

CERTIFICATE OF ANALYSIS

55X G26H1 (batch F)

Certified Reference Material Information

Type: ALUMINIUM/SILICON/COPPER (CAST)
Form and Size: Disc 40-50mm diameter x 15-20mm thick
Supplied by: MBH Analytical Limited
Produced by: Coleshill Laboratories Limited

Certified Analysis

Percentage element by weight

| Element | Cu | Mg | Si | Fe | Mn | Ni | Zn |
|---------|------|------|------|------|-------|-------|------|
| % | 4.34 | 0.29 | 7.69 | 1.78 | 0.015 | 0.012 | 1.14 |

| Element | Pb | Sn | Ti | Cr | Co | V | Bi |
|---------|------|---------|------|------|-------|-------|------|
| % | 0.24 | (0.008) | 0.21 | 0.20 | 0.022 | 0.012 | 0.07 |

Usage

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

Recommended method of use: Aluminium and aluminium 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 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.

Certified by:

MBH ANALYTICAL LIMITED _____

on 9th August 2000



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, and discs for homogeneity checks, were taken from several positions throughout the casting process

Homogeneity

Samples representative of the batch were checked for vertical 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 operating within the terms of ISO guide 25 - 1990, using documented standard methods of analysis.

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

Confidence Limits

These are the upper and lower values between which the actual measurements will fall, with the stated probabilities, assuming a Gaussian distribution.

68.3% of the results will fall within ± 1 x Standard Deviation of the mean.

95.4% of the results will fall within ± 2 x Standard Deviation of the mean.

99.7% of the results will fall within ± 3 x Standard Deviation of the mean.

Analytical Data

Percentage element by weight

| Sample | Cu | Mg | Si | Fe | Mn | Ni | Zn |
|----------------|--------------|--------------|-------------|--------------|--------------|--------------|--------------|
| 1 | 4.27 | 0.260 | 7.63 | 1.72 | 0.010 | 0.011 | 1.13 |
| 2 | 4.30 | 0.28 | 7.64 | 1.76 | 0.013 | 0.011 | 1.13 |
| 3 | 4.32 | 0.28 | 7.68 | 1.78 | 0.013 | 0.012 | 1.13 |
| 4 | 4.34 | 0.283 | 7.70 | 1.784 | 0.016 | 0.013 | 1.14 |
| 5 | 4.36 | 0.288 | 7.80 | 1.82 | 0.016 | 0.014 | 1.15 |
| 6 | 4.39 | 0.29 | | 1.84 | 0.017 | | 1.17 |
| 7 | 4.396 | 0.298 | | | 0.02 | | |
| 8 | | 0.31 | | | | | |
| Mean | 4.339 | 0.286 | 7.69 | 1.784 | 0.015 | 0.012 | 1.142 |
| Std Dev | 0.046 | 0.015 | 0.07 | 0.043 | 0.003 | 0.001 | 0.016 |

| Sample | Pb | Sn | Ti | Cr | Co | V | Bi |
|----------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 1 | 0.222 | 0.003 | 0.183 | 0.18 | 0.0209 | 0.010 | 0.06 |
| 2 | 0.23 | 0.005 | 0.20 | 0.182 | 0.021 | 0.010 | 0.061 |
| 3 | 0.24 | 0.0073 | 0.208 | 0.19 | 0.0220 | 0.0114 | 0.074 |
| 4 | 0.245 | 0.01 | 0.21 | 0.20 | 0.022 | 0.012 | 0.077 |
| 5 | 0.248 | 0.014 | 0.21 | 0.202 | 0.024 | 0.0125 | 0.08 |
| 6 | 0.25 | | 0.217 | 0.207 | 0.024 | 0.015 | |
| 7 | 0.25 | | 0.23 | 0.208 | | | |
| 8 | | | | 0.22 | | | |
| Mean | 0.241 | 0.008 | 0.208 | 0.199 | 0.022 | 0.012 | 0.070 |
| Std Dev | 0.011 | 0.004 | 0.014 | 0.014 | 0.001 | 0.002 | 0.009 |

Participating Laboratories

| | | |
|------------------------------------|---------------------|---------------------|
| Coleshill Laboratories Ltd | Birmingham, England | NAMAS Approval 0121 |
| Birmingham Assay Office | Birmingham, England | NAMAS Approval 0667 |
| LGC | Runcorn, England | NAMAS approval 1214 |
| RoTech Laboratories | Wednesbury, England | NAMAS Approval 0366 |
| University Metals Advisory Centre | Sheffield, England | NAMAS Approval 0411 |
| Metals Technology Testing Ltd | Sheffield, England | NAMAS Approval 0963 |
| Laboratory Testing Inc | Hatfield, Pa, USA | A2LA approval 0117 |
| Central Iron & Steel Research Inst | Beijing, China | National Reg. E0584 |
| Scientifics Ltd | Derby, England | I* |

Analytical Methods Used

| | | | |
|------------|------|-----|------------------------------------|
| Copper: | FAAS | ICP | |
| Magnesium: | FAAS | ICP | volumetric (EDTA) |
| Silicon: | FAAS | ICP | gravimetric |
| Iron: | FAAS | ICP | photometric (orthophenanthroline) |
| Manganese: | FAAS | ICP | photometric (periodate) |
| Nickel: | FAAS | ICP | photometric (dimethyl glyoxime) |
| Zinc: | FAAS | ICP | photometric (dithizone extraction) |
| Lead: | FAAS | ICP | |
| Tin: | FAAS | ICP | |
| Titanium: | FAAS | ICP | photometric (diantipyryl methane) |
| Chromium: | FAAS | ICP | photometric (diphenyl carbazide) |
| Cobalt: | FAAS | ICP | |
| Vanadium: | FAAS | ICP | |
| Bismuth: | FAAS | ICP | |

Notes

This Certified Reference Material has been produced in accordance with the requirements of ISO Guide 34-2000, ISO Guide 31-1981, ISO Guide 35-1989, and ASTM Guides E1724 and E1831.

To achieve NAMAS (UK National Measurement Accreditation Scheme) approval, test houses must demonstrate conformity to the general requirements of BS EN 45001, ISO Guide 25 and ISO9002.

I* - an ISO9000-approved company.

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 to the front face of the disc. Material to the rear of the disc, to a depth of 5mm, is not certified.

Figures shown in brackets are not certified; they are provided for information only.

This material will 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.