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CERTIFICATE OF ANALYSIS IMZ-112

SPECTROMETRIC REFERENCE MATERIAL OF LOW-ALLOY STEEL

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

C	0.195	Mo	0.043
Mn	0.43	V	0.045
Si	0.27	Ti	0.010
P	0.022	Nb	0.013
S	0.016	Al	0.034
Cr	0.034	Al _{sol.}	0.024
Ni	0.046	Sn	0.15
Cu	0.055	N	0.010

Certificate Number W14

See the following pages for more information

IMZ-112

Analysis	C	Mn	Si	P	S	Cr	Ni	Cu
1	0.187	0.413	0.233	0.0203	0.0160	0.0313	0.0413	0.0520
2	0.190	0.415	0.250	0.0203	0.0160	0.0330	0.0420	0.0527
3	0.191	0.427	0.257	0.0206	0.0163	0.0339	0.0443	0.0533
4	0.194	0.430	0.257	0.0207	0.0163	0.0340	0.0457	0.0543
5	0.194	0.432	0.263	0.0210	0.0164	0.0347	0.0457	0.0543
6	0.194	0.437	0.267	0.0213	0.0165	0.0347	0.0466	0.0547
7	0.195	0.437	0.270	0.0220	0.0166	0.0350	0.0473	0.0547
8	0.197	0.440	0.273	0.0230	0.0168	0.0356	0.0493	0.0556
9	0.197	0.447	0.278	0.0237	0.0169	0.0373	0.0493	0.0564
10	0.198	0.453	0.280	0.0256	0.0170		0.0500	0.0567
11	0.200		0.280					0.0577
12	0.202		0.280					
Average	0.1948	0.433	0.266	0.0218	0.0165	0.0344	0.0462	0.0547
Std. Dev.	0.0042	0.012	0.014	0.0017	0.0003	0.0017	0.0030	0.0017
Certified	0.195	0.43	0.27	0.022	0.016	0.034	0.046	0.055
C(95%)	0.0027	0.008	0.009	0.0012	0.0002	0.0013	0.0021	0.0012

Analysis	Mo	V	Ti	Nb	Al	Al _{sol.}	Sn	N
1	0.0398	0.0417	0.0087	0.0115	0.0310	0.0219	0.137	0.0097
2	0.0403	0.0420	0.0095	0.0120	0.0320	0.0234	0.138	0.0099
3	0.0417	0.0437	0.0096	0.0120	0.0327	0.0237	0.147	0.0099
4	0.0420	0.0447	0.0101	0.0133	0.0337	0.0243	0.147	0.0101
5	0.0430	0.0450	0.0102	0.0137	0.0340	0.0243	0.147	0.0103
6	0.0433	0.0457	0.0106	0.0140	0.0340	0.0246	0.148	0.0104
7	0.0438	0.0465	0.0111	0.0151	0.0350	0.0250	0.150	0.0107
8	0.0448	0.0467	0.0111		0.0352	0.0253	0.164	
9	0.0450	0.0468			0.0357	0.0263	0.170	
10	0.0457	0.0480			0.0374	0.0263		
11	0.0460							
12								
Average	0.0432	0.0451	0.0101	0.0131	0.0341	0.0245	0.150	0.0101
Std. Dev.	0.0021	0.0021	0.0008	0.0013	0.0019	0.0013	0.011	0.0003
Certified	0.043	0.045	0.010	0.013	0.034	0.024	0.15	0.010
C(95%)	0.0014	0.0015	0.0007	0.0012	0.0013	0.0010	0.008	0.0003

$C(95\%) = (t \cdot sd)/\sqrt{n - 1}$ - 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. Single values in the above table are the means obtained by individual laboratories. The following methods were used for analysis:

carbon and sulphur - high frequency infra-red absorption (HFIR);
manganese - flame AAS, ICP-AES, photometric with potassium periodate, titrimetric arsenite-nitrite;
silicon - ICP-AES, photometric as silicon-molybdenum blue, gravimetric;
phosphorus - photometric as molybdenum blue, photometric as phosphovanadomolybdate, titrimetric, ICP-AES;
chromium - flame AAS, ICP-AES, photometric with diphenylcarbazide, potentiometric, titrimetric;
nickel - flame AAS, ICP-AES, photometric with dimethylglyoxime, potentiometric;
copper - flame AAS, ICP-AES, photometric with diethyldithiocarbamate;
molybdenum - flame AAS, ICP-AES, photometric with ammonium thiocyanate;
vanadium - flame AAS, ICP-AES, potentiometric, photometric;
titanium - flame AAS, ICP-AES;
niobium - ICP-AES, photometric with PAR, photometric with sulphonchlorophenol S;
aluminium (total) - flame AAS, ICP-AES, photometric with aluminon, photometric with eriochromcyanin R;
aluminium (soluble) - flame AAS, ICP-AES, photometric with aluminon, photometric with eriochromcyanin R;
tin - flame and GF AAS, ICP-AES;
nitrogen - high temperature extraction

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

Huta Baildon, Katowice, Poland
Huta Częstochowa, Częstochowa, Poland
Huta Katowice S.A., Dąbrowa Górnica, Poland
Huta Łabędy, Gliwice, Poland
Huta Ostrowiec S.A., Ostrowiec Świętokrzyski, Poland
Huta im. Tadeusza Sendzimira, Kraków, Poland
Huta Stalowa Wola - Zakład Hutańczy Sp. z o.o., Stalowa Wola, Poland
Instytut Metalurgii Zelaza, Gliwice, Poland
Hilger Analytical Ltd, Margate, Great Britain.
Nova hut Ostrava s.p., Ostrava, Czech Republic.
Ströhlein West GmbH & Co., Kaarst, Germany.
Třinecke Zelezamy, a.s., Třinec, Czech Republic.
VSZ Labortest, spol. s r.o., Košice, Slovakia.

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: SS 431-435, SS 401-410, SS 50-60, SS 456-460, SS 421-424, CKD 162A-171A.

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

Available form: Discs 40 mm in diameter and 40 mm thick.

Intended use: This Reference Material is intended for use in optical emission and C-ray spectrometric methods.

Caution: In optical emission spectrometry with spark excitation the central part of the surface (approximately 5 mm) should be avoided because of possible segregation of the material.

Storage: This Reference Material should be stored in dry place and in environment free from chemical or other aggressive vapours. Proper storage of this Reference Material guarantees the stability of the chemical composition for more than 30 years.

Director of the Institute

Dr inż. Adam Schledler

Gliwice, January 2003