

# CERTIFICATE OF ANALYSIS

**517X LF1 (batch A)**

## Certified Reference Material Information

Type: ALUMINIUM / ZINC / INDIUM (CAST)  
Form and Size: Disc, 45mm diameter x 20mm thick  
Produced by: Sargam Metals Pvt Ltd, India  
Certified and Supplied by: MBH Analytical Ltd

## Assigned Values

### Percentage element by weight

Element	Cu	Mg	Si	Fe	Mn	Ni	Zn
Value <sup>1</sup>	0.0020	0.0097	0.248	0.101	0.0013	0.0010	3.71
Uncertainty <sup>2</sup>	0.0006	0.0006	0.007	0.006	0.0001	0.0002	0.05

Element	Pb	Sn	Ti	Cr	In	Ga	Cd
Value <sup>1</sup>	(0.002)	(0.005)	0.0396	(0.001)	0.0187	0.0164	<0.0005
Uncertainty <sup>2</sup>	-	-	0.0016	-	0.0011	0.0011	-

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

## Definitions

- <sup>1</sup> 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.
- <sup>2</sup> 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 22nd May 2008

C Eveleigh

## **Method of Preparation**

This reference material was produced from commercial-purity aluminium, with the main and trace elements added as master alloys or pure elements. The melt was degassed using sodium-free flux, and was cast into iron chill moulds. 2mm has been removed from the cast face to minimise any surface effects.

## **Sampling**

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

Using the combined data for 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 - 2000, 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**

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 method of use: Aluminium alloys are generally prepared by machining on a mill or 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	Cu	Mg	Si	Fe	Mn	Ni	Zn
1	0.0010	0.0088	0.238	0.094	0.0011	0.0007	3.582
2	0.0015	0.0092	0.239	0.0946	0.0012	0.0009	3.62
3	0.0016	0.0092	0.242	0.0950	0.0013	0.0010	3.665
4	0.0018	0.0095	0.243	0.101	0.0013	0.0010	3.690
5	0.0021	0.0095	0.245	0.1012	0.0014	0.0010	3.70
6	0.0026	0.0096	0.245	0.1016	0.0014	0.0010	3.70
7	0.0028	0.0100	0.248	0.1023	0.0014	0.0010	3.759
8	0.0029	0.0100	0.249	0.107	0.0015	0.0015	3.765
9		0.0101	0.252	0.110			3.773
10		0.0108	0.252				3.81
11			0.261				
12			0.267				
<b>Mean</b>	<b>0.0020</b>	<b>0.0097</b>	<b>0.248</b>	<b>0.101</b>	<b>0.0013</b>	<b>0.0010</b>	<b>3.706</b>
<b>Std Dev</b>	0.0007	0.0006	0.009	0.006	0.0001	0.0002	0.072
<b>C<sub>(95%)</sub></b>	0.0006	0.0004	0.005	0.004	0.0001	0.0002	0.051

Sample	Pb	Sn	Ti	Cr	In	Ga	Cd
1	0.0008	0.0040	0.0365	0.0003	0.0152	0.0143	0.0001
2	0.0011	0.0042	0.0367	0.0007	0.0172	0.0146	0.0002
3	0.0015	0.005	0.0375	0.0009	0.0180	0.0156	0.0003
4	0.0017	0.0050	0.0377	0.0010	0.0182	0.0163	0.0004
5	0.0018	0.0053	0.0383	0.0010	0.0182	0.0164	0.0004
6	0.0022	0.0055	0.0390	0.0011	0.0182	0.0168	<0.0005
7	0.0024		0.0392	0.0018	0.0185	0.0177	<0.0005
8			0.040		0.0185	0.018	<0.0005
9			0.0409		0.0200	0.0183	<0.001
10			0.0421		0.0202		
11			0.0425		0.0204		
12			0.045		0.0217		
<b>Mean</b>	<b>0.0016</b>	<b>0.0048</b>	<b>0.0396</b>	<b>0.0010</b>	<b>0.0187</b>	<b>0.0164</b>	<b>0.0003</b>
<b>Std Dev</b>	0.0006	0.0006	0.0026	0.0005	0.0017	0.0014	0.0001
<b>C<sub>(95%)</sub></b>	0.0005	0.0006	0.0016	0.0004	0.0011	0.0011	0.0002

Note: C<sub>(95%)</sub> 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

Bodycote Materials Testing Ltd	Middlesbrough, England	UKAS accreditation 0239
Sheffield Assay Office	Sheffield, England	UKAS accreditation 0012
Universal Scientific Laboratory Pty	Milperra, NSW, Australia	NATA accreditation 0492
Laboratory Testing Inc	Hatfield, PA, USA	A2LA accreditation 0117
Institute of Iron & Steel Technology	Shanghai, China	CNAL accreditation 0783
South-West Aluminium Group	Sichuan Province, China	CNAL accreditation T007
Luo Yang Copper	Luo Yang, He Nan, China	CNAL accreditation 0173
Sargam Metals Pvt Ltd	Chennai, India	NABL accreditation 0025
TCR Engineering Services Ltd	Mumbai, India	NABL accreditation 0367
Rotech Laboratories Ltd	Wednesbury, England	
London & Scandinavian Met. Co. Ltd	Rotherham, England	
De Bruyn Spectroscopic Solutions	Johannesburg, South Africa	

Note: to achieve National Accreditation (eg UKAS, A2LA, NATA, CNAL, NABL), test houses are required to demonstrate conformity to the general requirements of EN ISO/IEC 17025.

## Analytical Methods Used

ELEMENT	RESULT No. & METHOD			
	ICP-AES	ICP-MS	FAAS	OTHER
Copper	1, 3, 6-8	-	2, 4, 5	
Magnesium	1, 4, 6-10	-	2, 3, 5	
Silicon	1, 4, 8-11	-	-	2, 3, 6, 12 gravimetric (perchloric acid)
Iron	1, 2, 4, 6, 7, 9	-	3, 5	1, 5, 7 photometric (molybdenum yellow)
Manganese	2, 4-7	-	3, 8	8 photometric (orthophenanthroline)
Nickel	1, 2, 6-8	5	3, 4	1 photometric (periodate)
Zinc	3, 4, 6-10	-	1, 2, 5	
Lead	1, 2, 4-6	7	3	
Tin	1, 6	2	3, 4	5 photometric (phenylfluorone)
Titanium	1-5, 7, 8, 10	6	12	9, 11 photometric (di-antipyryl methane)
Chromium	1-5, 7	-	6	
Indium	1, 2, 4, 5, 7, 9-12	3	6	8 photometric
Gallium	1, 3, 4, 6-9	5	-	2 photometric (butyl rhodamine B)
Cadmium	2, 5-8	4	1, 3, 9	

## 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 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 for a depth of 12mm. Material to the rear of the disc, to a depth of 8mm, 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 May 2028, although we reserve the right to make changes as issue revisions, in the intervening period.

The preparation, 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.