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**CERTIFICATE OF CHEMICAL ANALYSIS No 07 – 23**

**STAINLESS STEEL (grade AISI316L, DIN 1.4404, X2CrNiMo17-2-2) for solid sample spectrometry, combustion and wet-way methods**

**SPL SL-2B (PT 31/6A)**

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

<b>Element</b>	<b>Value [%wt.]</b>	<b>Uncertainty [%wt.]</b>
<b>C</b>	<b>0.0179</b>	0.0007
<b>Mn</b>	<b>1.706</b>	0.011
<b>Si</b>	<b>0.414</b>	0.008
<b>P</b>	<b>0.041</b>	0.002
<b>S</b>	<b>0.0207</b>	0.0011
<b>Cu</b>	<b>0.688</b>	0.009
<b>Cr</b>	<b>16.98</b>	0.06
<b>Ni</b>	<b>10.15</b>	0.06
<b>Al</b>	<b>0.0048</b>	0.0010
<b>Mo</b>	<b>2.010</b>	0.030
<b>W</b>	<b>0.069</b>	0.005

<b>Element</b>	<b>Value [%wt.]</b>	<b>Uncertainty [%wt.]</b>
<b>V</b>	<b>0.066</b>	0.002
<b>Ti</b>	<b>0.0030</b>	0.0006
<b>Co</b>	<b>0.267</b>	0.007
<b>Sn</b>	<b>0.0108</b>	0.0008
<b>B</b>	<b>0.0012</b>	0.0003
<b>Ca</b>	<b>0.0008</b>	0.0003
<b>Nb</b>	<b>0.064</b>	0.003
<b>Zr</b>	<i>0.003</i>	
<b>Zn</b>	<i>0.011</i>	
<b>N</b>	<b>0.0788</b>	0.0021

**PARTICIPATING LABORATORIES:**

CMC Poland, Poland  
COGNOR S.A. - Ferrostal Łabędy, Poland  
COMTES, Czech Republic  
ČEZ - JE Temelín, Czech Republic  
ČZ, Czech Republic  
DAIMLER TRUCK AG, Germany  
DEFEKTA NDT, Czech Republic  
DUNAFERR Labor Nonprofit, Hungary  
ESAB CZ, Czech Republic  
GENERALZOLLDIREKTION BWZ, Germany  
GO STEEL, Czech Republic  
INSPEKT, Slovakia

ŁUKASIEWICZ-GIT, Poland  
MATERIÁLOVÉ LAB. CHOMUTOV, Czech Republic  
SVÚM, Czech Republic  
TÜV NORD Czech, Czech Republic  
ÚJV Řež, Czech Republic  
VOESTALPINE STAHL, Austria  
VÚHŽ Foundry, Czech Republic  
VÝZKUMNÝ A ZKUŠ. ÚSTAV PLZEŇ, Czech Republic  
VÝZKUMNÝ ÚSTAV ZVÁRAČSKÝ, Slovakia  
ZPS - SLÉVÁRNA, Czech Republic  
ŽĐAS, Czech Republic

**SL-2B - ANALYTICAL DATA:**

Method	C	Method	Mn	Method	Si	Method	P	Method	S	Method	Cu	Method	Cr
		AES	1,484*					IR	0,0171			AES	16,39*
AES	0,0134*	AES	1,657	ICP	0,374			AES	0,0176	AES	0,557*	AES	16,59*
AES	0,0147	AES	1,663	AES	0,379			AES	0,0178	AES	0,644	XRF	16,76
IR	0,0157	AES	1,678	AES	0,381			XRF	0,0181	ICP	0,665	AES	16,85
AES-m.	0,0162	AES	1,684	ICP	0,386			AES	0,0187	ICP	0,668	AES	16,87
IR	0,0162	AES	1,690	XRF-m.	0,392			AES	0,0188	AES	0,671	ICP	16,87
AES	0,0164	AES	1,690	AES	0,394			AES	0,0192	XRF-m.	0,671	AES	16,92
IR	0,0167	AES-m.	1,691	AES	0,394	AES	0,037	AES	0,0193	AES	0,672	AES	16,94
AES	0,0173	ICP	1,692	AES	0,400	AES	0,038	IR	0,0194	AES	0,681	AES	16,94
IR	0,0176	XRF	1,692	AES	0,401	AES	0,039	IR	0,0196	AES	0,682	AES	16,95
AES	0,0176	ICP	1,694	XRF	0,403	AES	0,039	AES	0,0196	AES	0,682	AES	16,95
IR	0,0177	AES	1,696	AES	0,404	AES	0,039	AES	0,0197	AES	0,685	XRF	16,95
IR	0,0179	XRF	1,698	AES	0,404	AES	0,039	IR	0,0200	XRF	0,686	XRF-m.	16,96
AES	0,0179	XRF-m.	1,700	AES-m.	0,404	AES	0,040	AES	0,0206	AES	0,687	AES	16,97
AES	0,0180	ICP	1,703	AES	0,410	AES	0,040	IR	0,0207	AES	0,687	Volumetric	16,98
AES	0,0180	AES	1,704	AES	0,414	ICP	0,040	IR	0,0207	AES	0,687	AES	16,99
AES	0,0181	XRF-m.	1,708	AES	0,419	AES	0,041	AES	0,0208	AES	0,692	AES	17,00
AES	0,0182	AES	1,709	AES	0,420	AES	0,041	IR	0,0208	AES	0,692	AES	17,00
AES	0,0184	AES	1,709	AES	0,421	AES	0,041	IR	0,0208	AES	0,693	AES	17,02
AES	0,0184	AES	1,710	AES	0,424	XRF	0,041	AES	0,0208	AES-m.	0,693	ICP	17,03
AES	0,0184	AES	1,712	AES	0,426	AES	0,041	AES	0,0209	AES	0,695	XRF	17,04
IR	0,0185	AES	1,712	AES	0,426	AES	0,041	AES	0,0214	AES	0,696	XRF-m.	17,04
IR	0,0185	XRF	1,718	XRF-m.	0,427	AES	0,041	AES	0,0216	XRF-m.	0,699	AES	17,04
IR	0,0186	AES	1,720	XRF	0,429	AES	0,042	IR	0,0217	XRF	0,699	AES	17,04
AES	0,0186	AES	1,724	AES	0,430	AES	0,042	AES	0,0226	AES	0,700	ICP	17,05
AES	0,0188	AES	1,727	AES-m.	0,433	ICP	0,042	IR	0,0233	ICP	0,700	AES-m.	17,07
IR	0,0191	AES-m.	1,727	AES	0,436	AES	0,043	IR	0,0235	AES	0,704	AES-m.	17,07
IR	0,0191	AES	1,732	ICP	0,440	AES	0,043	AES	0,0240	AES-m.	0,705	AES	17,09
IR	0,0194	AES	1,742	AES	0,440	AES	0,044	AES	0,0243	AES	0,713	AES	17,11
AES	0,0196	AES	1,746	AES	0,442	AES	0,045	AES	0,0246	AES	0,720	AES	17,21*
AES	0,0206	AES	1,764	AES	0,462	AES	0,045	AES	0,0250	XRF	0,749*	AES	17,28*

	C	Mn	Si	P	S	Cu	Cr
Value	0,0179	1,706	0,414	0,041	0,0207	0,688	16,98
S <sub>rel</sub>	0,0013	0,023	0,021	0,002	0,0021	0,016	0,08
U	0,0007	0,011	0,008	0,002	0,0011	0,009	0,06

Method	Ni	Method	Al	Method	Mo	Method	W	Method	V	Method	Ti	Method	Co
AES	9,78*							XRF	0,041*				
AES	9,83*			ICP	1,888			AES	0,058				
AES	9,95			AES	1,934			AES	0,060			XRF	0,236
AES-m.	9,97			AES	1,946			AES	0,061			AES	0,248
ICP	9,98			AES	1,959			AES	0,062			AES	0,249
XRF-m.	10,02			AES	1,977			AES	0,063			AES	0,250
AES	10,03			AES	1,980			AES	0,063			AES	0,256
AES	10,06			AES	1,988			XRF-m.	0,063			AES	0,261
XRF	10,06			AES	1,992			ICP	0,064			XRF-m.	0,261
AES	10,07			AES	1,992			ICP	0,064			AES	0,262
AES	10,09			ICP	1,994	AES	0,050	AES	0,065			AES	0,264
XRF	10,12			AES	2,001	AES	0,052	XRF	0,065			XRF	0,265
AES	10,12			XRF-m.	2,001	AES	0,058	AES	0,065			AES	0,265
AES	10,12			AES	2,004	AES	0,062	XRF-m.	0,065			AES	0,265
AES-m.	10,14	AES	0,0005	XRF	2,006	ICP	0,062	AES	0,066			ICP	0,265
AES	10,17	AES	0,0020	AES	2,008	AES	0,063	AES	0,066	ICP	0,0013	AES	0,266
AES	10,17	AES	0,0026	AES	2,010	AES	0,064	AES	0,066	AES	0,0013	AES	0,267
AES	10,18	AES	0,0039	AES	2,010	AES	0,065	AES	0,066	AES	0,0016	ICP	0,268
AES	10,19	AES	0,0039	AES	2,011	XRF-m.	0,066	ICP	0,066	AES	0,0020	AES	0,270
AES	10,19	AES	0,0040	XRF-m.	2,012	AES	0,067	AES	0,066	AES	0,0022	AES	0,270
AES	10,20	AES	0,0041	AES	2,012	ICP	0,067	AES	0,066	AES	0,0022	AES	0,270
AES	10,21	AES	0,0042	AES	2,016	XRF-m.	0,067	AES	0,066	AES	0,0023	AES	0,272
AES	10,22	AES	0,0044	XRF	2,023	AES	0,067	AES	0,066	AES	0,0023	XRF-m.	0,273
ICP	10,22	AES	0,0052	ICP	2,034	AES	0,068	AES-m.	0,067	AES	0,0037	AES	0,273
AES	10,23	ICP	0,0058	XRF	2,037	ICP	0,069	AES	0,070	AES	0,0039	AES	0,275
AES	10,24	AES	0,0062	AES	2,039	XRF	0,073	AES	0,071	AES	0,0040	ICP	0,275
XRF-m.	10,25	AES	0,0065	AES	2,058	AES	0,082	AES	0,072	AES	0,0040	AES	0,275
ICP	10,26	AES	0,0066	AES	2,069	AES	0,084	AES	0,072	AES	0,0040	AES-m.	0,282
XRF	10,31	AES	0,0068	AES-m.	2,077	AES	0,086	AES	0,074	AES	0,0043	AES	0,284
AES	10,35	AES	0,0070	AES-m.	2,086	AES	0,090	AES	0,076	AES	0,0044	AES	0,285
AES	10,81*	AES	0,0072	AES	2,140	AES	0,093	AES-m.	0,077	AES	0,0048	AES	0,290

	Ni	Al	Mo	W	V	Ti	Co
Value	10,15	0,0048	2,010	0,069	0,066	0,0030	0,267
S <sub>rel</sub>	0,10	0,0019	0,048	0,012	0,004	0,0012	0,012
U	0,06	0,0010	0,030	0,005	0,002	0,0006	0,007

Method	Sn	Method	B	Method	Ca	Method	Nb	Method	Zr	Method	Zn	Method	N	
						XRF	0,049							
						AES	0,053							
						AES	0,054					AES	0,0624*	
						AES	0,056					AES	0,0674	
AES	0,0084					AES	0,059					AES	0,0740	
ICP	0,0086					AES	0,061					AES	0,0749	
AES	0,0090	AES	0,0007			ICP	0,062					AES	0,0752	
AES	0,0096	AES	0,0008			AES	0,063					AES	0,0763	
ICP	0,0096	AES	0,0009			AES	0,064					AES	0,0764	
AES	0,0098	AES	0,0010			AES	0,065					TCM	0,0787	
AES	0,0098	AES	0,0010			XRF	0,065					AES	0,0787	
AES	0,0100	AES	0,0010			AES	0,065					AES	0,0789	
AES	0,0114	AES	0,0011			XRF-m.	0,065					TCM	0,0789	
AES	0,0115	AES	0,0013			AES	0,067					TCM	0,0799	
AES	0,0116	AES	0,0014			XRF-m.	0,067					TCM	0,0799	
AES	0,0118	AES	0,0014	AES	0,0006	AES	0,067				AES	0,0046	AES	0,0807
AES	0,0120	AES	0,0015	AES	0,0007	AES	0,068	AES	0,0009	AES	0,0062	TCM	0,0819	
AES	0,0120	AES	0,0015	AES	0,0008	AES	0,068	AES	0,0024	AES	0,0104	AES	0,0824	
AES	0,0124	AES	0,0016	AES	0,0008	AES	0,071	AES	0,0024	AES	0,0110	AES	0,0841	
AES	0,0131	AES	0,0016	AES	0,0008	AES	0,072	AES	0,0036	AES	0,0155	AES	0,0842	
ICP	0,0137	AES	0,0017	AES	0,0010	AES	0,074	AES	0,0040	ICP	0,0164	AES	0,0862	

	Sn	B	Ca	Nb	Zr	Zn	N
Value	0,0108	0,0012	0,0008	0,064	0,0027	0,0107	0,0788
S <sub>rel</sub>	0,0016	0,0003	0,00020	0,006			0,0043
U	0,0008	0,0003	0,0003	0,003			0,0021

## COMMENTS:

**Value** – reference value, **s<sub>M</sub>** – standard deviation of intralaboratory means (\* - result excluded as outlier)

**U** – Uncertainty of the reference value  $U \geq \pm \frac{t_{5;0,05}}{\sqrt{n}} \cdot s_M$  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 31/6A** - 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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