



SPL-LABMAT s.r.o.

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CERTIFICATE OF CHEMICAL ANALYSIS No 09 – 21

**CAST IRON for solid sample spectrometry, combustion and wet-way methods
SPL-L2 (PT 29/4B)**

CERTIFIED VALUES – Mass content in %wt.

Element	Value [%wt.]	Uncertainty [%wt.]
C	3.202	0.025
Mn	0.308	0.002
Si	1.128	0.011
P	0.173	0.003
S	0.024	0.001
Cu	0.089	0.002
Cr	0.065	0.001
Ni	0.120	0.002
Mo	0.309	0.004
W	0.024	0.001

Element	Value [%wt.]	Uncertainty [%wt.]
V	0.053	0.001
Ti	0.0313	0.0008
As	0.0210	0.0016
Sn	0.075	0.003
B	0.0090	0.0005
Nb	0.0089	0.0007
Sb	0.0207	0.0024
Pb	0.0048	0.0006
Zn	0.0057	0.0004
Mg	0.0015	0.0006

PARTICIPATING LABORATORIES:

AZTERLAN, Spain

CASTCO, Hong Kong

COGNOR S.A. - Ferrostal Łabędy, Poland

DEGERFORS LAB. AB, Sweden

DUNAFERR Labor Nonprofit, Hungary

ENVIFORM, Czech Republic

IMŻ, Poland

IMT, Slovenia

LIBERTY Ostrava, Czech Republic

SECO INDUSTRIES, Czech Republic

SSAB, Sweden

ŠKODA AUTO, Czech Republic

TATA STEEL IJMUIDEN, Netherlands

UNEX, Czech Republic

VOESTALPINE, Austria

VÚHŽ, Czech Republic

Z - GROUP OC. HRÁDEK, Czech Republic

ZPS - SLÉVÁRNA, Czech Republic

SPL-L2 - ANALYTICAL DATA:

Method	C	Method	Mn	Method	Si	Method	P	Method	S	Method	Cu	Method	Cr	Method	Ni	Method	Mo	Method	W
								ICP	0,021										
		ICP	0,298	ICP	1,034*			AES	0,021			AES	0,050*	ICP	0,110				
AAS	3,032	AES	0,299	ICP	1,080			AES	0,022		AES	0,083	AES	0,060	AES	0,111			
AES	3,103	AES	0,300	ICP	1,094			XRF	0,023	AES	0,083	AES	0,061	ICP	0,111				
AAS	3,108	AES	0,301	AES	1,102			AES	0,023	AES	0,084	ICP	0,062	ICP	0,114	AES	0,283		
AES	3,126	XRF	0,302	AES	1,104			IR	0,023	AES	0,085	AAS	0,062	AES	0,115	AES	0,297		
AES	3,143	AES	0,303	AES	1,106			AES	0,024	ICP	0,086	XRF	0,062	AES	0,115	AES	0,300		
AES	3,160	AES	0,303	AES	1,108			IR	0,024	AES	0,086	AAS	0,063	AES	0,116	AES	0,301		
AES	3,160	AES	0,303	AES	1,109	XRF	0,163	AES	0,024	AES	0,087	AES	0,063	AES	0,116	AES	0,303		
XRF	3,179	ICP	0,304	Gravim.	1,110	AES	0,164	IR	0,024	ICP	0,087	AES	0,063	AES	0,118	AES	0,304		
IR	3,182	AES	0,304	XRF	1,111	AES	0,164	IR	0,024	AES	0,087	AES	0,064	AES	0,118	AES	0,304		
IR	3,192	AES	0,306	AES	1,115	AES	0,166	AES	0,024	XRF	0,087	ICP	0,064	XRF	0,118	AES	0,305	AES	0,018
AES	3,199	AES	0,306	XRF	1,119	AES	0,167	XRF	0,024	AES	0,088	AES	0,064	AAS	0,120	AES	0,306	AES	0,020
IR	3,199	AES	0,307	AAS	1,119	AES	0,167	AES	0,024	ICP	0,088	AES	0,064	AES	0,120	AES	0,307	AES	0,020
AES	3,202	XRF	0,308	AES	1,124	AES	0,168	AES	0,024	AES	0,089	AES	0,064	ICP	0,121	XRF	0,307	AES	0,021
IR	3,212	AES	0,308	AES	1,126	ICP	0,168	IR	0,025	AES	0,089	AES	0,064	AES	0,121	AES	0,308	AES	0,021
IR	3,216	Photom.	0,309	Gravim.	1,128	XRF	0,169	AES	0,025	AES	0,089	AES	0,065	ICP	0,122	XRF	0,309	ICP	0,021
IR	3,217	ICP	0,310	AES	1,129	ICP	0,170	IR	0,025	AES	0,090	AES	0,065	XRF	0,122	AAS	0,311	XRF	0,022
AES	3,218	AES	0,310	AES	1,131	AES	0,171	IR	0,025	AAS	0,090	AES	0,066	XRF	0,122	ICP	0,311	ICP	0,023
IR	3,218	AES	0,310	Photom.	1,134	XRF	0,172	IR	0,025	ICP	0,090	AES	0,066	AAS	0,123	AES	0,313	ICP	0,025
IR	3,225	XRF	0,311	Gravim.	1,135	ICP	0,175	IR	0,025	XRF	0,090	AES	0,066	AES	0,123	AAS	0,313	AES	0,025
IR	3,226	AES	0,312	AES	1,150	AES	0,175	IR	0,026	AES	0,091	XRF	0,066	AES	0,123	AES	0,314	AES	0,026
AES	3,236	AES	0,315	AES	1,150	AES	0,175	AES	0,026	XRF	0,092	XRF	0,066	AES	0,123	XRF	0,315	ICP	0,027
IR	3,239	ICP	0,315	AES	1,163	AES	0,179	XRF	0,026	AES	0,092	Titrim.	0,067	XRF	0,123	ICP	0,316	AES	0,027
IR	3,264	AAS	0,317	AES	1,163	AES	0,180	AAS	0,026	ICP	0,093	AES	0,067	ICP	0,123	ICP	0,317	ICP	0,027
AES	3,274	AES	0,318	XRF	1,165	AES	0,182	AES	0,026	AES	0,094	ICP	0,068	AES	0,124	AES	0,318	AAS	0,027
AES	3,280	XRF	0,319	AES	1,175	Photom.	0,184	AES	0,026	AES	0,094	XRF	0,068	AES	0,125	ICP	0,321	AAS	0,027
IR	3,300	AAS	0,320	XRF	1,178	AES	0,185	IR	0,029	XRF	0,094	AES	0,068	AES	0,130	Photom.	0,324	AES	0,028
AES	3,306	ICP	0,331*	AAS	1,410*	AES	0,186	AAS	0,036*	AAS	0,099	ICP	0,069	AES	0,133	Photom.	0,329	XRF	0,029

	C	Mn	Si	P	S	Cu	Cr	Ni	Mo	W
Value	3,202	0,308	1,128	0,173	0,024	0,089	0,065	0,120	0,309	0,024
S ₉₁	0,063	0,006	0,026	0,007	0,002	0,004	0,002	0,005	0,009	0,003
U	0,025	0,002	0,011	0,003	0,001	0,002	0,001	0,002	0,004	0,001

Method	V	Method	Ti	Method	As	Method	Sn	Method	B	Method	Nb	Method	Sb	Method	Pb	Method	Zn	Method	Mg
ICP	0,047	AAS	0,0234*																
AES	0,050	AAS	0,0267																
AES	0,051	ICP	0,0270		ICP	0,062													
AES	0,051	AES	0,0290		AES	0,068													
AES	0,051	ICP	0,0295		XRF	0,071													
XRF	0,051	AES	0,0295		AES	0,072													
AES	0,052	AES	0,0300		AES	0,072													
AES	0,052	AES	0,0300		AES	0,072													
AES	0,052	AES	0,0304		AES	0,072											AES	0,0043	
AES	0,052	AES	0,0311		AES	0,073											AES	0,0047	
AES	0,052	ICP	0,0312	AES	0,0159	AES	0,073										XRF	0,0048	
XRF	0,053	AES	0,0314	XRF	0,0172	XRF	0,074										AES	0,0050	
AES	0,053	AES	0,0315	AES	0,0174	AES	0,074	AES	0,0079	AES	0,0080	ICP	0,0106	AES	0,0034	AAS	0,0050		
AES	0,053	XRF	0,0318	AES	0,0182	AES	0,074	AES	0,0079	AES	0,0082	AAS	0,0173	AES	0,0040	AES	0,0051		
XRF	0,053	AES	0,0320	AES	0,0182	AES	0,075	AES	0,0081	ICP	0,0083	AES	0,0179	AES	0,0044	AES	0,0053		
ICP	0,054	ICP	0,0321	AAS	0,0208	AES	0,075	AES	0,0082	AES	0,0083	AES	0,0204	ICP	0,0045	AES	0,0053		
XRF	0,054	ICP	0,0321	AES	0,0210	AES	0,075	AES	0,0084	AES	0,0084	AES	0,0213	AAS	0,0045	AES	0,0057		
AES	0,054	AES	0,0322	ICP	0,0215	AES	0,075	ICP	0,0087	XRF	0,0088	ICP	0,0214	AAS	0,0047	XRF	0,0059		
AAS	0,054	XRF	0,0325	AES	0,0218	XRF	0,075	AES	0,0089	AAS	0,0088	AES	0,0220	XRF	0,0048	AES	0,0060		
ICP	0,054	XRF	0,0325	XRF	0,0225	ICP	0,076	AAS	0,0090	AES	0,0089	AES	0,0220	AES	0,0050	AES	0,0060		
AES	0,054	AES	0,0332	AES	0,0230	ICP	0,082	AES	0,0093	AAS	0,0094	XRF	0,0227	AES	0,0051	AES	0,0062	AES	0,010
AAS	0,055	AES	0,0335	XRF	0,0237	ICP	0,082	AES	0,0094	AES	0,0104	AES	0,0232	ICP	0,0057	XRF	0,0062	AES	0,010
AES	0,056	AES	0,0336	AAS	0,0244	AAS	0,084	AAS	0,0100	ICP	0,0105	AES	0,0250	AES	0,0058	ICP	0,0063	AES	0,013
AES	0,056	XRF	0,0339	AES	0,0244	ICP	0,086	AES	0,0102	ICP	0,0106	AES	0,0250	AES	0,0063	ICP	0,0066	AES	0,020
ICP	0,059	AES	0,0340	ICP	0,0246	AAS	0,087	Photom.	0,0104	ICP	0,0210*	AAS	0,0254	ICP	0,0072	AAS	0,0076	ICP	0,021

	V	Ti	As	Sn	B	Nb	Sb	Pb	Zn	Mg
Value	0,053	0,0313	0,0210	0,075	0,0090	0,0089	0,0207	0,0048	0,0057	0,0015
S ₉₁	0,002	0,0020	0,0029	0,006	0,0009	0,0011	0,0041	0,0011	0,0008	0,0005
U	0,001	0,0008	0,0016	0,003	0,0005	0,0007	0,0024	0,0006	0,0004	0,0006

COMMENTS:

Value – reference value, s_M – 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 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 chill-casting and machining.

Supplied as discs 40 mm in diameter and approx. 18 mm of 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 29/4B** - 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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