MBH ANALYTICAL LTD

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CERTIFICATE OF ANALYSIS

83X PR7 (batch C)

Certified Reference Material Information

Type:	LEAD WITH IMPURITIES (CAST)
Form and Size:	Disc ~40mm diameter
Produced by:	Universal Scientific Laboratory Pty Ltd, Australia
Certified and supplied by:	MBH Analytical Ltd

Assigned Values

Percentage element by weight

Element	Sn	Sb	Bi	Cu	Cd	Ag
Value [1]	**0.218**	**0.789**	**0.497**	**0.148**	**0.450**	**0.287**
Uncertainty [2]	0.003	0.010	0.007	0.004	0.009	0.005

Element	As	Ni	Se	Te	In	Pt
Value [1]	**0.0503**	**0.0027**	**0.0069**	**0.0094**	**0.550**	**0.0047**
Uncertainty [2]	0.0011	0.0002	0.0007	0.0006	0.010	0.0007

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 9th July 2019

MBH ANALYTICAL LIMITED _____

C Eveleigh

Method of Preparation

This reference material was produced from commercial refined lead to UNS L50010; the trace elements were added as single elements or as binary alloys. The melt was cast by sequential transfer of aliquots into iron moulds. 2mm has been removed from the working face to minimise any surface effects.

Sampling

Samples for chemical analysis were taken from various positions throughout the casting process. Approximately 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.

Using the combined data for each surface, 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 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.

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:	Lead and its alloys are generally prepared by machining on a 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.
	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	Sn	Sb	Bi	Cu	Cd	Ag
1	0.2070	0.7661	0.4780	0.1412	0.4330	0.2740
2	0.2119	0.7664	0.4801	0.1430	0.4360	0.2742
3	0.2143	0.7690	0.4852	0.1440	0.4410	0.2742
4	0.2145	0.7750	0.4880	0.1453	0.4424	0.2780
5	0.2170	0.7820	0.4935	0.1455	0.4444	0.2800
6	0.2172	0.7838	0.4960	0.1461	0.4478	0.2820
7	0.2180	0.7884	0.4989	0.1468	0.4485	0.2863
8	0.2190	0.7892	0.5000	0.1471	0.4505	0.2885
9	0.2190	0.7971	0.5000	0.1475	0.4510	0.2899
10	0.2203	0.7987	0.5020	0.1488	0.4521	0.2900
11	0.2207	0.8003	0.5031	0.1491	0.4538	0.2924
12	0.2211	0.8100	0.5040	0.1510	0.4591	0.2940
13	0.2220	0.8127	0.5109	0.1541	0.4630	0.2946
14	0.2241	0.8180	0.5162	0.1578	0.4659	0.3008
15	0.2270				0.4680	0.3030
Mean	**0.2182**	**0.7894**	**0.4969**	**0.1477**	**0.4504**	**0.2868**
Std Dev	0.0050	0.0171	0.0110	0.0044	0.0104	0.0095
$C_{(95\%)}$	0.0027	0.0099	0.0063	0.0025	0.0057	0.0052

Sample	As	Ni	Se	Te	In	Pt
1	0.0470	0.00220	0.00540	0.00820	0.5253	0.00340
2	0.0478	0.00226	0.00550	0.00830	0.5345	0.00377
3	0.0486	0.00253	0.00578	0.00883	0.5350	0.00387
4	0.0487	0.00253	0.00620	0.00890	0.5380	0.00440
5	0.0494	0.00270	0.00670	0.00930	0.5420	0.00480
6	0.0499	0.00270	0.00673	0.00940	0.5441	0.00504
7	0.0501	0.00272	0.00680	0.00940	0.5475	0.00520
8	0.0502	0.00273	0.00710	0.00952	0.5520	0.00540
9	0.0502	0.00275	0.00725	0.00953	0.5537	0.00620
10	0.0518	0.00277	0.00726	0.01000	0.5620	
11	0.0522	0.00280	0.00760	0.01000	0.5700	
12	0.0522	0.00283	0.00780	0.01006	0.5763	
13	0.0524	0.00290	0.00820	0.01020		
14	0.0530	0.00330	0.00875			
Mean	**0.0503**	**0.00269**	**0.00693**	**0.00936**	**0.5496**	**0.00468**
Std Dev	0.0019	0.00027	0.00099	0.00065	0.0153	0.00090
$C_{(95\%)}$	0.0011	0.00015	0.00057	0.00039	0.0097	0.00069

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.