

CERTIFICATE OF ANALYSIS

73X SC3 (batch A)

Certified Reference Material Information

Type:	TIN WHITE METAL (CAST)
Form and Size:	Disc 40mm Diameter x 15mm Thickness
Manufactured by:	MBH Analytical Limited
Certified and Supplied by:	MBH Analytical Limited

Certified Analysis

Percentage element by weight

Element	Sb	As	Bi	Pb	Cu	Fe	Ni
Value ¹	4.60	0.029	0.020	0.040	0.222	0.017	0.0136
Uncertainty ²	0.09	0.005	0.003	0.002	0.010	0.002	0.0014

Element	Al	Cd	Zn	In	Ag	Co	S
Value ¹	0.001	0.024	0.001(4)	0.031	0.013	0.006	(0.002)
Uncertainty ²	0.0005	0.004	0.0005	0.003	0.003	0.001	-

Note: values given in parentheses are not certified - they are provided for information only.

Definitions

- ¹ The certified values are derived from the results of an interlaboratory testing programme, detailed on page 3.
- ² The uncertainty values are generated from the 95% confidence interval derived from the analysis results (page 3). When appropriate, these values have been modified to account for additional information from the material homogeneity checks.

Certified by:

MBH ANALYTICAL LIMITED _____

on 30th October 2000

Method of Preparation

This reference material was produced from commercial-purity tin, with the major and trace elements added as single elements or as binary alloys. The melt was cast by sequential transfer of aliquots into steel chill moulds. 2mm has been removed from the cast face to minimise any surface effects.

Sampling

Discs taken from throughout the casting process were used to monitor homogeneity within the cast. Chemical analyses were carried out on turnings taken from the working faces of several discs.

Homogeneity

Samples representative of the batch were checked for uniformity using an optical emission spectrometer.

Multiple measurements were taken from each surface under test.

The mean value of the material was then calculated from the multiple measurement averages.

For each of the surfaces checked, the differences between the averaged result and the overall mean value were evaluated to ensure that the homogeneity of the material satisfied the acceptance criteria defined in ISO guide 30 - 1992, and fell within 95% probability limits.

Chemical Analysis

Analysis was carried out on millings 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 usually the average of each analyst's results.

Usage

Intended use: With optical emission and X-ray fluorescence spectrometers.

Recommended method of use: Tin alloys are generally prepared by machining on a lathe. However, users are recommended to follow the calibration and sample preparation methods specified by the relevant instrument manufacturer.

Preparation should be the same for reference materials and the samples for test.

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	Sb	As	Bi	Pb	Cu	Fe	Ni
1	4.50	0.022	0.016	0.037	0.21	0.014	0.011
2	4.56	0.026	0.019	0.037	0.21	0.015	0.013
3	4.56	0.0288	0.0192	0.0384	0.219	0.0176	0.013
4	4.57	0.029	0.020	0.039	0.22	0.018	0.0134
5	4.58	0.03	0.020	0.042	0.228	0.0181	0.0138
6	4.61	0.030	0.0227	0.042	0.228	0.0185	0.014
7	4.67	0.038	0.023	0.042	0.23	0.019	0.0145
8	4.72				0.234		0.0160
Mean	4.60	0.029	0.020	0.040	0.222	0.0172	0.0136
Std Dev	0.07	0.005	0.002	0.002	0.009	0.0019	0.0014
C_(95%)	0.06	0.004	0.002	0.002	0.008	0.0018	0.0012

Sample	Al	Cd	Zn	In	Ag	Co	S
1	0.001	0.021	0.001	0.028	0.009	0.004	0.001
2	0.001	0.0214	0.001	0.028	0.0117	0.005	0.002
3	0.001	0.022	0.0011	0.03	0.0124	0.006	0.0021
4	0.0013	0.023	0.0013	0.0301	0.014	0.0063	
5	0.0015	0.024	0.0016	0.0321	0.014	0.0063	
6	<0.005	0.027	0.002	0.0353	0.0151	0.0064	
7		0.0292	0.002				
Mean	0.0012	0.024	0.0014	0.031	0.013	0.0057	(0.002)
Std Dev	0.0002	0.003	0.0004	0.003	0.002	0.0010	-
C_(95%)	0.0003	0.003	0.0004	0.003	0.002	0.0010	-

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

RoTech Laboratories Ltd	Wednesbury, England	UKAS approval 0366
Sheffield Assay Office	Sheffield, England	UKAS approval 0012
University Metals Advisory Centre	Sheffield, England	UKAS approval 0411
Metals Technology Testing	Sheffield, England	UKAS approval 0963
Universal Scientific Laboratory Pty Ltd	Milperra, NSW, Australia	NATA approval 492
Laboratory Testing Inc	Hatfield, Pa, USA	A2LA approval 0117
Central Iron and Steel Res Inst	Beijing, China	National reg. E0584
Shiva Analyticals Ltd	Bangalore, India	

Analytical Methods Used

Antimony:	FAAS	ICP	volumetric (bromate)	
Arsenic:	FAAS	ICP	photometric (molybdate)	
Bismuth:	FAAS	ICP		
Lead:	FAAS	ICP		
Copper:	FAAS	ICP	photometric (diethyl dithiocarbamate)	electrogravimetric
Iron:	FAAS	ICP		
Nickel:	FAAS	ICP	photometric (dimethyl glyoxime)	
Aluminium:	FAAS	ICP	GFAAS	
Cadmium:	FAAS	ICP		
Zinc:	FAAS	ICP		
Indium:	FAAS	ICP		
Silver:	FAAS	ICP		
Cobalt:	FAAS	ICP		
Sulfur:			combustion (infra-red detection)	

Notes

This Certified Reference Material has been produced in accordance with the requirements of ISO Guide 34-2000, ISO Guide 31-2000, ISO Guide 35-1989, and ASTM Guides E1724 and E1831.

To achieve UKAS (UK Accreditation Scheme) approval, test houses must demonstrate conformity to the general requirements of EN ISO/IEC 17025 and ISO9002.

The combination of alloying elements used in a complex cast material of this type may produce a structure which exhibits micro-porosity on the rear (engraved) surface of the disc. In addition, 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 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; however, it will otherwise remain stable provided adequate precautions are taken to protect it from cross-contamination, extremes of temperature and atmospheric moisture.

The material to which this certificate of analysis refers is supplied subject to our general conditions of sale.