

CERTIFICATE OF ANALYSIS

36X 274 (batch A)

Certified Reference Material Information

Type: COPPER / NICKEL / CHROMIUM
(WROUGHT)

Form and Size: Disc 46mm Diameter x 17mm Thickness

Produced by: Cerro Manganese Bronze Ltd

Certified and supplied by: MBH Analytical Limited

Certified Analysis

Percentage element by weight

Element	Sn	Pb	Zn	Fe	Ni	Al	Si	As
Value ¹	0.0140	0.0021	0.0395	0.0779	2.54	0.0013	0.594	0.0011
Uncertainty ²	0.0006	0.0003	0.0017	0.0015	0.02	0.0002	0.008	0.0002

Element	Mn	P	Cr	Co	Zr	S	C	Cu
Value ¹	0.0148	0.0011	0.531	0.0028	<0.005	0.0035	(0.0033)	96.23
Uncertainty ²	0.0003	0.0002	0.007	0.0003	-	0.0003	-	0.09

Note: values given in parentheses are not certified - they are 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 1st June 2004

C Eveleigh



Method of Preparation

This reference material was produced from commercial rolled bar, after solution treatment. The discs are derived from a single piece of bar, from one batch.

Sampling

Samples for chemical analysis, and discs for homogeneity checks, were taken at regular intervals from the bar. At least 10% of all discs were incorporated into the schedule for homogeneity checking.

Homogeneity

The discs were checked for lateral and batch uniformity using an optical emission spectrometer. Multiple measurements were taken from each surface under test.

For each of the surfaces checked, the differences between the averaged result and the overall mean value were evaluated to ensure that the overall homogeneity of the material comprising the batch satisfied the definition given in ISO guide 30 - 1992. There was minimal evidence of central segregation.

Using the individual data from each check, standard deviation values were derived for each element. These values were combined with the 95% half-width confidence intervals ($C_{(95\%)}$) obtained from the wet analysis programme, using the square-root of the summed squares, to derive the final uncertainty values.

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.

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: Copper 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 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	Sn	Pb	Zn	Fe	Ni	Al	Si	As
1	0.0128	0.0016	0.0364	0.0756	2.489	0.0009	0.58	0.0009
2	0.013	0.002	0.0377	0.076	2.506	0.0011	0.59	0.0009
3	0.0134	0.0020	0.039	0.077	2.52	0.0011	0.590	0.0010
4	0.0137	0.0021	0.0397	0.0770	2.53	0.0012	0.591	0.001
5	0.014	0.0022	0.0398	0.0772	2.53	0.0014	0.594	0.0011
6	0.014	0.0023	0.0400	0.0795	2.546	0.0015	0.598	0.0011
7	0.014	0.0025	0.040	0.0795	2.548	0.0015	0.605	0.0012
8	0.0147		0.043	0.0798	2.563	0.0017	0.607	0.0014
9	0.0151			0.0798	2.57			0.0014
10	0.0152				2.581			<0.005
Mean	0.0140	0.0021	0.0395	0.0779	2.539	0.0013	0.594	0.0011
Std Dev	0.0008	0.0003	0.0019	0.0017	0.028	0.0003	0.009	0.0002
C_(95%)	0.0006	0.0003	0.0016	0.0013	0.020	0.0002	0.007	0.0002

Sample	Mn	P	Cr	Co	Zr	S	C	Cu
1	0.0141	0.0008	0.52	0.0021	0.0000	0.0029	0.0025	96.01
2	0.0146	0.0008	0.524	0.0026	0.0001	0.0030	0.0029	96.19
3	0.0146	0.0010	0.530	0.0027	<0.0005	0.0033	0.003	96.20
4	0.0147	0.0010	0.53	0.0028	<0.0005	0.0034	0.0032	96.24
5	0.015	0.0010	0.531	0.0029	0.0017	0.0034	0.0037	96.28
6	0.0150	0.0013	0.535	0.0031	0.0018	0.0036	0.0045	96.30
7	0.015	0.0013	0.537	0.0031	0.0025	0.0037		96.3
8	0.0151	0.0013	0.543	0.0031	<0.005	0.0039		96.35
9		0.0013		0.0032		0.004		
10						0.0040		
Mean	0.0148	0.0011	0.531	0.0028	<0.005	0.0035	0.0033	96.23
Std Dev	0.0003	0.0002	0.007	0.0003	-	0.0004	0.0007	0.11
C_(95%)	0.0003	0.0002	0.006	0.0003	-	0.0003	0.0007	0.09

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

Zurich Certification
Bodycote Materials Testing Ltd
Sheffield Assay Office
Universal Scientific Laboratory Pty Ltd
Laboratory Testing Inc
Central Iron & Steel Research Inst
Luo Yang Copper
Institute of Iron & Steel Technology
RWTUV Laboratory
Genitest Inc
Spectroscopic Solutions Ltd
Coleshill Laboratories Ltd

West Bromwich, England
Middlesbrough, England
Sheffield, England
Milperra, NSW, Australia
Hatfield, PA, USA
Beijing, China
Luo Yang, He Nan, China
Shanghai, China
Brno, Czech Republic
Montreal, Canada
Johannesburg, South Africa
Coleshill, England

UKAS accreditation 0584
UKAS accreditation 0239
UKAS accreditation 0012
NATA accreditation 492
A2LA accreditation 0117
CNAL accreditation 0435
CNAL accreditation 0173
CNAL accreditation 0783
CIA accreditation 1060

Note: to achieve National Accreditation (eg UKAS, NATA, A2LA, CNAL, CIA), test houses must demonstrate conformity to the general requirements of EN ISO/IEC 17025 and ISO9002.

Analytical Methods Used

ELEMENT	RESULT No. & METHOD			
	ICP-AES	FAAS	OTHER	
Tin	1, 3, 4, 6-10	2	5	photometric (catechol violet)
Lead	1-3, 5-7	4		
Zinc	1-7	8		
Iron	1, 3-7, 9	2, 8		
Nickel	1, 2, 5-8, 10	3	4	photometric (dimethyl glyoxime)
			9	gravimetric (dimethyl glyoxime)
Aluminium	1-5, 7, 8	6		
Silicon	1, 3-7	-	2	photometric (molybdenum blue)
			8	gravimetric (perchloric acid)
Arsenic	2-10	1		
Manganese	1-8	-		
Phosphorus	2, 5-9	-	1, 3, 4	photometric (molybdenum yellow)
Chromium	1, 3-8	-	2	volumetric (ferrous sulphate)
Cobalt	2-9	1		
Zirconium	1-7	-		
Sulfur	1	-	2-10	combustion (infra-red or volumetric detection)
Carbon	-	-	1-6	combustion (infra-red or volumetric detection)
Copper	3, 7	-	6, 8	electrogravimetric
			1, 2, 4, 5	volumetric (thiosulfate)

Notes

This Certified Reference Material has been tested 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, ASTM E1831 and the ISO Guide to the Expression of Uncertainty in Measurement (GUM).

This certification is applicable to the whole of the disc.

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 this certificate. This certification will therefore expire in June 2024, 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.