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CERTIFICATE OF CHEMICAL ANALYSIS No 01 – 21

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

SPL CM-25A (PT 29/1A)

CERTIFIED VALUES – Mass content in %wt.

Element	*Value* [%wt.]	*Uncertainty* [%wt.]
C	**0.097**	0.002
Mn	**0.781**	0.004
Si	**0.656**	0.008
P	**0.0036**	0.0006
S	**0.0051**	0.0004
Cu	**0.0040**	0.0004

Element	*Value* [%wt.]	*Uncertainty* [%wt.]
Cr	**0.0248**	0.0006
Ni	**0.0214**	0.0006
Al	**0.0030**	0.0006
W	**0.0048**	0.0020
V	**0.0161**	0.0006
N	**0.0061**	0.0004

PARTICIPATING LABORATORIES:

ARCELORMITTAL Avilés (Asturias), Spain
ARCELORMITTAL Gijón (Asturias), Spain
ARCELORMITTAL Warszawa, Poland
BONATRANS, Czech Republic
BRITISH STEEL, United Kingdom
CMC Poland, Poland
COGNOR S.A. - Ferrostal Łabędy, Poland
COGNOR S.A. - HSJ, Poland
COMTES, Czech Republic
ČEZ - JE Temelín, Czech Republic
ČZ, Czech Republic
DEFEKTA NDT, Czech Republic
DILLINGER, Germany
DUNAFERR Labor Nonprofit, Hungary
ENVIFORM, Czech Republic
ERÉGLI DEMIR, Turkey
FERROMET, Czech Republic
GO STEEL, Czech Republic
JSC Moldova Steel Works, Moldova
LIBERTY Częstochowa, Poland
LIBERTY Ostrava, Czech Republic
MM VÝZKUM, Czech Republic
MS UTILITIES & SERVICES, Czech Republic
OCAS NV, Belgium
ORLEN UNIPETROL RPA, Czech Republic
SSAB EMEA, Sweden
ŠKODA AUTO, Czech Republic
TATA STEEL IJMUIDEN, Netherlands
TÜV NORD Czech, Czech Republic
ÚJV ŘEŽ, Czech Republic
VOESTALPINE STAHL, Austria
VZÚ PLZEŇ, Czech Republic
Z - GROUP - Ocelárna Hrádek, Czech Republic
ZPS - SLÉVÁRNA, Czech Republic
ŽĎAS, Czech Republic
ŽELEZIARNE PODBREZOVÁ, Slovakia

CM-25A - ANALYTICAL DATA:

Method	C	Method	Mn	Method	Si	Method	P	Method	S	Method	Cu	Method	Cr	Method	Ni	Method	Al	Method	W	Method	V	Method	N
IR	**0,089**							AES	**0,0040**														
IR	**0,090**							IR	**0,0041**														
IR	**0,092**							IR	**0,0042**														
IR	**0,093**							AES	**0,0043**														
IR	**0,093**							AES	**0,0044**														
IR	**0,093**							IR	**0,0045**														
AES	**0,094**							AES	**0,0045**														
IR	**0,094**	ICP	**0,759**					IR	**0,0045**														
IR	**0,094**	AES	**0,764**					IR	**0,0045**														
AES	**0,094**	AES	**0,765**	AES-m.	**0,616**			AES	**0,0046**														
AES	**0,094**	AES	**0,767**	ICP	**0,618**			AES	**0,0046**														
AES	**0,094**	AES	**0,768**	ICP	**0,627**			IR	**0,0046**			ICP	**0,0174***	AES	**0,0164**					ICP	**0,0127**		
IR	**0,095**	ICP	**0,769**	AES	**0,628**			IR	**0,0046**			ICP	**0,0225**	AES	**0,0178**					AES	**0,0132**		
IR	**0,095**	AES	**0,770**	XRF	**0,630**	AES	**0,0009**	IR	**0,0046**			AES	**0,0230**	XRF-m.	**0,0181**					ICP	**0,0143**		
IR	**0,095**	ICP	**0,771**	AES	**0,634**	AES-m.	**0,0010**	AES	**0,0046**			ICP	**0,0230**	AES	**0,0189**					AES	**0,0144**		
IR	**0,095**	Titrimetric	**0,772**	ICP	**0,635**	AES-m.	**0,0016**	AES	**0,0047**			ICP	**0,0231**	AES	**0,0190**					AES	**0,0146**		
IR	**0,095**	AES	**0,772**	AES	**0,635**	AES	**0,0020**	IR	**0,0047**			XRF	**0,0231**	AES-m.	**0,0195**					AES	**0,0148**		
IR	**0,095**	AES-m.	**0,774**	AES	**0,635**	AES	**0,0024**	AES-m.	**0,0048**	ICP	**0,0007***	ICP	**0,0232**	AES	**0,0196**					AES	**0,0148**	AES	**0,0050**
AES-m.	**0,096**	AES	**0,774**	AES	**0,641**	ICP	**0,0024**	AES-m.	**0,0048**	AES-m.	**0,0024**	AES	**0,0235**	ICP	**0,0196**					AES	**0,0150**	AES	**0,0052**
AES	**0,096**	AES	**0,774**	AES	**0,645**	AES	**0,0025**	IR	**0,0049**	AES	**0,0025**	AES	**0,0236**	AES	**0,0205**					ICP	**0,0152**	TCM	**0,0053**
AES	**0,096**	AES	**0,775**	AES	**0,645**	AES	**0,0027**	AES	**0,0049**	AES	**0,0027**	AES-m.	**0,0236**	ICP	**0,0205**					ICP	**0,0152**	TCM	**0,0053**
IR	**0,096**	AES	**0,775**	AES	**0,645**	AES	**0,0030**	IR	**0,0049**	AES	**0,0028**	AES	**0,0236**	AES	**0,0206**					AES	**0,0153**	TCM	**0,0054**
AES	**0,097**	AES-m.	**0,776**	AES	**0,646**	AES	**0,0030**	AES	**0,0050**	AES	**0,0028**	AES	**0,0237**	ICP	**0,0207**					AES	**0,0156**	AES	**0,0055**
AES	**0,097**	XRF-m.	**0,776**	AES	**0,648**	AES	**0,0030**	IR	**0,0050**	AES	**0,0032**	AES	**0,0239**	AES	**0,0210**	ICP	**0,0007**			AES	**0,0156**	TCM	**0,0055**
AES	**0,097**	AES-m.	**0,777**	AES	**0,650**	AES	**0,0031**	IR	**0,0050**	XRF	**0,0032**	AES	**0,0240**	AES	**0,0210**	AES	**0,0014**			ICP	**0,0156**	AES	**0,0056**
IR	**0,097**	ICP	**0,777**	Gravim.	**0,650**	AES	**0,0031**	IR	**0,0051**	AES	**0,0033**	AES	**0,0241**	AES	**0,0211**	AES	**0,0018**			AES	**0,0158**	TCM	**0,0057**
AES	**0,097**	XRF-m.	**0,778**	ICP	**0,654**	AES	**0,0032**	AES	**0,0051**	ICP	**0,0036**	AES	**0,0242**	AES	**0,0212**	AES	**0,0019**			AES-m.	**0,0158**	IR	**0,0057**
AES	**0,098**	AES	**0,778**	AES-m.	**0,655**	AES	**0,0032**	AES	**0,0051**	ICP	**0,0037**	AES-m.	**0,0242**	AES	**0,0213**	AES	**0,0020**			AES	**0,0158**	AES	**0,0057**
IR	**0,098**	ICP	**0,778**	AES	**0,655**	AES	**0,0032**	AES	**0,0052**	AES	**0,0037**	AES	**0,0243**	AES	**0,0214**	AES-m.	**0,0020**			AES	**0,0159**	AES	**0,0058**
IR	**0,098**	AES	**0,779**	ICP	**0,656**	ICP	**0,0033**	AES	**0,0052**	ICP	**0,0038**	AES	**0,0246**	AES	**0,0214**	AES	**0,0021**			XRF	**0,0159**	AES	**0,0058**
AES	**0,098**	ICP	**0,780**	AES	**0,657**	AES	**0,0033**	IR	**0,0052**	AES	**0,0038**	AES	**0,0248**	AES	**0,0214**	AES	**0,0021**			AES	**0,0160**	AES	**0,0058**
IR	**0,098**	AES	**0,780**	AES	**0,657**	AES	**0,0034**	AES	**0,0052**	AES	**0,0039**	AES	**0,0249**	AES	**0,0216**	AES	**0,0022**			AES	**0,0160**	TCM	**0,0059**
AES	**0,098**	ICP	**0,781**	AES	**0,658**	AES	**0,0035**	AES	**0,0052**	AES	**0,0040**	AES	**0,0250**	ICP	**0,0216**	AES	**0,0022**			AES	**0,0160**	TCM	**0,0059**
IR	**0,099**	AES	**0,781**	AES-m.	**0,659**	AES	**0,0035**	AES	**0,0052**	AES	**0,0040**	AES	**0,0250**	AES	**0,0216**	AES	**0,0025**			AES	**0,0163**	AES	**0,0060**
IR	**0,099**	AES	**0,781**	AES	**0,660**	AES	**0,0035**	IR	**0,0052**	AES	**0,0040**	AES	**0,0251**	AES	**0,0217**	AES	**0,0027**			AES	**0,0163**	IR	**0,0060**
IR	**0,099**	ICP	**0,781**	AES	**0,660**	AES	**0,0035**	IR	**0,0052**	AES	**0,0041**	ICP	**0,0251**	AES	**0,0217**	AES	**0,0028**			AES	**0,0164**	TCM	**0,0060**
AES	**0,099**	AES	**0,781**	AES	**0,661**	Photom.	**0,0036**	AES	**0,0052**	AES	**0,0042**	AES	**0,0251**	AES	**0,0218**	AES	**0,0028**			AES	**0,0164**	TCM	**0,0061**
AES	**0,099**	AES	**0,783**	AES	**0,661**	ICP	**0,0037**	AES	**0,0052**	AES	**0,0042**	AES	**0,0252**	AES	**0,0218**	AES-m.	**0,0028**	AES	**0,0010**	ICP	**0,0164**	TCM	**0,0061**
IR	**0,100**	AES	**0,783**	AES	**0,662**	ICP	**0,0038**	IR	**0,0053**	AES	**0,0043**	AES	**0,0253**	AES	**0,0220**	AES	**0,0028**	AES	**0,0014**	AES-m.	**0,0164**	TCM	**0,0062**
AES	**0,100**	AES	**0,784**	Gravim.	**0,663**	AES	**0,0038**	AES	**0,0053**	AES	**0,0043**	ICP	**0,0254**	AES	**0,0220**	ICP	**0,0029**	AES	**0,0017**	AES	**0,0165**	AES	**0,0063**
AES	**0,100**	AES	**0,786**	AES	**0,664**	ICP	**0,0038**	AES	**0,0053**	AES	**0,0044**	AES	**0,0256**	AES	**0,0221**	AES	**0,0030**	AES	**0,0017**	AES	**0,0166**	AES	**0,0064**
IR	**0,100**	AES	**0,786**	AES	**0,665**	AES	**0,0041**	IR	**0,0053**	AES	**0,0044**	AES	**0,0256**	AES	**0,0221**	AES	**0,0030**	AES	**0,0020**	AES	**0,0167**	TCM	**0,0064**
AES	**0,100**	AES	**0,788**	AES	**0,665**	AES	**0,0041**	AES	**0,0054**	ICP	**0,0044**	AES	**0,0256**	AES	**0,0222**	AES	**0,0032**	AES	**0,0021**	ICP	**0,0168**	TCM	**0,0064**
AES	**0,101**	AES	**0,791**	AES	**0,668**	AES	**0,0042**	IR	**0,0055**	AES	**0,0044**	AES	**0,0256**	AES-m.	**0,0222**	AES	**0,0033**	AES	**0,0031**	XRF-m.	**0,0169**	AES	**0,0065**
AES	**0,101**	XRF	**0,793**	Gravim.	**0,671**	XRF	**0,0042**	AES	**0,0055**	AES	**0,0047**	AES	**0,0257**	ICP	**0,0223**	AES	**0,0034**	AES-m.	**0,0034**	AES	**0,0170**	AES-m.	**0,0065**
IR	**0,101**	AES	**0,793**	AES	**0,671**	AES-m.	**0,0042**	IR	**0,0056**	AES	**0,0048**	AES	**0,0258**	AES	**0,0226**	AES	**0,0037**	AES	**0,0050**	AES	**0,0170**	AES	**0,0065**
AES	**0,101**	AES	**0,793**	AES	**0,673**	AES	**0,0042**	IR	**0,0056**	AES-m.	**0,0048**	ICP	**0,0258**	AES	**0,0227**	ICP	**0,0037**	AES	**0,0051**	AES	**0,0170**	AES-m.	**0,0065**
AES	**0,102**	AES	**0,795**	AES	**0,676**	AES	**0,0043**	ICP	**0,0057**	ICP	**0,0048**	AES	**0,0258**	ICP	**0,0227**	AES-m.	**0,0038**	AES-m.	**0,0056**	AES-m.	**0,0172**	AES	**0,0066**
AES-m.	**0,103**	AES	**0,796**	AES	**0,678**	AES	**0,0043**	AES	**0,0058**	AES	**0,0048**	AES-m.	**0,0258**	AES-m.	**0,0228**	AES	**0,0038**	XRF	**0,0066**	AES	**0,0172**	AES	**0,0066**
AES-m.	**0,103**	AES	**0,799**	AES	**0,681**	AES	**0,0044**	AES	**0,0060**	AES	**0,0050**	AES	**0,0260**	AES	**0,0230**	AES	**0,0041**	AES	**0,0070**	AES	**0,0175**	TCM	**0,0066**
AES	**0,104**	AES	**0,802**	XRF-m.	**0,688**	AES	**0,0054**	IR	**0,0062**	AES	**0,0050**	AES	**0,0262**	XRF	**0,0231**	AES	**0,0043**	AES	**0,0081**	AES	**0,0180**	TCM	**0,0067**
AES	**0,105**	AES	**0,802**	AES	**0,689**	AES	**0,0061**	IR	**0,0062**	AES	**0,0052**	AES	**0,0266**	AES	**0,0234**	AES	**0,0047**	AES	**0,0087**	AES	**0,0182**	AES	**0,0067**
AES	**0,111***	AES	**0,805**	AES	**0,694**	AES	**0,0064**	AES-m.	**0,0064**	AES-m.	**0,0056**	AES	**0,0267**	AES	**0,0240**	AES	**0,0050**	AES	**0,0088**	AES	**0,0184**	AES	**0,0074**
AES	**0,114***	AES	**0,806**	AES	**0,701**	AES	**0,0067**	AES	**0,0066**	ICP	**0,0074***	AES	**0,0272**	ICP	**0,0261**	ICP	**0,0055**	AES	**0,0110**	AES	**0,0187**	AES	**0,0077**

	C		Mn		Si		P		S		Cu		Cr		Ni		Al		W		V		N
Value	**0,097**		**0,781**		**0,656**		**0,0036**		**0,0051**		**0,0040**		**0,0248**		**0,0214**		**0,0030**		**0,0048**		**0,0161**		**0,0061**
s_M	0,003		0,011		0,019		0,0014		0,0006		0,0008		0,0012		0,0017		0,0011		0,0031		0,0012		0,0006
U	**0,002**		**0,004**		**0,008**		**0,0006**		**0,0004**		**0,0004**		**0,0006**		**0,0006**		**0,0006**		**0,0020**		**0,0006**		**0,0004**

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 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 29/1A** - laboratories by various spectrometric methods (AES spark, glow discharge, XRF) and alternative methods (combustion, thermoevolution, wet-way) standard methods, with measurements metrological traceabled 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 ± 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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