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CERTIFICATE OF CHEMICAL ANALYSIS No 06 – 20

STEEL for solid sample spectrometry, combustion and wet-way methods

SPL CM-5D (PT 28/1B)

CERTIFIED VALUES – Mass content in %wt.

Element	Value [%wt.]	Uncertainty [%wt.]
C	1.140	0.006
Mn	1.425	0.007
Si	0.521	0.007
P	0.0284	0.0011
S	0.0277	0.0007
Cu	0.157	0.002
Cr	2.455	0.018
Ni	0.451	0.006
Al	0.086	0.003
Mo	0.137	0.003
W	0.028	0.003

Element	Value [%wt.]	Uncertainty [%wt.]
V	0.113	0.002
Ti	0.040	0.001
Co	0.0237	0.0005
As	0.0243	0.0012
Sn	0.0200	0.0007
B	0.0021	0.0002
Nb	0.035	0.002
Pb	0.0134	0.0014
Zr	0.072	0.003
N	0.0168	0.0009

PARTICIPATING LABORATORIES:

ARCELORMITTAL Warszawa, Poland
BOSMAL, Poland
BRITISH STEEL, United Kingdom
COGNOR S.A. - Ferrostal Łabędy, Poland
COMTES FHT, Czech Republic
DUNAFERR Labor Nonprofit, Hungary
FERONA, Czech Republic
JSC Moldova Steel Works, Moldova
MS UTILITIES & SERVICES, Czech Republic
OCAS NV, Belgium
PRECHEZA, Czech Republic
SES Inspekt, Slovakia

SSAB EMEA AB, Sweden
SSAB Special Steels, Sweden
SUNNINGWELL INTERNATIONAL, Poland
ŠKODA AUTO, Czech Republic
U. S. STEEL Košice – Labortest, Slovakia
ÚJV Řež, Czech Republic
VÁLCOVNY TRUB Chomutov, Czech Republic
VOESTALPINE STAHL, Austria
VÚHŽ, Czech Republic
ZPS - SLÉVÁRNA, Czech Republic
ŽDAS, Czech Republic

CM-5D – ANALYTICAL DATA

Method	C	Method	Mn	Method	Si	Method	P	Method	S	Method	Cu	Method	Cr
AES	1,104							AES	0,0238				
AES	1,110							AES	0,0242	XRF-m.	0,098*	AES	2,014*
AES	1,118	AES	1,400					AES	0,0245	AES	0,140	ICP	2,272*
IR	1,120	AES	1,400	AES	0,456*			XRF-m.	0,0256	ICP	0,143	AES	2,308*
AES	1,121	AES	1,402	ICP	0,462*	ICP	0,0208		0,0260	AES	0,147	AES	2,333
IR	1,122	AES	1,402	ICP	0,486				0,0260	AES	0,149	AES	2,374
AES	1,123	AES	1,405	XRF	0,490	XRF	0,0239		0,0262	AES	0,153	ICP	2,393
AES	1,126	AES	1,410	AES	0,497	ICP	0,0252		0,0263	AES	0,154	XRF-m.	2,406
AES	1,127	AES	1,411	XRF	0,498	ICP	0,0264		0,0264	AES	0,154	AES	2,411
IR	1,132	AES	1,413	AES	0,504	AES	0,0271		0,0266	AES	0,154	AES	2,418
IR	1,134	AES	1,414	AES	0,507	AES	0,0272		0,0271	AES	0,155	AES	2,419
AES	1,134	AES	1,414	AES	0,508	AES	0,0273		0,0274	AES	0,155	AES	2,420
IR	1,136	AES	1,414	AES	0,511	AES	0,0274		0,0274	XRF	0,156	AES	2,421
AES	1,138	AES	1,416	AES	0,512	AES	0,0275		0,0275	IR	0,156	AES	2,427
IR	1,138	ICP	1,419	ICP	0,512	AES	0,0282		0,0275	AES	0,156	ICP	2,428
AES	1,139	AES	1,420	AES	0,515	AES	0,0282		0,0275	AES	0,156	AES	2,437
AES	1,140	XRF	1,421	AES	0,516	AES	0,0283		0,0278	ICP	0,156	AES	2,450
IR	1,140	AES	1,422	AES	0,520	AES	0,0285		0,0279	AES	0,157	AES	2,462
IR	1,142	AES	1,424	AES	0,521	AES	0,0287		0,0279	AES	0,157	XRF-m.	2,468
IR	1,142	AES	1,424	AES	0,522	AES	0,0289		0,0281	AES	0,158	XRF	2,469
IR	1,143	AES	1,425	AES	0,525	AES	0,0289		0,0284	AES	0,158	XRF	2,473
IR	1,144	XRF	1,428	AES	0,525	AES	0,0292		0,0284	AES	0,158	AES	2,473
AES	1,145	AES	1,428	AES	0,525	AES	0,0294		0,0284	AES	0,158	AES	2,482
AES	1,147	AES	1,430	AES	0,526	AES	0,0294		0,0288	AES	0,158	AES	2,483
IR	1,147	AES	1,430	AES	0,526	AES	0,0301		0,0288	XRF	0,159	AES	2,485
AES	1,149	AES	1,431	AES	0,526	AES	0,0303		0,0290	ICP	0,159	AES	2,496
AES	1,152	AES	1,433	AES	0,527	AES	0,0304		0,0292	AES	0,159	AES	2,498
AES	1,153	ICP	1,433	AES	0,533	AES	0,0307		0,0292	XRF-m.	0,159	AES	2,504
AES	1,155	AES	1,434	AES	0,540	AES	0,0312		0,0292	AES	0,160	AES	2,505
IR	1,157	XRF-m.	1,446	AES	0,542	AES	0,0322		0,0299	AES	0,161	AES	2,509
AES	1,176	XRF-m.	1,461	AES	0,545	AES	0,0324		0,0300	AES	0,165	AES	2,518
AES	1,179	ICP	1,463	AES	0,548	AES	0,0325		0,0304	AES	0,171	AES	2,518
AES	1,180	AES	1,463	XRF-m.	0,552	AES	0,0341		0,0330	AES	0,171	AES	2,523
AES	1,256*	AES	1,478	AES	0,558	AES							

	C	Mn	Si	P	S	Cu	Cr
Value	1,140	1,425	0,521	0,0284	0,0277	0,157	2,455
s _u	0,018	0,019	0,018	0,0029	0,0019	0,006	0,048
U	0,006	0,007	0,007	0,0011	0,0007	0,002	0,018

Method	Ni	Method	Al	Method	Mo	Method	W	Method	V	Method	Ti	Method	Co
AES	0,417			AES	0,120			ICP	0,099*				
AES	0,425			AES	0,123			ICP	0,105				
ICP	0,427	AES	0,070	AES	0,125			AES	0,106		XRF		0,0188*
AES	0,433	AES	0,073	ICP	0,125			ICP	0,107				0,0207
AES	0,433	ICP	0,079	AES	0,131			AES	0,108				0,0222
AES	0,439	XRF	0,080	AES	0,131			XRF-m.	0,108				0,0222
AES	0,439	AES	0,082	AES	0,132	AES	0,014	AES	0,109	XRF	0,031*	ICP	0,0224
XRF	0,441	AES	0,082	AES	0,132	AES	0,019	AES	0,109	AES	0,034	AES	0,0227
AES	0,444	AES	0,082	AES	0,133	AES	0,020	AES	0,111	AES	0,035	AES	0,0229
AES	0,445	AES	0,082	AES	0,133	AES	0,023	AES	0,112	AES	0,037	AES	0,0230
ICP	0,445	AES	0,082	AES	0,134	AES	0,023	XRF	0,112	ICP	0,038	AES	0,0232
XRF-m.	0,447	AES	0,083	XRF	0,135	AES	0,024	AES	0,113	XRF	0,038	ICP	0,0232
AES	0,447	AES	0,084	XRF-m.	0,135	AES	0,025	AES	0,113	AES	0,038	AES	0,0233
AES	0,447	AES	0,084	ICP	0,135	AES	0,025	AES	0,113	AES	0,038	AES	0,0234
AES	0,448	ICP	0,084	AES	0,138	AES	0,025	AES	0,113	AES	0,039	AES	0,0236
AES	0,450	AES	0,085	AES	0,138	AES	0,025	AES	0,113	AES	0,039	AES	0,0236
AES	0,452	AES	0,086	AES	0,139	AES	0,026	AES	0,113	ICP	0,040	AES	0,0236
AES	0,452	AES	0,086	AES	0,139	AES	0,026	AES	0,113	AES	0,040	AES	0,0239
AES	0,452	AES	0,086	AES	0,139	AES	0,027	AES	0,114	AES	0,040	AES	0,0240
AES	0,454	AES	0,087	XRF-m.	0,140	AES	0,027	AES	0,114	AES	0,040	AES	0,0240
AES	0,455	XRF	0,088	AES	0,140	AES	0,028	AES	0,115	AES	0,040	AES	0,0240
XRF	0,457	AES	0,088	AES	0,140	AES	0,029	AES	0,116	AES	0,040	AES	0,0242
AES	0,457	AES	0,089	AES	0,140	AES	0,029	AES	0,116	AES	0,041	ICP	0,0243
ICP	0,459	AES	0,091	AES	0,140	AES	0,029	AES	0,116	AES	0,041	AES	0,0243
AES	0,459	AES	0,091	AES	0,141	AES	0,030	AES	0,117	AES	0,041	AES	0,0244
AES	0,460	AES	0,091	AES	0,142	XRF	0,032	XRF	0,117	AES	0,041	AES	0,0246
XRF-m.	0,462	AES	0,092	AES	0,142	ICP	0,033	AES	0,117	AES	0,041	AES	0,0248
AES	0,463	AES	0,092	XRF	0,142	AES	0,035	XRF-m.	0,117	AES	0,041	AES	0,0250
AES	0,464	AES	0,092	ICP	0,144	AES	0,035	AES	0,118	AES	0,042	AES	0,0250
AES	0,470	AES	0,095	AES	0,145	AES	0,036	AES	0,118	AES	0,042	AES	0,0250
AES	0,487	AES	0,097	AES	0,146	AES	0,038	AES	0,119	AES	0,044	AES	0,0251
AES	0,488	XRF-m.	0,106	AES	0,149	ICP	0,042	AES	0,119	XRF-m.	0,063*	XRF	0,0256

	Ni	Al	Mo	W	V	Ti	Co
Value	0,451	0,086	0,137	0,028	0,113	0,040	0,0237
s _u	0,015	0,007	0,007	0,006	0,004	0,002	0,0011
U	0,006	0,003	0,003	0,003	0,002	0,001	0,0005

Method	As	Method	Sn	Method	B	Method	Nb	Method	Pb	Method	Zr	Method	N	
						AES	0,029						AES	0,0119*
		XRF-m.	0,0168			AES	0,032						AES	0,0128*
		AES	0,0174			XRF	0,032						TCM	0,0148
		XRF	0,0179			XRF	0,032						TCM	0,0150
		ICP	0,0181			AES	0,033	AES	0,0081				TCM	0,0150
XRF	0,0128*	ICP	0,0183			AES	0,033	AES	0,0086				TCM	0,0152
AES	0,0189	AES	0,0189			XRF-m.	0,033	AES	0,0092				TCM	0,0152
ICP	0,0200	AES	0,0193	ICP	0,0008*	XRF-m.	0,034	AES	0,0095				AES	0,0155
AES	0,0221	AES	0,0196	AES	0,0018	AES	0,034	AES	0,0100				TCM	0,0156
AES	0,0222	AES	0,0196	AES	0,0018	AES	0,034	AES	0,0112				TCM	0,0157
ICP	0,0224	AES	0,0197	AES	0,0020	AES	0,035	AES	0,0113				TCM	0,0162
AES	0,0228	AES	0,0201	AES	0,0020	AES	0,035	AES	0,0121			AES	0,0163	
AES	0,0237	AES	0,0202	AES	0,0020	ICP	0,035	AES	0,0123	AES	0,065	AES	0,0165	
AES	0,0239	AES	0,0202	AES	0,0021	ICP	0,035	ICP	0,0124	AES	0,067	AES	0,0166	
AES	0,0240	AES	0,0203	AES	0,0021	ICP	0,035	AES	0,0128	XRF-m.	0,069	AES	0,0167	
AES	0,0243	AES	0,0204	AES	0,0021	AES	0,035	AES	0,0132	AES	0,069	AES	0,0168	
AES	0,0244	XRF	0,0207	AES	0,0021	AES	0,036	AES	0,0136	ICP	0,069	TCM	0,0169	
AES	0,0245	AES	0,0207	AES	0,0021	AES	0,036	AES	0,0138	AES	0,069	AES	0,0174	
AES	0,0248	AES	0,0208	AES	0,0021	AES	0,036	AES	0,0141	XRF-m.	0,072	AES	0,0175	
AES	0,0249	AES	0,0208	AES	0,0022	AES	0,036	AES	0,0156	AES	0,073	AES	0,0177	
AES	0,0252	AES	0,0210	AES	0,0022	AES	0,036	AES	0,0156	AES	0,073	AES	0,0179	
AES	0,0256	AES	0,0210	AES	0,0022	AES	0,036	XRF	0,0159	AES	0,074	AES	0,0180	
AES	0,0258	AES	0,0210	AES	0,0023	AES	0,036	AES	0,0164	AES	0,074	AES	0,0183	
AES	0,0275	AES	0,0212	AES	0,0024	AES	0,038	AES	0,0166	AES	0,074	AES	0,0185	
AES	0,0276	AES	0,0217	AES	0,0024	AES	0,040	AES	0,0171	AES	0,074	AES	0,0186	
AES	0,0281	AES	0,0218	AES	0,0024	AES	0,045*	ICP	0,0186	AES	0,075	AES	0,0186	
AES	0,0283	ICP	0,0229	AES	0,0035*	AES	0,045*	ICP	0,0198	AES	0,078	AES	0,0188	
								XRF-m.	0,0589*	AES	0,083	AES	0,0190	

	As	Sn	B	Nb	Pb	Zr	N
Value	0,0243	0,0200	0,0021	0,035	0,0134	0,072	0,0168
s _u	0,0025	0,0014	0,0002	0,002	0,0032	0,004	0,0013
U	0,0012</						

COMMENTS:

Value – reference value, s_M – standard deviation of intralaboratory means (* - result excluded as outlier)

U – Uncertainty of the reference value $U = \pm \frac{t_{5;0,05}}{\sqrt{n}} \cdot s_M$ in the sense of the ISO Guide to the Expression of the Uncertainty of Measurement (1993), dependent on the standard deviation of the laboratory results.

Certified fully compliant with the ISO 17034 definition of Reference Material – with the characterization for determining the property values and their associated uncertainties.

Intended for calibration, matrix-match verification and statistical process control of low alloy steel spectrometric analysis from a plane of solid sample. They may not substitute CRM in a statement of metrological traceability, method validation. A single analysis area of at least 4 mm in diameter defines the minimum sample intake. They may be used for combustion and wet-way methods too.

Manufactured by casting to a special ingot with discarding of the parts, which have been suspected inhomogenous and the rest has been machined to the samples of the ultimate size.

Supplied as discs 37 mm in diameter and 25 mm of standard height.

Homogeneity (random and trend, within- and between- samples) was tested by various analytical techniques of adequate repeatability. Its uncertainty contribution, when statistically significant, was combined to the ultimate uncertainty statement. The RM are stable by a nature of material.

Characterised by results from SPL proficiency test **PT 28/1B** - laboratories by various spectrometric methods (AES spark, glow discharge, XRF) and alternative methods (combustion, thermoevolution, wet-way) standard methods, with measurements metrological traceable to adequate CRM (CZ 2001, 2003 - 2008, 2015-2024, BAS, Brammer Standard). Identity of PT participating laboratories is confidential.

Certified values in % m/m, tabulated below in bold, are robust means of a minimum five accepted laboratory means. They are rounded to the same digit as their uncertainty statement.

Uncertainty is expressed as a \pm half width interval combined from the standard uncertainty, expanded by the coverage factor $k = 2$ (corresponding to 95% level of confidence). It does not exceed 1,5 multiple of the typical uncertainty of the matching CRM.

Non-certified values in regular without the uncertainty statement do not meet the requirements for certification and are intended for the matrix information.

User instruction: the surface of the specimens and RM should be prepared in a similar manner in accordance with manufacturer's instructions of spectrometers. It is recommended to storage of RM in dry and non-corrosive conditions.

Produced by: SPL-LABMAT s.r.o. ,

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