

CERTIFICATE OF ANALYSIS

41X 4380Zn7 (batch D)

Certified Reference Material Information

Type: ZINC WITH IMPURITIES (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	1.18	0.0029	0.277	0.0156	0.0018	0.0036
Uncertainty ²	0.02	0.0001	0.007	0.0005	0.0002	0.0003

Element	Cu	Mn	Ni	Ti	Sb
Value ¹	0.0133	0.0036	0.0120	0.0065	0.086
Uncertainty ²	0.0003	0.0003	0.0005	0.0003	0.003

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:

MBH ANALYTICAL LIMITED _____

on 29th July 2011

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 a modified version of the nominal composition indicated for UNS Z19001. 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	1.150	0.0026	0.2564	0.0145	0.0015	0.0028
2	1.154	0.0026	0.2630	0.0146	0.0016	0.0029
3	1.160	0.0027	0.2650	0.0150	0.0016	0.0030
4	1.161	0.0028	0.2694	0.0154	0.0018	0.0032
5	1.168	0.0028	0.2709	0.0155	0.0018	0.0033
6	1.176	0.0029	0.2720	0.0156	0.0018	0.0033
7	1.180	0.0029	0.2794	0.0157	0.0018	0.0036
8	1.190	0.0030	0.2807	0.0158	0.0019	0.0038
9	1.190	0.0031	0.2820	0.0158	0.0021	0.0038
10	1.192	0.0031	0.2884	0.0160	0.0025	0.0039
11	1.198	0.0031	0.2897	0.0161		0.0040
12	1.199	0.0032	0.2900	0.0161		0.0041
13	1.206		0.2919	0.0162		0.0046
14	1.207			0.0163		0.0047
Mean	1.181	0.0029	0.2768	0.0156	0.0018	0.0036
Std Dev	0.019	0.0002	0.0116	0.0006	0.0003	0.0006
C_(95%)	0.011	0.0001	0.0070	0.0003	0.0002	0.0003

Sample	Cu	Mn	Ni	Ti	Sb
1	0.0126	0.0032	0.0108	0.0057	0.0829
2	0.0127	0.0032	0.0115	0.0061	0.0843
3	0.0128	0.0034	0.0115	0.0063	0.0849
4	0.0129	0.0034	0.0115	0.0063	0.0850
5	0.0130	0.0035	0.0116	0.0063	0.0856
6	0.0130	0.0037	0.0116	0.0064	0.0858
7	0.0135	0.0037	0.0118	0.0064	0.0860
8	0.0135	0.0037	0.0120	0.0065	0.0860
9	0.0136	0.0038	0.0122	0.0067	0.0874
10	0.0138	0.0038	0.0123	0.0069	0.0878
11	0.0138	0.0039	0.0124	0.0069	0.0881
12	0.0140	0.0040	0.0125	0.0071	0.0901
13	0.0143		0.0126		
14			0.0131		
Mean	0.0133	0.0036	0.0120	0.0065	0.0862
Std Dev	0.0005	0.0003	0.0006	0.0004	0.0019
C_(95%)	0.0003	0.0002	0.0003	0.0002	0.0012

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
 Universal Scientific Laboratory Pty Ltd
 Laboratory Testing, Inc
 Genitest, Inc
 Luo Yang Copper
 Institute of Iron & Steel Technology
 South-West Aluminium Group
 TCR Engineering Services Ltd
 Sargam Metals Pvt Ltd
 Raghavendra SpectroMet Laboratory
 Institute of Non-Ferrous Metals
 London & Scandinavian Met Co
 Coleshill Laboratories Ltd
 Sun Metals Corp

Middlesbrough, England
 Milperra, NSW, Australia
 Hatfield, PA, USA
 Montreal, Canada
 Luo Yang, He Nan, China
 Shanghai, China
 Jiulong Puo, Sichuan, China
 Mumbai, India
 Chennai, India
 Bangalore, India
 Gliwice, Poland
 Rotherham, England
 Birmingham, England
 Townsville, Qld, Australia

UKAS accreditation 0239
 NATA accreditation 492
 A2LA accreditation 0117
 PRI accreditation 123077
 CNAL accreditation 0173
 CNAL accreditation 0783
 CNAL accreditation T007
 NABL accreditation 0367
 NABL accreditation 0025
 NABL accreditation T371
 PCA accreditation AB274

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, 2, 4-7, 11, 13, 14	3, 8-10, 12	
Magnesium	3, 4, 6, 7, 9-11	1, 2, 5, 8, 12	
Aluminium	1, 4, 5, 8-10, 12, 13	6, 7, 11	2 volumetric (EDTA) 3 photometric (chrome azurol S)
Cadmium	1, 2, 4, 5, 7, 9-11, 13, 14	3, 6, 8, 12	
Iron	2, 3, 6-10	1, 4, 5	
Tin	1, 3-5, 9, 10, 13, 14	2, 8, 11, 12	6, 7 photometric (phenylfluorone)
Copper	1, 2, 5, 6, 10-13	3, 4, 7-9	
Manganese	1-4, 7, 8, 10-12	9	5, 6 photometric (periodate)
Nickel	1-4, 7, 10, 12-14	5, 6, 8, 9, 11	
Titanium	1, 3-6, 9-12	7, 8	2 photometric (peroxide)
Antimony	1, 4, 5, 7, 8, 10-12	2, 6, 9	3 photometric (iodide)

Notes

This Certified Reference Material has been produced and certified (wherever possible) 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 ~14mm. Material to the rear of the disc, to a depth of ~6mm, 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 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.