



INSTITUTE OF NON-FERROUS METALS

Analytical Chemistry Department

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CERTIFICATE OF ANALYSIS

Naval brasses M 63, MC 62 - WK series - SRMs 1776 - 1780

(in co-operation with the National Institute of Standards and Technology NIST, USA)

The average results of chemical analyses in wt %

| Element No | WK 1 | WK 2 | WK 3 | WK 4 | WK 5 |
|------------|----------|----------|----------|----------|----------|
| Sn | 0,11 | 1,34 | 0,49 | 1,04 | 0,47 |
| Pb | 0,17 | 0,33 | 0,11 | 0,047 | 0,0063 |
| Fe | 0,28 | 0,16 | 0,065 | 0,085 | 0,0095 |
| Ni | 0,28 | 0,21 | 0,13 | 0,070 | 0,0052 |
| Sb | 0,024 | 0,018 | 0,012 | 0,006 | 0,0029 |
| Bi | 0,014 | 0,011 | 0,009 | 0,0052 | 0,0011 |
| P | 0,030 | 0,018 | 0,018 | 0,011 | 0,0056 |
| Mn | 0,12 | 0,086 | 0,044 | 0,020 | 0,0055 |
| Al | 0,11 | 0,078 | 0,044 | 0,013 | 0,0042 |
| Si | 0,30 | 0,23 | 0,15 | 0,08 | 0,0064 |
| Cu | 59,97 | 60,54 | 62,09 | 63,28 | 64,92 |
| Zn | the rest | the rest | the rest | the rest | the rest |

Director of the Institute

Prof. Ph.D. Zbigniew Smieszek

The confidence intervals in wt % at the probability level of 0,05
Std.dev.*

| No Element | WK 1 | WK 2 | WK 3 | WK 4 | WK 5 |
|------------------|----------------|----------------|----------------|----------------|----------------|
| Sn* std.dev. | 0,01 0,02 | 0,07 0,08 | 0,03 0,04 | 0,05 0,06 | 0,05 0,06 |
| Pb* std.dev. | 0,01 0,02 | 0,03 0,04 | 0,02 0,03 | 0,01 0,02 | 0,002 0,004 |
| Fe* std.dev. | 0,02 0,03 | 0,02 0,04 | 0,006 0,007 | 0,004 0,006 | 0,001 0,003 |
| Ni* std.dev. | 0,01 0,03 | 0,01 0,02 | 0,01 0,03 | 0,006 0,007 | 0,001 0,003 |
| Sb* std.dev. | 0,004 0,006 | 0,002 0,004 | 0,002 0,003 | 0,001 0,002 | 0,001 0,003 |
| Bi* std.dev. | 0,001 0,003 | 0,001 0,002 | 0,001 0,003 | 0,001 0,002 | 0,001 0,002 |
| P* std.dev. | 0,004 0,006 | 0,005 0,007 | 0,004 0,006 | 0,001 0,003 | 0,001 0,004 |
| Mn* std.dev. | 0,01 0,02 | 0,002 0,003 | 0,004 0,006 | 0,001 0,003 | 0,001 0,004 |
| Al.* std.dev. | 0,01 0,03 | 0,008 0,009 | 0,006 0,007 | 0,004 0,005 | 0,001 0,003 |
| Si* std.dev. | 0,02 0,03 | 0,03 0,04 | 0,02 0,03 | 0,01 0,02 | 0,001 0,003 |
| Cu* std.dev. | 0,20 0,30 | 0,16 0,22 | 0,25 0,29 | 0,07 0,09 | 0,15 0,25 |

Analytical methods applied:

Cu - electrolytic;

*Pb - AAS directly and after co-precipitation with Fe(OH)₃, OES,
XRFS;*

Sn - AAS, OES, XRFS;

Ni - AAS, OES, XRFS;

*Fel - AAS directly and after co-precipitation with La(OH)₃, OES,
XRFS;*

Si - gravimetric, spectrophotometric, OES and XRFS;

*Sb - AAS directly and after co-precipitation with Fe(OH)₃ at pH=4,
OES;*

Bi - AAS directly and after co-precipitation with $\text{Fe}(\text{OH})_3$ at $\text{pH}=4$;

Al - AAS, spectrophotometric after matrix separation electrolytically with the whirling mercury cathode, OES;

P - titrimetric, spectrophotometric, OES.

The chemical analyses have been carried out in five laboratories (ZHPMN "Hutmen" Wrocław; WM "Łabędy; HMN "Szopienice") including two laboratories of the Institute of Non-Ferrous Metals using minimal when possible three different methods.

Naval brasses SRMs were made by melting of all components in the coreless induction furnace and by casting into special cast iron moulds. Final product of SRMs has been obtained after extrusion in form of discs 40 mm in diameter and 25 mm in height.