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CERTIFICATE OF CHEMICAL ANALYSIS No 04 – 20

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

SPL LA-5C

CERTIFIED VALUES – Mass content in %wt.

Element	Value [%wt.]	Uncertainty [%wt.]
C	0.439	0.007
Mn	1.873	0.012
Si	0.394	0.008
P	0.0179	0.0011
S	0.0088	0.0008
Cu	0.138	0.002
Cr	3.815	0.026
Ni	2.591	0.020
Al	0.081	0.003
Mo	0.867	0.011
W	0.631	0.008

Element	Value [%wt.]	Uncertainty [%wt.]
V	0.536	0.006
Ti	0.048	0.001
Co	0.088	0.002
As	0.026	0.002
Sn	0.031	0.001
Sb	0.018	0.003
Pb	0.0156	0.0011
Zn	0.013	
Nb	0.057	0.002
N	0.0248	0.0012

PARTICIPATING COUNTRIES:

Russian Federation (10), Czech Republic (7), Belgium (3), Spain (2), Brazil (2), Hungary (2), Bulgaria (1), Switzerland (1), Poland (1) and Austria (1).

COMMENTS:

Value – reference value, s_M – standard deviation of intralaboratory means (* - result excluded as outlier)

U – Uncertainty of the reference value $U = \pm \frac{t_{5;0.05}}{\sqrt{n}} \cdot s_M$ 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.

LA-5C - ANALYTICAL DATA:

Method	C	Method	Mn	Method	Si	Method	P	Method	S	Method	Cu	Method	Cr
		AES	1,670*										
		XRF	1,697*	AES	0,351	AES	0,0120			AES	0,128	XRF	3,308*
		AES	1,759*	XRF	0,366	ICP	0,0121	AES	0,0044	AES	0,128	AES	3,674
AES	0,402	AES	1,816	ICP	0,375	XRF	0,0130	AES	0,0048	ICP	0,129	XRF	3,691
AES	0,408	ICP	1,821	XRF	0,375	AES	0,0152	AES	0,0066	AES	0,131	AES	3,701
AES	0,420	AES	1,827	ICP	0,377	AES	0,0157	XRF	0,0066	AES	0,133	ICP	3,754
AES	0,423	AES	1,840	AES	0,380	AES	0,0157	AES	0,0071	AES	0,133	AES	3,765
AES	0,425	AES	1,841	XRF	0,381	AES	0,0159	XRF	0,0074	ICP	0,134	AES	3,775
AES	0,426	AES	1,850	AES	0,381	AES	0,0163	AES	0,0081	AES	0,134	AES	3,784
AES	0,433	AES	1,852	AES	0,382	AES	0,0166	AES	0,0082	AES	0,135	XRF	3,786
AES	0,433	AES	1,854	AES	0,384	AES	0,0174	IR+TCM	0,0083	AES	0,135	AES	3,788
IR+TCM	0,440	XRF	1,855	AES	0,384	AES	0,0178	IR+TCM	0,0083	AES	0,135	AES	3,797
AES	0,440	AES	1,873	AES	0,389	AES	0,0180	AES	0,0084	ICP	0,136	ICP	3,806
AES	0,440	AES	1,876	AES	0,390	ICP	0,0181	AES	0,0088	XRF	0,136	AES	3,816
AES	0,441	AES	1,880	ICP	0,393	AES	0,0182	AES	0,0088	AES	0,136	ICP	3,831
AES	0,443	AES	1,881	AES	0,393	ICP	0,0182	IR+TCM	0,0088	XRF	0,136	AES	3,833
AES	0,443	AES	1,882	AES	0,395	AES	0,0183	IR+TCM	0,0089	AES	0,138	XRF	3,834
AES	0,443	XRF	1,883	Gravim.	0,396	AES	0,0187	AES	0,0090	AES	0,138	AES	3,838
IR+TCM	0,444	AES	1,888	AES	0,402	AES	0,0190	AES	0,0091	AES	0,139	AES	3,842
IR+TCM	0,444	AES	1,889	AES	0,404	AES	0,0193	AES	0,0092	AES	0,139	AES	3,844
AES	0,445	Photom.	1,891	AES	0,405	XRF	0,0198	AES	0,0092	AES	0,140	AES	3,849
AES	0,446	AES	1,892	AES	0,408	AES	0,0205	AES	0,0097	AES	0,143	AES	3,850
AES	0,446	ICP	1,893	AES	0,409	AES	0,0206	AES	0,0097	AES	0,143	AES	3,860
IR+TCM	0,450	ICP	1,894	AES	0,414	AES	0,0211	AES	0,0097	XRF	0,144	Titrim.	3,863
AES	0,452	AES	1,904	AES	0,416	XRF	0,0212	IR+TCM	0,0107	AES	0,145	AES	3,870
IR+TCM	0,453	AES	1,908	AES	0,417	AES	0,0214	XRF	0,0114	AES	0,146	AES	3,876
AES	0,459	AES	1,909	AES	0,426	AES	0,0217	AES	0,0131	AES	0,150	AES	3,925
IR+TCM	0,480	AES	1,916	Photom.	0,433	Photom.	0,0222	AES	0,0140	AES	0,155	AES	3,938
													4,068*
C		Mn		Si		P		S		Cu		Cr	
Value	0,439		1,873		0,394		0,0179		0,0088		0,138		3,815
s ₉₅	0,016		0,028		0,019		0,0028		0,0021		0,006		0,064
U	0,007		0,012		0,008		0,0011		0,0008		0,002		0,026

Method	Ni	Method	Al	Method	Mo	Method	W	Method	V	Method	Ti	Method	Co
AES	2,496												
AES	2,504			AES	0,797			XRF	0,459*				
AES	2,506			AES	0,819			AES	0,506	AES	0,044		
AES	2,532			AES	0,830			AES	0,508	AES	0,044		
AES	2,547	ICP	0,062	XRF	0,849			AES	0,516	AES	0,044		
AES	2,556	AES	0,069	AES	0,851	AES	0,589	AES	0,522	XRF	0,045		
AES	2,560	AES	0,070	AES	0,855	AES	0,611	AES	0,528	AES	0,045	XRF	0,062*
XRF	2,561	AES	0,072	AES	0,855	AES	0,613	AES	0,529	AES	0,046	AES	0,081
AES	2,569	AES	0,072	AES	0,856	AES	0,613	AES	0,529	AES	0,046	ICP	0,082
AES	2,574	ICP	0,076	AES	0,857	XRF	0,614	AES	0,530	ICP	0,046	XRF	0,082
XRF	2,574	AES	0,076	AES	0,858	AES	0,614	AES	0,530	AES	0,047	AES	0,084
ICP	2,579	AES	0,077	ICP	0,859	AES	0,621	AES	0,533	Photom.	0,048	AES	0,084
AES	2,579	AES	0,081	AES	0,859	AES	0,623	AES	0,533	ICP	0,048	AES	0,085
AES	2,581	AES	0,082	AES	0,861	AES	0,624	AES	0,536	AES	0,048	AES	0,085
ICP	2,586	AES	0,082	AES	0,864	AES	0,625	AES	0,536	AES	0,048	AES	0,087
AES	2,606	XRF	0,082	AES	0,866	ICP	0,626	AES	0,537	AES	0,048	ICP	0,087
XRF	2,615	AES	0,083	XRF	0,867	AES	0,626	AES	0,538	AES	0,048	ICP	0,088
AES	2,626	AES	0,084	Photom.	0,869	AES	0,628	ICP	0,539	AES	0,048	AES	0,088
XRF	2,629	AES	0,085	AES	0,870	AES	0,634	ICP	0,540	AES	0,049	AES	0,088
AES	2,629	AES	0,086	AES	0,874	XRF	0,635	AES	0,541	AES	0,049	AES	0,088
AES	2,632	ICP	0,086	AES	0,878	AES	0,635	AES	0,541	AES	0,049	AES	0,089
AES	2,637	AES	0,088	AES	0,885	AES	0,641	AES	0,542	AES	0,049	AES	0,089
AES	2,637	AES	0,089	ICP	0,894	AES	0,642	AES	0,542	AES	0,050	AES	0,089
AES	2,638	AES	0,089	AES	0,897	ICP	0,648	ICP	0,554	AES	0,051	AES	0,090
Photom.	2,641	AES	0,089	AES	0,898	ICP	0,654	XRF	0,556	AES	0,051	AES	0,091
ICP	2,661	AES	0,089	ICP	0,899	AES	0,658	AES	0,557	ICP	0,051	AES	0,093
AES	2,689	AES	0,089	XRF	0,904	AES	0,665	AES	0,579	AES	0,051	AES	0,096
AES	2,790*	AES	0,090	AES	0,931	AES	0,667	XRF	0,633*	XRF	0,052	AES	0,096
Ni		Al		Mo		W		V		Ti		Co	
Value	2,591		0,081		0,867		0,631		0,536		0,048		0,088
s ₉₅	0,050		0,008		0,027		0,019		0,015		0,002		0,004
U	0,020		0,003		0,011		0,008		0,006		0,001		0,002

Method	As	Method	Sn	Method	Sb	Method	Pb	Method	Zn	Method	Nb	Method	N
ICP	0,017	ICP	0,026								ICP		0,048
ICP	0,019	ICP	0,027								ICP		0,049
AES	0,021	ICP	0,028								XRF		0,049
AES	0,021	AES	0,029								AES		0,052
AES	0,022	AES	0,030								ICP		0,052
AES	0,024	AES	0,030								XRF		0,053
AES	0,025	XRF	0,030	ICP	0,010	AES	0,0063*				AES		0,055
AES	0,025	AES	0,031	ICP	0,013	AES	0,0121				AES	AES	0,0152*
AES	0,026	AES	0,031	AES	0,014	ICP	0,0134				AES	AES	0,0199
AES	0,026	AES	0,031	AES	0,014	XRF	0,0137				AES	AES	0,0221
AES	0,026	AES	0,031	AES	0,015	AES	0,0138				AES	IR+TCM	0,0223
AES	0,026	AES	0,032	AES	0,015	AES	0,0148				AES	AES	0,0238
AES	0,026	AES	0,032	AES	0,016	AES	0,0151				AES	AES	0,0243
AES	0,027	AES	0,032	AES	0,017	AES	0,0152				AES	IR+TCM	0,0251
AES	0,028	AES	0,032	AES	0,018	AES	0,0152				AES	AES	0,0254
AES	0,028	AES	0,033	AES	0,018	AES	0,0157				AES	AES	0,0254
AES	0,029	AES	0,033	AES	0,019	ICP	0,0161				AES	AES	0,0255
AES	0,031	AES	0,034	AES	0,020	AES	0,0171	5	0,0059	AES	0,061	AES	0,0260
AES	0,032	AES	0,034	AES	0,021	AES	0,0173	2	0,0089	AES	0,062	IR+TCM	0,0262
ICP	0,034	AES	0,034	AES	0,024	ICP	0,0179	18	0,0124	AES	0,063	AES	0,0264
XRF	0,038	AES	0,040*	AES	0,025	AES	0,0179	17	0,0170	AES	0,064	AES	0,0269
AES	0,076*	AES	0,040*	ICP	0,026	AES	0,0183	13	0,0266	AES	0,066	AES	0,0277
As		Sn		Sb		Pb		Zn		Nb		N	
Value	0,026		0,031		0,018		0,0156		0,013		0,057		0,0248
s ₉₅	0,005		0,002		0,005		0,0019				0,005		0,0021
U	0,002		0,001		0,003		0,0011				0,002		0,0012

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 26/6 - 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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