

CERTIFICATE OF ANALYSIS

91X S40P (batch D)

Certified Reference Material Information

Type: LEAD-TIN SOLDER BINARY (CAST)

Form and Size: Disc 40mm diameter x 15mm thick

Manufactured by: Universal Scientific Laboratory Pty Ltd

Certified and Supplied by: MBH Analytical Ltd

Certified Analysis

Percentage element by weight

Element	Sn	Sb	Bi	Cu	As	Ag
Value ¹	40.00	(0.002)	(0.005)	(0.001)	(0.007)	(0.001)
Uncertainty ²	0.16	-	-	-	-	-

Element	Fe	Zn	Cd	Ni	Al	In
Value ¹	(0.001)	(<0.0001)	(<0.0001)	(<0.001)	(<0.0005)	(0.002)
Uncertainty ²	-	-	-	-	-	-

Note: information in parentheses is not certified - it is 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:

MBH ANALYTICAL LIMITED _____

on 5th January 2007

C Eveleigh

Method of Preparation

This reference material was produced from commercial high-purity lead and tin. 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 various positions throughout the casting process. At least 10% of all discs were selected for non-destructive homogeneity testing.

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.

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).

The vertical uniformity check showed that this material is of satisfactory homogeneity for the first 10 mm of depth from the original chilled face.

Chemical Analysis

Analysis was carried out on turnings taken from samples representative of the product. It was performed by participating laboratories mostly operating within the terms of EN ISO/IEC 17025 - 2000, using documented standard methods of analysis.

The individual values listed overpage are the average of each analyst's results.

Estimation of Uncertainty

The tin value certified has been analysed by several laboratories, and a 95% half-width confidence interval ($C_{(95\%)}$) for the resultant mean value has been derived by the method shown on page 3.

As a separate exercise, the degree of non-homogeneity of the batch has been quantified by a programme of non-destructive application testing, discussed above.

The final certified uncertainty 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 to method of use: Solders are generally prepared by machining on a lathe. However, users are recommended 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.

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

<u>Percentage element by weight</u>						
Sample	Sn	Sb	Bi	Cu	As	Ag
1	39.80	0.0021	0.0055	0.0014	0.0071	0.0006
2	39.85					
3	39.90					
4	39.95					
5	40.01					
6	40.07					
7	40.18					
8	40.23					
Mean	40.00	(0.0021)	(0.0055)	(0.0014)	(0.0071)	(0.0006)
Std Dev	0.15	-	-	-	-	-
C_(95%)	0.13	-	-	-	-	-

Sample	Fe	Zn	Cd	Ni	Al	In
1	0.0010	<0.0001	<0.0001	0.0005	<0.0005	0.0016
Mean	(0.0010)	(<0.0001)	(<0.0001)	(0.0005)	(<0.0005)	(0.0016)
Std Dev	-	-	-	-	-	-
C_(95%)	-	-	-	-	-	-

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

Universal Scientific Laboratory Pty Ltd	Milperra, NSW, Australia	NATA accreditation 0492
Laboratory Testing, Inc	Hatfield, PA, USA	A2LA accreditation 0117
Luo Yang Copper Co	Luo Yang, He Nan, China	CNAL accreditation 0173
Institute of Non-Ferrous Metals	Gliwice, Poland	PCA accreditation AB274
Sargam Metals Pvt Ltd	Chennai, India	NABL accreditation 0025
TCR Engineering Services Pvt Ltd	Mumbai, India	NABL accreditation 0367
Cookson Electronics, Fry Technologies	Altoona, PA, USA	
De Bruyn Spectroscopic Solutions	Johannesburg, South Africa	

Note: to achieve National Accreditation (eg NATA, A2LA, CNAL, PCA, 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
Tin	5, 8	-	2-4, 6, 7 1 volumetric (iodate) gravimetric (nitric acid)
Antimony	-	1	
Bismuth	-	1	
Copper	-	1	
Arsenic	-	1	
Silver	-	1	
Iron	-	1	
Zinc	-	1	
Cadmium	-	1	
Nickel	-	1	
Aluminium	-	1	
Indium	-	1	

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

The unidirectional solidification effects associated with semi-chill 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 10mm. Material to the rear of the disc, to a depth of ~5mm, is not certified.

This material is liable to superficial corrosion, and there is some possibility of microstructural changes due to recrystallisation; however, it will otherwise 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 this certificate. This certification will therefore expire in January 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.