

**CERTIFICATE OF CHEMICAL ANALYSIS No 08 – 20**

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

**SPL CM-22B (PT 28/1D)**

**CERTIFIED VALUES – Mass content in %wt.**

Element	Value [%wt.]	Uncertainty [%wt.]
<b>C</b>	<b>0.168</b>	0.003
<b>Mn</b>	<b>1.733</b>	0.008
<b>Si</b>	<b>0.322</b>	0.005
<b>P</b>	<b>0.084</b>	0.003
<b>S</b>	<b>0.067</b>	0.003
<b>Cu</b>	<b>0.402</b>	0.004
<b>Cr</b>	<b>0.159</b>	0.002
<b>Ni</b>	<b>2.883</b>	0.027
<b>Al</b>	<b>0.048</b>	0.002

Element	Value [%wt.]	Uncertainty [%wt.]
<b>Mo</b>	<b>0.146</b>	0.004
<b>W</b>	<b>0.573</b>	0.016
<b>V</b>	<b>0.608</b>	0.006
<b>Ti</b>	<b>0.0094</b>	0.0003
<b>Co</b>	<b>0.124</b>	0.002
<b>As</b>	<b>0.061</b>	0.002
<b>Sn</b>	<b>0.067</b>	0.002
<b>B</b>	<b>0.0034</b>	0.0004
<b>Ca</b>	<b>0.0042</b>	0.0003

Element	Value [%wt.]	Uncertainty [%wt.]
<b>Nb</b>	<b>0.051</b>	0.002
<b>Sb</b>	<b>0.0132</b>	0.0015
<b>Pb</b>	<b>0.0223</b>	0.0024
<b>Zn</b>	<b>0.0139</b>	0.0011
<b>N</b>	<b>0.0100</b>	0.0008
<b>Bi</b>	<i>0.025</i>	
<b>Ta</b>	<b>0.060</b>	0.004

**PARTICIPATING LABORATORIES:**

ARCELORMITTAL Warszawa, Poland  
 BRITISH STEEL, United Kingdom  
 COGNOR S.A. - Ferrostal Łabędy, Poland  
 DUNAFERR Labor Nonprofit, Hungary  
 IK4AZTERLAN, Spain  
 JSC Moldova Steel Works, Moldova  
 MATERIÁLOVÉ LAB. CHOMUTOV, Czech Republic  
 MS UTILITIES & SERVICES, Czech Republic  
 OCAS NV, Belgium  
 PRECHEZA, Czech Republic  
 SES Inspekt, Slovakia

SIJ METAL RAVNE, Slovenia  
 SSAB EMEA, Sweden  
 ŠKODA AUTO, Czech Republic  
 U. S. STEEL Košice – Labortest, Slovakia  
 ÚJV Řež, Czech Republic  
 UNEX, Czech Republic  
 VÁLCOVNY TRUB Chomutov, Czech Republic  
 VÚHŽ, Czech Republic  
 ZPS - SLÉVÁRNA, Czech Republic  
 ŽDAS, Czech Republic

# CM-22B – ANALYTICAL DATA

Method	C	Method	Mn	Method	Si	Method	P	Method	S	Method	Cu	Method	Cr	Method	Ni	Method	Al
AES	0,156	XRF	1,695	ICP	0,249*	XRF	0,071	AES	0,048	AES-m.	0,385	AES	0,152	AES	2,732		
AES-m.	0,160	ICP	1,698	ICP	0,299	AES	0,074	AES	0,052	AES-m.	0,386	AES	0,152	AES	2,779		
AES	0,161	AES	1,707	AES	0,300	AES	0,075	AES-m.	0,055	AES	0,391	XRF-m.	0,153	AES-m.	2,785	XRF	0,036
AES-m.	0,161	AES-m.	1,709	AES	0,304	ICP	0,075	AES	0,057	AES	0,391	ICP	0,154	AES	2,801	ICP	0,040
AES-m.	0,162	XRF-m.	1,713	XRF	0,306	AES	0,076	AES	0,057	AES	0,391	AES-m.	0,154	AES	2,807	ICP	0,043
AES	0,162	AES	1,715	AES	0,308	AES	0,077	AES-m.	0,057	AES	0,394	AES	0,156	AES	2,817	AES	0,045
AES-m.	0,162	AES	1,718	AES	0,311	ICP	0,078	AES	0,058	AES	0,396	XRF	0,156	ICP	2,832	AES	0,045
AES	0,163	AES	1,719	ICP	0,312	AES-m.	0,080	AES	0,058	AES-m.	0,396	AES	0,157	AES	2,841	AES	0,045
AES	0,163	AES	1,719	AES	0,314	AES	0,081	AES-m.	0,059	AES	0,398	AES	0,158	AES	2,842	AES	0,046
AES	0,164	AES	1,728	AES	0,314	AES	0,081	AES-m.	0,060	XRF-m.	0,399	AES	0,159	AES	2,859	AES	0,046
IR	0,165	AES	1,728	AES	0,315	AES	0,081	AES	0,061	AES	0,399	AES	0,159	AES	2,861	AES	0,047
AES	0,165	AES-m.	1,728	AES	0,317	AES-m.	0,083	AES	0,063	AES	0,400	AES	0,159	XRF	2,865	AES	0,047
AES	0,166	AES	1,732	AES	0,317	AES-m.	0,083	AES	0,063	AES	0,401	AES	0,159	AES	2,869	AES-m.	0,047
AES-m.	0,169	AES-m.	1,733	AES-m.	0,319	AES	0,084	AES	0,064	AES	0,403	AES	0,160	ICP	2,884	AES	0,048
IR	0,169	AES	1,734	AES	0,320	ICP	0,084	AES	0,064	AES-m.	0,403	AES	0,160	AES	2,885	AES	0,048
IR	0,171	AES	1,734	AES	0,321	AES-m.	0,085	AES	0,065	AES-m.	0,404	AES	0,160	AES	2,887	AES	0,048
AES	0,171	AES	1,735	AES	0,321	AES	0,086	IR	0,066	AES-m.	0,406	AES	0,160	AES-m.	2,905	AES	0,048
AES	0,172	AES	1,736	AES	0,326	AES-m.	0,086	IR	0,067	AES	0,409	ICP	0,160	AES-m.	2,913	AES	0,048
IR	0,172	AES	1,737	AES	0,326	AES	0,086	IR	0,067	ICP	0,409	XRF-m.	0,160	AES	2,918	AES	0,049
AES	0,172	AES	1,739	AES-m.	0,329	AES	0,086	AES-m.	0,068	ICP	0,411	AES	0,161	AES	2,919	AES	0,050
IR	0,172	AES-m.	1,746	AES-m.	0,331	AES	0,088	IR	0,070	AES	0,412	AES-m.	0,161	AES-m.	2,920	AES	0,050
IR	0,173	ICP	1,754	AES	0,335	AES	0,089	IR	0,070	AES	0,412	AES	0,161	XRF-m.	2,952	AES	0,051
IR	0,173	AES	1,754	AES-m.	0,336	AES	0,089	IR	0,071	AES	0,412	AES	0,163	AES-m.	2,952	AES	0,052
IR	0,173	AES	1,757	AES	0,337	AES	0,090	IR	0,071	AES	0,413	AES	0,163	XRF-m.	2,954	AES	0,052
IR	0,174	AES	1,762	AES-m.	0,339	AES	0,091	IR	0,072	XRF	0,414	AES	0,163	AES	2,961	AES	0,053
AES	0,177	AES	1,763	AES	0,340	AES	0,091	AES	0,072	ICP	0,414	AES-m.	0,164	AES	2,963	AES-m.	0,053
IR	0,178	XRF-m.	1,772	AES	0,340	AES	0,093	IR	0,072	AES	0,414	AES-m.	0,166	AES	2,963	AES-m.	0,054
AES	0,178	AES	1,775	AES	0,343	AES	0,096	AES	0,073	AES	0,418	AES	0,169	AES	2,988	AES-m.	0,056
IR	0,179	AES	1,812*	AES	0,347	AES	0,102	XRF-m.	0,083	AES	0,437*	AES	0,171	AES	3,033	AES	0,058

	C	Mn	Si	P	S	Cu	Cr	Ni	Al
Value	0,168	1,733	0,322	0,084	0,067	0,402	0,159	2,883	0,048
sM	0,006	0,021	0,014	0,007	0,008	0,010	0,005	0,071	0,005
U	0,003	0,008	0,005	0,003	0,003	0,004	0,002	0,027	0,002

Method	Mo	Method	W	Method	V	Method	Ti	Method	Co	Method	As	Method	Sn	Method	B	Method	Ca
AES-m.	0,132			AES	0,557*												
AES-m.	0,133			XRF-m.	0,572												
AES-m.	0,134			AES	0,584												
AES	0,136			AES	0,591			AES-m.	0,120								
AES	0,137	AES-m.	0,515	AES	0,592			AES	0,121			AES	0,062				
ICP	0,139	AES-m.	0,515	AES	0,592			AES	0,121			AES-m.	0,062				
AES	0,140	AES-m.	0,524	AES	0,594			XRF	0,121			AES	0,063				
AES	0,140	XRF-m.	0,531	ICP	0,595	AES	0,0070*	AES	0,121			ICP	0,063				
AES	0,141	AES	0,547	AES	0,599	AES	0,0075*	AES-m.	0,122			AES	0,064				
AES	0,142	AES	0,559	AES	0,603	AES	0,0084	ICP	0,122	AES	0,049	AES	0,064				
AES-m.	0,143	AES	0,560	AES	0,603	AES	0,0087	AES	0,123	AES	0,055	AES	0,065				
AES	0,146	XRF-m.	0,564	AES	0,604	ICP	0,0090	AES	0,123	ICP	0,055	ICP	0,065	ICP	0,0015		
ICP	0,146	AES	0,567	AES	0,605	AES	0,0091	AES	0,123	AES	0,056	AES	0,066	AES	0,0023		
AES	0,146	AES	0,568	ICP	0,606	AES	0,0091	ICP	0,123	AES	0,056	AES	0,067	AES	0,0030		
ICP	0,147	ICP	0,571	AES	0,607	ICP	0,0093	AES	0,124	AES	0,057	AES	0,067	AES	0,0030	AES	0,0035
AES-m.	0,147	AES	0,574	AES-m.	0,608	AES	0,0093	AES	0,124	AES	0,060	XRF	0,067	AES	0,0031	AES	0,0036
XRF-m.	0,147	AES-m.	0,580	AES	0,612	AES	0,0094	AES	0,124	AES-m.	0,060	AES	0,067	AES	0,0031	AES	0,0037
AES	0,147	AES	0,582	AES	0,613	AES-m.	0,0094	AES	0,124	AES	0,060	AES	0,068	AES	0,0032	AES	0,0037
AES	0,148	AES	0,583	XRF-m.	0,614	AES	0,0094	AES	0,125	AES	0,060	AES	0,068	AES	0,0033	AES	0,0037
AES	0,148	AES	0,584	AES	0,614	AES	0,0095	AES	0,125	AES	0,060	AES	0,068	AES	0,0033	AES	0,0038
AES	0,148	AES	0,585	AES	0,614	AES	0,0095	AES	0,125	AES	0,062	AES	0,069	AES-m.	0,0035	AES	0,0040
XRF-m.	0,149	AES	0,588	AES-m.	0,616	AES	0,0096	AES	0,125	AES	0,062	AES	0,069	AES	0,0035	AES	0,0042
AES	0,149	AES	0,591	AES	0,617	AES	0,0096	AES-m.	0,125	AES	0,062	AES	0,069	AES	0,0035	AES	0,0042
AES	0,151	AES	0,593	ICP	0,617	AES	0,0096	AES	0,126	AES	0,063	AES	0,069	AES	0,0035	AES	0,0042
AES	0,152	AES	0,594	AES-m.	0,618	AES	0,0096	AES	0,126	AES	0,063	AES	0,069	AES	0,0036	AES	0,0043
AES	0,153	AES	0,596	AES	0,620	AES	0,0097	AES	0,127	ICP	0,063	AES	0,070	AES	0,0036	AES	0,0043
AES	0,154	AES	0,606	XRF	0,620	AES	0,0098	AES-m.	0,127	AES	0,064	AES	0,070	AES	0,0036	AES	0,0044
XRF	0,156	AES	0,619	AES	0,626	AES	0,0101	AES	0,127	AES	0,064	ICP	0,071	AES	0,0036	AES	0,0044
AES	0,159	AES	0,641	AES-m.	0,628	AES	0,0106	AES	0,128	AES	0,065	XRF-m.	0,072	AES	0,0038	AES	0,0046
AES	0,160	ICP	0,683*	AES	0,629	AES	0,0127*	AES	0,129	AES	0,067	AES	0,072	AES	0,0038	ICP	0,0050
AES	0,171	AES-m.	0,713*	AES-m.	0,631	XRF-m.	0,0410*	AES-m.	0,130	AES	0,068	XRF-m.	0,072	AES	0,0052	AES	0,0053

	Mo	W	V	Ti	Co	As	Sn	B	Ca
	0,146	0,573	0,608	0,0094	0,124	0,061	0,067	0,0034	0,0042
	0,008	0,030	0,014	0,0005	0,003	0,004	0,003	0,0007	0,0005
	0,004	0,016	0,006	0,0003	0,002	0,002	0,002	0,0004	0,0003

Method	Nb	Method	Sb	Method	Pb	Method	Zn	Method	N	Method	Bi	Method	Ta	Method	Te
AES	0,041							AES-m.	0,0072						
AES	0,044							AES	0,0076						
AES	0,045							AES-m.	0,0082						
AES	0,046							AES	0,0082						
AES	0,048							AES	0,0088						
AES	0,048							TCM	0,0091						
AES	0,048							AES	0,0093						
XRF	0,048			ICP	0,0140			IR	0,0094						
AES-m.	0,049			AES	0,0197			TCM	0,0094						
AES	0,050			AES	0,0197			AES	0,0096						
AES	0,050			AES	0,0200			AES	0,0097						
XRF-m.	0,051	AES	0,0083	AES	0,0200			TCM	0,0097						
AES	0,052	AES	0,0104	ICP	0,0201			TCM	0,0098						
AES	0,052	AES	0,0119	AES	0,0209	AES	0,0092	AES	0,0101						
ICP	0,052	ICP	0,0123	AES	0,0222	AES	0,0117	AES	0,0102						
AES	0,052	AES	0,0128	AES	0,0223	AES	0,0120	AES	0,0102						
AES	0,053	AES	0,0133	AES	0,0232	AES	0,0134	TCM	0,0103						
AES	0,053	AES	0,0133	AES	0,0240	ICP	0,0136	AES	0,0109	AES	0,0162	AES	0,038		
AES	0,053	AES	0,0136	AES	0,0248	AES	0,0136	AES	0,0111	ICP	0,0184	AES	0,058		
AES	0,053	ICP	0,0138	AES	0,0267	AES	0,0143	AES	0,0114	AES	0,0195	XRF	0,059		
AES	0,054	AES	0,0140	AES	0,0278	AES	0,0147	AES-m.	0,0117	AES	0,0210	AES	0,059		
AES	0,054	AES	0,0143	AES	0,0292	AES-m.	0,0152	AES	0,0119	XRF-m.	0,0272	AES	0,060	AES	0,0060

## 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 28/1D** - 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.

**Responsible person:** Martin Bogumský

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