



SPL-LABMAT s.r.o.

1.máje 432, CZ-735 31 Bohumín, Czech Republic
e-mail: info@spl-labmat.cz, www.spl-labmat.cz, phone: +420 596 014 627

CERTIFICATE OF CHEMICAL ANALYSIS No 14 – 22

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

SPL SP-5C (PT 30/6B)

CERTIFIED VALUES – Mass content in %wt.

Element	Value [%wt.]	Uncertainty [%wt.]
C	0.233	0.003
Mn	1.518	0.012
Si	2.681	0.051
P	0.117	0.005
S	0.0226	0.0008
Cu	0.288	0.004
Cr	0.628	0.008
Ni	2.881	0.027
Al	0.371	0.009
Mo	0.148	0.002
W	0.579	0.017

Element	Value [%wt.]	Uncertainty [%wt.]
V	0.718	0.012
Ti	0.446	0.010
Co	0.139	0.002
As	0.115	0.011
Sn	0.091	0.002
Nb	0.140	0.005
Sb	0.0799	0.0028
Pb	0.089	0.007
Zr	0.0494	0.0023
N	0.0079	0.0006
B	<i>0.18</i>	

PARTICIPATING LABORATORIES:

CMC Poland, Poland
COGNOR S.A. - Ferrostal Łabędy, Poland
COMTES, Czech Republic
DUNAFERR Labor Nonprofit, Hungary
ENVIROLAB MIKE, Greece
ESAB CZ, Czech Republic
GENERALZOLLDIREKTION, Germany
GO STEEL, Czech Republic
INSTITUT PRO TEST. A CERTIFIKACI, Czech Republic

IMT, Slovenia
OCAS NV, Belgium
PCS, Czech Republic
SSAB EMEA, Sweden
ŠKODA AUTO, Czech Republic
TATA STEEL IJMUIDEN, Netherlands
VOESTALPINE, Austria
VÚHŽ, Czech Republic
ZPS - SLÉVÁRNA, Czech Republic

SP-5C - ANALYTICAL DATA:

Method	C	Method	Mn	Method	Si	Method	P	Method	S	Method	Cu	Method	Cr	Method	Ni	
		AES-m.	1,466									ICP	0,468*			
		AES	1,468								AES	0,272	AES	0,600	XRF	2,650*
		AES	1,476								AES-m.	0,273	XRF-m.	0,606	ICP	2,728
AES-m.	0,222	AES	1,481					IR	0,0202	AES-m.	0,277	AES	0,607	AES-m.	2,788	
TCM	0,224	AES	1,484					IR	0,0206	AES	0,279	AAS	0,608	AES	2,790	
AES	0,227	AES	1,494					AES	0,0208	AES	0,279	AES	0,611	AES	2,802	
AES	0,227	AES-m.	1,496	AES	2,528			AES	0,0210	XRF	0,283	AES	0,611	AES	2,806	
AES	0,227	AES	1,500	AES	2,538			IR	0,0217	ICP	0,284	XRF	0,611	AES-m.	2,819	
IR	0,228	XRF	1,502	AES-m.	2,558	AES	0,105	IR	0,0218	AES	0,284	AES-m.	0,612	AES	2,846	
AES	0,228	XRF	1,504	XRF	2,569	AES-m.	0,107	IR	0,0219	ICP	0,285	AES	0,616	XRF	2,848	
IR	0,229	AES	1,510	XRF	2,579	ICP	0,109	IR	0,0219	XRF-m.	0,286	AES	0,619	XRF	2,875	
AES	0,230	XRF	1,515	AES	2,596	AES	0,111	IR	0,0224	AES	0,286	XRF	0,622	AES	2,877	
IR	0,231	AES	1,521	AES	2,605	AES	0,112	IR	0,0225	AES	0,286	AES	0,625	XRF-m.	2,879	
AES	0,231	AES	1,524	XRF-m.	2,622	XRF-m.	0,112	IR	0,0226	AES	0,287	ICP	0,625	AES	2,880	
IR	0,232	ICP	1,526	AES	2,622	AES	0,113	AES	0,0228	ICP	0,289	AES	0,629	AES	2,896	
AES	0,232	AES	1,528	AES	2,647	AES	0,113	AES	0,0230	AAS	0,290	AES	0,630	AES	2,909	
IR	0,235	AES	1,530	AES	2,668	AES	0,114	AES	0,0237	AES	0,290	AES	0,630	AES	2,921	
IR	0,236	AAS	1,533	Gravim.	2,673	ICP	0,114	AES	0,0239	AES	0,290	AES	0,632	AAS	2,927	
IR	0,236	XRF-m.	1,538	Gravim.	2,688	ICP	0,117	AES	0,0240	AES	0,291	ICP	0,632	AES	2,929	
IR	0,236	ICP	1,538	AES	2,721	AES	0,121	IR	0,0242	AES	0,294	AES	0,633	AES	2,932	
IR	0,237	AES	1,541	AES	2,734	XRF	0,124	AES	0,0245	XRF	0,297	AES	0,635	AES	2,934	
IR	0,238	XRF	1,550	AES	2,757	AES	0,125	AES	0,0255	XRF	0,298	AES	0,636	XRF	2,935	
IR	0,238	AES	1,551	AES	2,783	AES	0,127	AES	0,0257	AES	0,300	ICP	0,639	ICP	2,946	
AES	0,239	ICP	1,554	AES	2,800	AES	0,128	AES	0,0274*	ICP	0,306	ICP	0,644	ICP	2,950	
AES	0,242	AES	1,555	ICP	2,803	AES	0,129	AES-m.	0,0286*	XRF	0,315	XRF	0,662	ICP	2,964	
AES	0,244	ICP	1,574	AES	2,857	ICP	0,131	XRF	0,030*	AES	0,317*	AES-m.	0,664	ICP	2,967	
AES	0,245	ICP	1,735*	AES-m.	2,944	AES	0,144*	XRF-m.	0,0319*	AES	0,328*	XRF	0,677	AES	3,357*	
	C		Mn		Si		P		S		Cu		Cr		Ni	
Value	0,233		1,518		2,681		0,117		0,0226		0,288		0,628		2,881	
S _M	0,006		0,029		0,112		0,010		0,0019		0,010		0,019		0,065	
U	0,003		0,012		0,051		0,005		0,0008		0,004		0,008		0,027	

Method	Al	Method	Mo	Method	W	Method	V	Method	Ti	Method	Co	Method	As	Method	Sn
		AES-m.	0,136												
		ICP	0,141			ICP	0,648								
		AES	0,142			XRF	0,683								
AES	0,160*	ICP	0,142			ICP	0,692				ICP	0,113*			
AES	0,338	ICP	0,142			AES	0,697				ICP	0,130		ICP	0,032*
AES-m.	0,346	AES	0,142	ICP	0,486	AES-m.	0,699	ICP	0,419	XRF	0,131			AES	0,082
AES	0,347	AES	0,143	AES	0,532	AES	0,703	ICP	0,420	AES-m.	0,136			XRF	0,083
ICP	0,350	AES	0,143	AES	0,538	AES	0,706	AES-m.	0,424	AES	0,136			ICP	0,084
AES	0,352	XRF	0,146	AES	0,540	ICP	0,707	ICP	0,425	AES	0,137			AES	0,087
AES	0,353	AES	0,147	AES	0,559	AES	0,708	AES	0,426	AES	0,137			AES-m.	0,088
AES-m.	0,354	AES	0,148	XRF	0,562	AES	0,709	XRF-m.	0,427	AES	0,137	AES	0,077	AES	0,088
ICP	0,355	AES	0,148	AES	0,562	AES	0,712	AES-m.	0,429	AES	0,137	AES	0,089	AES	0,090
ICP	0,362	AES	0,148	AES	0,564	AES	0,715	AES	0,431	AES	0,138	AES	0,097	AES	0,090
AES	0,363	AES	0,148	AES	0,574	AES	0,715	ICP	0,439	AES	0,138	XRF	0,099	AES	0,090
XRF	0,373	AES	0,150	AES	0,574	XRF	0,718	AES	0,440	AES	0,138	ICP	0,105	XRF-m.	0,091
ICP	0,374	AES	0,150	AES	0,575	AES	0,718	XRF	0,447	AES	0,138	ICP	0,106	AES	0,091
AES	0,376	XRF	0,151	AES	0,580	ICP	0,718	ICP	0,447	AES	0,139	AES	0,107	ICP	0,092
AES	0,377	AES	0,152	AES	0,591	AES	0,719	AES	0,450	ICP	0,139	AES-m.	0,110	AES	0,092
AES	0,380	ICP	0,153	XRF	0,596	AAS	0,726	AES	0,451	ICP	0,140	AES	0,116	AES	0,092
ICP	0,381	AES	0,154	AES	0,598	ICP	0,728	AES	0,453	XRF-m.	0,141	AES	0,117	AES	0,093
XRF-m.	0,383	AES	0,154	XRF-m.	0,607	XRF-m.	0,730	AES	0,455	AES	0,141	AES	0,123	AES	0,093
AES	0,385	ICP	0,154	XRF-m.	0,611	AES	0,738	AES	0,455	AES-m.	0,142	AES	0,129	XRF	0,094
AES	0,391	XRF-m.	0,156	AES	0,612	AES	0,740	AES	0,476	AES	0,143	AES	0,133	AES	0,096
AES	0,401	XRF	0,157	XRF	0,613	AES	0,765	AES	0,480	ICP	0,144	AES	0,133	AES	0,098
AES	0,412	AES	0,161	AES-m.	0,614	XRF	0,783	AES	0,480	AES	0,147	AES	0,146	AES	0,098
AES	0,416	AES-m.	0,185*	AES-m.	0,666	AES-m.	0,783	AES	0,496	AES	0,149	XRF	0,149	XRF-m.	0,100
	Al		Mo		W		V		Ti		Co		As		Sn
Value	0,371		0,148		0,579		0,718		0,446		0,139		0,115		0,091
S _M	0,021		0,006		0,038		0,029		0,022		0,004		0,020		0,005
U	0,009		0,002		0,017		0,012		0,010		0,002		0,011		0,002

Method	Nb	Method	Sb	Method	Pb	Method	Zr	Method	N	Method	B
ICP	0,084*			XRF	0,062						
XRF	0,115			AES-m.	0,064						
AES	0,128			AES	0,074						
AES	0,133			AES	0,075						
AES	0,133			AES	0,079	ICP	0,0438				
AES	0,134			AES	0,079	AES	0,0441	AES	0,0072		
AES	0,134			AES	0,079	AES	0,0447	TCM	0,0074		
AES-m.	0,134			AES	0,083	AES	0,0455	TCM	0,0075		
AES	0,136			ICP	0,084	AES	0,0468	TCM	0,0076		
XRF-m.	0,137	AES	0,0732	ICP	0,090	AES	0,0468	TCM	0,0076		
AES	0,137	AES-m.	0,0761	ICP	0,091	AES-m.	0,0470	AES	0,0078		
AES	0,138	AES	0,0772	AES	0,094	AES	0,0490	AES	0,0078		
XRF-m.	0,139	AES	0,0784	AES-m.	0,094	ICP	0,0496	ICP	0,0079		
AES	0,139	AES	0,0785	ICP	0,095	XRF	0,0506	AES	0,0085		
AES	0,146	ICP	0,0788	AES	0,095	AES	0,0511	AES	0,0089		
AES	0,153	XRF	0,0798	AES	0,100	AES	0,0515	AES	0,0091		
AES	0,153	AES	0,0810	AES	0,101	AES	0,0517	AES	0,0094	AES	0,157
AES	0,153	AES	0,0820	AES	0,107	AES	0,0528	AES	0,0096	AES	0,179
AES	0,156	XRF-m.	0,0854	XRF	0,115	XRF	0,0558	TCM	0,0100	AES-m.	0,183
AES-m.	0,158	XRF	0,0883	AES	0,119	AES	0,0596	TCM	0,0103	AES	0,200
	Nb		Sb		Pb		Zr		N		B
Value	0,140		0,0799		0,089		0,0494		0,0079		0,18
S _M	0,011		0,0042		0,015		0,0044		0,0010		
U	0,005		0,0028		0,007		0,0023		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 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 30/6B** - 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.

Responsible person: Martin Bogumský

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SPL-LABMAT s.r.o.
1. máje 432
735 31 Bohumín, CZ
IČO: 06480870, DIČ: CZ06480870
www.spl-labmat.cz
e-mail: info@spl-labmat.cz