 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	Al	Cd	Fe	Sn	Cu	Ag
1	0.00240	0.2117	0.00100	0.0048	0.00060	0.0044	0.00080
2	0.00247	0.2141	0.00100	0.0048	0.00060	0.0046	0.00090
3	0.00250	0.2160	0.00103	0.0049	0.00077	0.0046	0.00100
4	0.00266	0.2162	0.00103	0.0050	0.00077	0.0048	0.00107
5	0.00280	0.2176	0.00108	0.0050	0.00080	0.0048	0.00110
6	0.00290	0.2178	0.00110	0.0051	0.00090	0.0048	0.00118
7	0.00310	0.2179	0.00110	0.0054	0.00100	0.0048	0.00120
8	0.00310	0.2186	0.00110	0.0055	0.00103	0.0048	0.00120
9	0.00313	0.2200	0.00110	0.0055	0.00110	0.0049	0.00120
10	0.00320	0.2210	0.00113	0.0057	0.00120	0.0050	0.00123
11	0.00340	0.2230	0.00113	0.0059	0.00130	0.0050	0.00128
12		0.2237	0.00116		0.00144	0.0051	0.00130
13		0.2260	0.00116			0.0053	0.00130
14		0.2287	0.00120			0.0054	0.00131
15			0.00120				
16			0.00120				
Mean	**0.00288**	**0.2194**	**0.00111**	**0.0052**	**0.00096**	**0.0049**	**0.00114**
Std Dev	0.00033	0.0047	0.00007	0.0004	0.00027	0.0003	0.00016
$C_{(95\%)}$	0.00022	0.0027	0.00004	0.0002	0.00017	0.0002	0.00009

Sample	Ni	Mn	Co	Bi	Sb	Mg
1	0.00230	0.00060	0.00080	0.00070	0.00020	0.00100
2	0.00240	0.00060	0.00090	0.00073	0.00040	0.00108
3	0.00257	0.00070	0.00100	0.00078	0.00050	0.00110
4	0.00260	0.00070	0.00100	0.00080	0.00075	0.00110
5	0.00263	0.00072	0.00100	0.00080	0.00076	0.00110
6	0.00270	0.00073	0.00105	0.00089	0.00090	0.00115
7	0.00276	0.00073	0.00106	0.00090	0.00099	0.00120
8	0.00278	0.00076	0.00109	0.00100	<0.001	0.00128
9	0.00280	0.00080	0.00110	0.00100	<0.001	0.00129
10	0.00280	0.00080	0.00110	0.00101	<0.001	0.00130
11	0.00281	0.00080	0.00110	0.00115		0.00130
12	0.00300	0.00090	0.00118	0.00130		0.00130
13	0.00303	0.00090	0.00120			0.00133
14	0.00310	0.00100	0.00120			0.00150
15	0.00330	0.00103	0.00132			0.00153
16			0.00140			
Mean	**0.00277**	**0.00078**	**0.00109**	**0.00092**	**0.00064**	**0.00124**
Std Dev	0.00026	0.00013	0.00015	0.00018	0.00028	0.00015
$C_{(95\%)}$	0.00014	0.00007	0.00008	0.00011	0.00026	0.00008

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.