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**CERTIFICATE OF CHEMICAL ANALYSIS No 08 – 23**

**STEEL SLAG for X-Ray Fluorescence spectrometries and wet-way analysis, S on  
combustion analysers by IR absorption**

**SPL S-2A (PT 31/9A)**

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

<b>Element</b>	<b>Value [%wt.]</b>	<b>Uncertainty [%wt.]</b>
<b>Fe</b>	<b>0.668</b>	0.047
<b>SiO<sub>2</sub></b>	<b>24.10</b>	0.52
<b>Al<sub>2</sub>O<sub>3</sub></b>	<b>6.75</b>	0.11
<b>MnO</b>	<b>0.196</b>	0.011
<b>CaO</b>	<b>58.03</b>	0.58
<b>MgO</b>	<b>6.93</b>	0.06
<b>P<sub>2</sub>O<sub>5</sub></b>	<b>0.0118</b>	0.0033
<b>S</b>	<b>0.711</b>	0.034
<b>Cr<sub>2</sub>O<sub>3</sub></b>	<b>0.0255</b>	0.0036
<b>TiO<sub>2</sub></b>	<b>0.345</b>	0.005
<b>F</b>	<b>3.43</b>	0.25

**PARTICIPATING LABORATORIES:**

ARCELORMITTAL Poland S.A., Poland  
CASTCO, Hong Kong  
CMC Poland, Poland  
COGNOR S.A. - Ferrostal Łabędy, Poland  
COGNOR S.A., Poland  
DAIMLER TRUCK AG, Germany  
DUNAFERR Labor Nonprofit, Hungary

ENVIFORM, Czech Republic  
ESAB CZ, Czech Republic  
SSAB, Sweden  
TATA STEEL IJMUIDEN, Netherlands  
U. S. STEEL Košice-Labortest, Slovakia  
VOESTALPINE STAHL, Austria

**S-2A - ANALYTICAL DATA:**

Method	Fe	Method	SiO <sub>2</sub>	Method	Al <sub>2</sub> O <sub>3</sub>	Method	MnO	Method	CaO	Method	MgO
								ICP	52,34*	XRF	6,69
		Gravim.	22,41					XRF	56,00	ICP	6,69
		Gravim.	22,49	Titrimetric	5,61*			XRF	56,85	XRF	6,82
XRF	0,540	XRF	23,29	XRF	6,34	ICP	0,160	XRF	57,17	XRF	6,83
XRF	0,540	Gravim.	23,31	ICP	6,35	ICP	0,162	Titrimetric	57,24	XRF	6,85
XRF	0,575	Gravim.	23,46	ICP	6,53	XRF	0,172	XRF	57,33	XRF	6,87
XRF	0,575	XRF	23,63	XRF	6,66	XRF	0,174	ICP	57,36	XRF	6,92
XRF	0,577	XRF	23,86	ICP	6,67	XRF	0,195	Titrimetric	57,60	Titrimetric	6,92
ICP	0,609	XRF	23,86	XRF	6,73	XRF	0,195	XRF	57,63	Titrimetric	6,92
XRF	0,666	XRF	24,01	XRF	6,73	ICP	0,196	Titrimetric	57,77	Titrimetric	6,97
XRF	0,714	XRF	24,04	XRF	6,74	XRF	0,196	XRF	58,06	XRF	6,97
ICP	0,715	XRF	24,09	XRF	6,76	XRF	0,197	XRF	58,21	ICP	6,99
XRF	0,721	XRF	24,31	XRF	6,83	XRF	0,201	XRF	58,22	XRF	7,02
Titrimetric	0,735	Gravim.	24,67	XRF	6,84	XRF	0,206	XRF	58,43	XRF	7,05
XRF	0,736	XRF	24,97	XRF	6,86	XRF	0,214	XRF	59,01	ICP	7,06
XRF	0,753	XRF	25,44	XRF	6,88	XRF	0,218	ICP	59,38	XRF	7,07
XRF	0,757	XRF	25,49	XRF	6,94	XRF	0,226	XRF	60,39	XRF	7,07
XRF	0,802	XRF	26,38	XRF	7,05	Photom.	0,226	XRF	60,46	XRF	7,09
<b>Fe</b>		<b>SiO<sub>2</sub></b>		<b>Al<sub>2</sub>O<sub>3</sub></b>		<b>MnO</b>		<b>CaO</b>		<b>MgO</b>	
Value	0,668		24,10		6,75		0,196		58,03		6,93
s <sub>M</sub>	0,089		1,05		0,21		0,021		1,17		0,12
U	0,047		0,52		0,11		0,011		0,58		0,06

Method	P <sub>2</sub> O <sub>5</sub>	Method	S	Method	Cr <sub>2</sub> O <sub>3</sub>	Method	TiO <sub>2</sub>	Method	F
						XRF	0,325		
						XRF	0,330		
ICP	0,0032					XRF	0,338		
Titrimetric	0,0034			XRF	0,0098	XRF	0,341		
ICP	0,0066			XRF	0,0191	XRF	0,341		
XRF	0,0080			XRF	0,0229	XRF	0,343		
XRF	0,0083	IR	0,636	XRF	0,0242	XRF	0,343		
ICP	0,0107	XRF	0,641	XRF	0,0251	ICP	0,343		
XRF	0,0120	XRF	0,653	XRF	0,0254	XRF	0,344		
XRF	0,0122	IR	0,698	ICP	0,0258	XRF	0,347	Potentiom.	3,13
XRF	0,0128	XRF	0,700	XRF	0,0264	ICP	0,351	XRF	3,20
XRF	0,0134	IR	0,702	XRF	0,0267	ICP	0,352	XRF	3,34
XRF	0,0148	XRF	0,710	ICP	0,0290	XRF	0,353	Potentiom.	3,41
XRF	0,0148	IR	0,751	XRF	0,0296	XRF	0,354	Potentiom.	3,57
XRF	0,0197	IR	0,754	XRF	0,0328	Photom.	0,354	XRF	3,61
XRF	0,0248	IR	0,791	XRF	0,0345	XRF	0,356	XRF	3,74
<b>P<sub>2</sub>O<sub>5</sub></b>		<b>S</b>		<b>Cr<sub>2</sub>O<sub>3</sub></b>		<b>TiO<sub>2</sub></b>		<b>F</b>	
Value	0,0118		0,711		0,0255		0,345		3,43
s <sub>M</sub>	0,0059		0,048		0,0062		0,009		0,22
U	0,0033		0,034		0,0036		0,005		0,25

## 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 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 100g bottle.

**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 31/9A** – X-Ray Fluorescence spectrometries and wet-way analysis, S on combustion analysers by IR absorption with measurements metrological traceable to adequate CRM. 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.

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

**Responsible person:** Martin Bogumský

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