



INSTITUTE OF NON-FERROUS METALS
Analytical Chemistry Department

CERTIFICATE OF ANALYSIS

Al.-Zn-Sn bronzes BO series

The average results of chemical analyses in wt %

| Element No. | BO 1 | BO 2 | BO 3 | BO 4 | BO 5 |
|-------------|-----------|-----------|----------|-----------|----------|
| Al | 3,16 | 4,03 | 4,67 | 6,15 | 7,02 |
| Zn | 7,10 | 6,26 | 5,07 | 4,28 | 3,08 |
| Sn | 2,54 | 1,83 | 1,17 | 0,704 | 0,117 |
| Cd | 0,00035 | 0,00182 | 0,00570 | 0,00881 | 0,0134 |
| Fe | 0,0158 | 0,00569 | 0,0752 | 0,137 | 0,218 |
| Ni | 0,00517 | 0,00204 | 0,0683 | 0,111 | 0,0355 |
| Pb | 0,00384 | (0,00214) | 0,0537 | 0,102 | 0,0299 |
| As | 0,00033 | 0,00199 | 0,00662 | 0,0115 | 0,0161 |
| Cr | 0,00327 | 0,00037 | 0,00548 | 0,00910 | 0,0145 |
| Mn | 0,0167 | 0,00102 | 0,00884 | 0,00612 | 0,0772 |
| P | (0,00040) | 0,00227 | 0,00550 | 0,0100 | 0,0155 |
| Sb | 0,00035 | 0,00226 | 0,00568 | 0,0104 | 0,0152 |
| Zr | (0,00014) | (0,00187) | (0,0106) | (0,00741) | (0,0204) |
| Bi | 0,00030 | 0,00197 | 0,00660 | 0,0107 | 0,0152 |
| Si | (0,00471) | 0,00979 | 0,0552 | 0,0951 | 0,0135 |
| Cu | The rest | The rest | The rest | The rest | The rest |

Gliwice 2009

Director of the Institute

Prof. Ph.D. Zbigniew Śmieszek

The uncertainty in wt % at the probability level of 0,05

| Element | No. | BO1 | BO2 | BO3 | BO4 | BO5 |
|---------|-----|----------|----------|---------|---------|---------|
| Al | | 0,13 | 0,19 | 0,085 | 0,076 | 0,15 |
| Zn | | 0,091 | 0,013 | 0,11 | 0,14 | 0,14 |
| Sn | | 0,098 | 0,059 | 0,11 | 0,028 | 0,0030 |
| Cd | | 0,000047 | 0,00024 | 0,00046 | 0,00043 | 0,0017 |
| Fe | | 0,0021 | 0,00025 | 0,00072 | 0,011 | 0,026 |
| Ni | | 0,00018 | 0,00035 | 0,00080 | 0,0041 | 0,0012 |
| Pb | | 0,00013 | - | 0,0029 | 0,0087 | 0,0015 |
| As | | 0,000067 | 0,00021 | 0,00044 | 0,0017 | 0,00079 |
| Cr | | 0,00013 | 0,000054 | 0,00054 | 0,00049 | 0,0014 |
| Mn | | 0,0024 | 0,00017 | 0,00024 | 0,00029 | 0,0032 |
| P | | - | 0,00022 | 0,00038 | 0,0013 | 0,0027 |
| Sb | | 0,000038 | 0,00025 | 0,00038 | 0,00056 | 0,00052 |
| Zr | | - | - | - | - | - |
| Bi | | 0,000009 | 0,000066 | 0,00029 | 0,0013 | 0,0016 |
| Si | | - | 0,00022 | 0,00066 | 0,0030 | 0,020 |

Analytical methods applied:

Al, Zn, Sn, Cd, Fe, Ni, Pb, As, Cr, Mn, Sb, Bi – AES - ICP, AAS,

P, Zr – AES - ICP, spectrophotometric,

Si – AES - ICP, gravimetric

The chemical analyses have been carried out in four laboratories from Poland, by various parallel methods. The Al., Zn, Sn bronze CRM were made by melting of all components in the coreless induction furnace and by casting into special cast iron moulds protecting elimination of segregation of the components during solidification. Homogeneity testing were made taking into account over 30% of the material produced. Investigation were carried out using atomic emission spectrometry method with low voltage spark. Homogeneity was estimated statistically with application of the test F. The set consists of 5 standard certified reference materials in form of discs 40 mm in diameter and ~25 mm height.

Application for:

- atomic emission spectrometry with low voltage argon spark,*
- XRF spectrometry.*

Certified Reference Materials BO series is stable in time

