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CERTIFICATE OF CHEMICAL ANALYSIS No 08 – 24

PIG IRON for solid sample spectrometry, combustion and wet-way methods

SPL 35B (PT 32/4A)

CERTIFIED VALUES – Mass content in %wt.

Element	Value [%wt.]	Uncertainty [%wt.]
C	4.385	0.009
Mn	0.122	0.003
Si	0.054	0.004
P	0.0163	0.0014
S	0.0154	0.0013
Cu	0.0293	0.0015
Cr	0.040	0.001
Ni	0.0160	0.0014
Al	0.0039	0.0004

Element	Value [%wt.]	Uncertainty [%wt.]
Mo	0.0082	0.0008
V	0.0114	0.0004
Ti	0.0119	0.0009
Co	0.0082	0.0006
Sn	0.0082	0.0008
B	0.0044	0.0003
Nb	0.0070	0.0009
Sb	0.0083	0.0012

PARTICIPATING LABORATORIES:

ARCELORMITTAL Poland S.A., Poland
CMC Poland, Poland
COGNOR S.A. - Ferrostal Łabędy, Poland
DAIMLER TRUCK AG, Germany
DUNAFERR Labor Nonprofit, Hungary
ENVIFORM, Czech Republic

PCS, Czech Republic
SSAB, Sweden
TATA STEEL IJMUIDEN, Netherlands
TATRA METALURGIE, Czech Republic
ZPS - SLÉVÁRNA, Czech Republic

35B - ANALYTICAL DATA:

Method	C	Method	Mn	Method	Si	Method	P	Method	S	Method	Cu	Method	Cr	Method	Ni	Method	Al
AES-m.	3,534*							XRF	0,0128								
IR	4,265*							XRF	0,0130								
AES	4,294*							IR	0,0135								
XRF	4,361							IR	0,0142								
AAS	4,363							IR	0,0146								
IR	4,363							XRF	0,0148								
IR	4,365							AES	0,0150								
AES	4,370	AES	0,112			AES	0,0121	AES	0,0152	AES	0,0246	AES	0,035				
IR	4,373	AES	0,118	AES-m.	0,026*	AES	0,0132	IR	0,0153	AES	0,0254	AES	0,036	AES-m.	0,0069*		
IR	4,380	AES	0,118	AES	0,041	XRF	0,0136	IR	0,0155	XRF	0,0258	AES	0,037	AES	0,0130		
IR	4,384	AES	0,119	AES	0,044	ICP	0,0145	IR	0,0155	XRF	0,0269	AES	0,037	AES	0,0130		
IR	4,387	XRF	0,119	AES	0,048	XRF	0,0146	IR	0,0156	AES	0,0278	ICP	0,037	AES	0,0136		
AES	4,390	ICP	0,119	AES	0,050	AES	0,0160	IR	0,0160	AES	0,0282	ICP	0,039	AES	0,0138		
IR	4,390	AES	0,120	XRF	0,051	AES	0,0165	IR	0,0161	ICP	0,0283	AES	0,040	ICP	0,0147		
IR	4,392	AAS	0,121	AES	0,053	ICP	0,0168	AES	0,0163	AAS	0,0283	XRF	0,040	XRF	0,0149		
AES	4,396	XRF	0,121	AES	0,054	AES	0,0170	AES	0,0168	AES	0,0293	AES	0,040	ICP	0,0154	AES	0,0028
AES	4,396	AES	0,123	XRF	0,054	XRF	0,0174	IR	0,0170	XRF	0,0298	AES-m.	0,040	XRF	0,0160	AES	0,0036
IR	4,403	AES	0,123	AES	0,055	AES	0,0174	AAS	0,0171	AES	0,0301	AES	0,041	XRF	0,0161	AES	0,0036
AES	4,405	XRF	0,123	AAS	0,055	AES	0,0190	AES	0,0200	AES	0,0306	XRF	0,041	AES	0,0166	AES	0,0040
IR	4,424	AES	0,124	AES	0,056	AES-m.	0,0202	AES	0,0204	ICP	0,0307	AES	0,041	AES	0,0168	AES	0,0040
IR	4,454*	XRF	0,125	AES	0,059	AES	0,0210	AES	0,0208	AES	0,0315	XRF	0,041	AES	0,0183	AES	0,0040
AES	4,578*	AES	0,131	ICP	0,063	AAS	0,0245*	AES	0,0212	XRF	0,0315	AES	0,042	AES	0,0184	AES-m.	0,0040
XRF	4,648*	AES-m.	0,133	XRF	0,066	AES	0,0265*	AES	0,0218	AES	0,0336	XRF	0,042	AES	0,0198	AES	0,0043
								AES-m.	0,0251	AES-m.	0,0360	AAS	0,043	XRF	0,0211	AES	0,0045
	C		Mn		Si		P		S		Cu		Cr		Ni		Al
Value	4,385		0,122		0,054		0,0163		0,0154		0,0293		0,040		0,0160		0,0039
s _M	0,018		0,005		0,007		0,0026		0,0031		0,0029		0,002		0,0025		0,0005
U	0,009		0,003		0,004		0,0014		0,0013		0,0015		0,001		0,0014		0,0004

Method	Mo	Method	V	Method	Ti	Method	Co	Method	Sn	Method	B	Method	Nb	Method	Sb
AES-m.	0,0050	AES-m.	0,0058*	AES	0,0089										
AES	0,0062	AES	0,0098	AES	0,0090			AES-m.	0,0050						
AES	0,0065	XRF	0,0100	AAS	0,0100			AES	0,0066						
AES	0,0070	XRF	0,0109	AES	0,0103			AES	0,0068						
XRF	0,0078	ICP	0,0110	XRF	0,0110	AES-m.	0,0057	AES	0,0070	AES	0,0035				
AES	0,0082	AES	0,0112	AES	0,0111	AES	0,0070	AES	0,0072	AES	0,0041	AES	0,0050		
AES	0,0084	AES	0,0114	AES	0,0115	AES	0,0072	AES	0,0072	AES	0,0042	AES	0,0054		
AES	0,0087	XRF	0,0115	ICP	0,0120	AES	0,0079	XRF	0,0080	AES	0,0043	AES	0,0056	AES	0,0065
ICP	0,0089	AES	0,0116	AES	0,0120	AES	0,0080	ICP	0,0085	AES	0,0043	AES	0,0060	AES	0,0069
XRF	0,0090	AES	0,0116	XRF	0,0121	AES	0,0087	AES	0,0086	AES	0,0044	ICP	0,0065	AAS	0,0070
AES	0,0091	AES	0,0117	AES	0,0124	ICP	0,0087	AES	0,0088	AES	0,0044	AAS	0,0076	AES	0,0073
AAS	0,0093	AAS	0,0118	AES	0,0130	AES	0,0088	AES	0,0089	AES	0,0045	AES	0,0076	AES	0,0075
AES	0,0095	AES	0,0119	AES-m.	0,0130	AES	0,0088	AES	0,0090	AES	0,0045	AES	0,0076	AES	0,0075
XRF	0,0095	AES	0,0120	ICP	0,0132	AES	0,0088	ICP	0,0091	AES	0,0046	XRF	0,0080	AES	0,0090
ICP	0,0102	XRF	0,0123	XRF	0,0133	AAS	0,0089	AES	0,0092	AAS	0,0047	AES-m.	0,0080	AES	0,0094
AES	0,0136*	ICP	0,0127	XRF	0,0137	AES	0,0090	AAS	0,0095	ICP	0,0051	AES	0,0086	AES	0,0095
					0,0150	AES	0,0094	XRF	0,0111	AES-m.	0,0071*	AES	0,0090	ICP	0,0112
	Mo		V		Ti		Co		Sn		B		Nb		Sb
Value	0,0082		0,0114		0,0119		0,0082		0,0082		0,0044		0,0070		0,0083
s _M	0,0015		0,0008		0,0017		0,0010		0,0015		0,0004		0,0014		0,0016
U	0,0008		0,0004		0,0009		0,0006		0,0008		0,0003		0,0009		0,0012

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 pig iron 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 40 mm in diameter and approximately 18mm 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 32/4A** - 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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