

CERTIFICATE OF ANALYSIS

IMZ 158

REFERENCE MATERIAL HIGH ALLOY STEEL

Analysis listed as percent by weight [% m/m]

| | | | |
|----|-------|----|-------|
| C | 0.092 | Ni | 0.21 |
| Mn | 1.34 | Cu | 0.097 |
| Si | 2.24 | Mo | 0.025 |
| P | 0.015 | V | 0.078 |
| S | 0.007 | Ti | 0.12 |
| Cr | 25.51 | Al | 1.56 |

Certificate Number: IMZ158-260624

Certificate revision history on page 4

| Analysis | C | Mn | Si | P | S | Cr | Ni |
|-----------|--------------|-------------|-------------|--------------|--------------|--------------|-------------|
| 1 | 0.083 | 1.307 | 2.127 | 0.010 | 0.005 | 25.193 | 0.183 |
| 2 | 0.085 | 1.328 | 2.190 | 0.014 | 0.006 | 25.207 | 0.207 |
| 3 | 0.088 | 1.333 | 2.197 | 0.015 | 0.006 | 25.267 | 0.212 |
| 4 | 0.090 | 1.333 | 2.220 | 0.015 | 0.007 | 25.480 | 0.213 |
| 5 | 0.090 | 1.337 | 2.240 | 0.016 | 0.007 | 25.517 | 0.214 |
| 6 | 0.093 | 1.340 | 2.247 | 0.016 | 0.007 | 25.537 | 0.217 |
| 7 | 0.094 | 1.340 | 2.250 | 0.016 | 0.007 | 25.567 | 0.217 |
| 8 | 0.097 | 1.343 | 2.277 | 0.016 | 0.007 | 25.590 | 0.223 |
| 9 | 0.097 | 1.367 | 2.295 | 0.019 | 0.007 | 25.627 | 0.223 |
| 10 | 0.098 | 1.370 | 2.332 | | 0.008 | 25.670 | 0.227 |
| 11 | | | | | 0.008 | 25.740 | |
| 12 | | | | | 0.009 | 25.757 | |
| 13 | | | | | 0.009 | | |
| Average | 0.0915 | 1.3398 | 2.2375 | 0.0152 | 0.0072 | 25.5127 | 0.2136 |
| SD | 0.0051 | 0.0182 | 0.0582 | 0.0022 | 0.0011 | 0.1944 | 0.0123 |
| Certified | 0.092 | 1.34 | 2.24 | 0.015 | 0.007 | 25.51 | 0.21 |
| C(95%) | 0.0037 | 0.0130 | 0.0416 | 0.0017 | 0.0007 | 0.1235 | 0.0093 |

| Analysis | Cu | Mo | V | Al | Ti | Co | W |
|-----------|--------------|--------------|--------------|-------------|-------------|-------|-------|
| 1 | 0.091 | 0.020 | 0.069 | 1.517 | 0.093 | 0.030 | 0.020 |
| 2 | 0.096 | 0.020 | 0.070 | 1.537 | 0.106 | 0.022 | 0.022 |
| 3 | 0.097 | 0.020 | 0.071 | 1.567 | 0.111 | | |
| 4 | 0.097 | 0.022 | 0.074 | 1.587 | 0.116 | | |
| 5 | 0.097 | 0.024 | 0.077 | 1.603 | 0.118 | | |
| 6 | 0.097 | 0.027 | 0.084 | | 0.118 | | |
| 7 | 0.098 | 0.028 | 0.085 | | 0.123 | | |
| 8 | 0.108 | 0.030 | 0.094 | | 0.127 | | |
| 9 | | 0.036 | | | 0.127 | | |
| 10 | | | | | 0.134 | | |
| Average | 0.0975 | 0.0251 | 0.0781 | 1.5622 | 0.1173 | | |
| SD | 0.0047 | 0.0056 | 0.0087 | 0.0355 | 0.0118 | | |
| Certified | 0.097 | 0.025 | 0.078 | 1.56 | 0.12 | | |
| C(95%) | 0.0039 | 0.0043 | 0.0073 | 0.044 | 0.0085 | | |

$C(95\%) = (t \cdot SD) / \sqrt{n-1}$ - The half-width confidence interval, calculated for the 95 % confidence level, where t is the appropriate Student's t value, SD is the interlaboratory standard deviation and n is the number of acceptable mean values. For further information regarding the confidence interval for the certified value see ISO Guide 35:1989 section 4.

Certification Process: Both preparation of this Reference Material and certification process were prepared according to requirements of ISO Guide 31, ISO Guide 34 and ISO Guide 35. This Reference Material is in agreement with ISO Guide 30.

Chemical Analysis: Chemical analyses were carried out on chips prepared by milling of the certified portion of the bars and also for some solid samples. Single values in the above table are the means obtained by individual laboratories. The following methods were used for analysis:

C and S - high frequency infra-red absorption (HFIR);
Mn - flame AAS, AES spark, ICP-AES, photometric with potassium periodate, titrimetric arsenite-nitrite;
Si - ICP-AES, photometric as silicon-molybdenum blue, gravimetric;
P - photometric as molybdenum blue, photometric as phosphovanadomolybdate, titrimetric, ICP-AES;
Cr - flame AAS, ICP-AES, photometric with diphenylcarbazide, potentiometric, titrimetric;
Ni - flame AAS, ICP-AES, AES spark, photometric with dimethylglyoxime, potentiometric;
Cu - flame AAS, ICP-AES, AES spark, photometric with diethyldithiocarbamate;
Mo - flame AAS, ICP-AES, AES spark, photometric with ammonium thiocyanate;
V - flame AAS, ICP-AES, AES spark, photometric, potentiometric;
Ti - flame AAS, ICP-AES, AES spark, photometric;
Al - flame AAS, ICP-AES, AES spark, photometric with aluminon, photometric with eriochromocyanin R;
Co - ICP AES, AES spark;
W - photometric, ICP-AES.

The laboratories participating in the testing of this Reference Material were:

- Huta Baildon, Katowice
- Huta Częstochowa, Częstochowa
- Huta Katowice S.A., Dąbrowa Górnicza
- Huta Ostrowiec S.A., Ostrowiec Świętokrzyski
- Huta im. Tadeusza Sendzimira w Krakowie
- Huta Stalowa Wola - Zakład Hutniczy Sp. z o.o., Stalowa Wola
- Huta Małapanew – Ozimek
- Huta Zawiercie S.A. - Zawiercie
- Instytut Metalurgii Żelaza, Gliwice
- Nova hut Ostrava s.p., Ostrava, Ceska Republika
- Třinecké Železárny, a.s., Třinec, Ceska Republika
- VSŽ Labortest, spol. s r.o., Košice, Slovensko

Homogeneity: The homogeneity of this Reference Material was evaluated with the use of statistic parameters obtained during interlaboratory tests in 1996 and found acceptable. Optical emission spectrometry with spark excitation method was used.

Traceability: This Reference Material was tested with the use of optical emission spectrometry with spark excitation and was found compatible to the following CRMs: BCS SS460/1-468/1, BCS SS 69-72, MW13-37.

Production of melt: This material was produced by Huta Baildon, Katowice. The melt was made in an open induction furnace'

Available form: Discs: 40 mm in diameter and 40 mm thick; chips: bottles 100 g.

Intended use: This Reference Material is intended for use in optical emission and X-ray spectrometric methods (bulks sample) and also in classical wet methods, UV-Vis spectrometry, AAS, ICP-AES, C,S- and N- analyzers and other wet methods (chips). Caution: In optical emission spectrometry with spark excitation the central part of the surface of discs (approximately 5 mm) should be avoided because of possible segregation of the material.

Validity of certification: The certification of IMZ 158 is valid indefinitely provided this Reference Material is stored in dry place and in environment free from chemical or other aggressive vapours. Periodic recertification is not required. The certification is nullified if this Reference Material is damaged, contaminated or otherwise modified. Chips: if the contents of the bottle becomes changed (for example oxidized) or contaminated, the whole contents of bottle should be discarded.

Safety: This Reference Material and packing does not contain substances which can directly influence health.

Storage: This Reference Material should be stored in dry place and in environment free from chemical or other aggressive vapours.

Inquiries regarding this Reference Material should be directed to:
rm@git.lukasiewicz.gov.pl

Approved by
Director of the Institute

Prof. Dr. Hab. Eng. Adam Zieliński

Certificate issue date: 26 June 2024

Certificate revision history:

26 June 2024 (editorial changes)

21 January 2021 (change of information regarding validity of certification, editorial changes);

January 2003 (Original certificate date)