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CERTIFICATE OF CHEMICAL ANALYSIS No 08 – 21

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

SPL-L3 (PT 29/4A)

CERTIFIED VALUES – Mass content in %wt.

Element	*Value* [%wt.]	*Uncertainty* [%wt.]
C	**3.533**	0.022
Mn	**1.414**	0.012
Si	**3.006**	0.029
P	**0.074**	0.002
S	**0.0106**	0.0005
Cu	**0.690**	0.006
Cr	**0.669**	0.007
Ni	**1.027**	0.007
Al	**0.0240**	0.0010
Mo	**0.055**	0.002
Mg	**0.048**	0.002

Element	*Value* [%wt.]	*Uncertainty* [%wt.]
Ce	**0.034**	0.002
W	**0.0141**	0.0017
V	**0.351**	0.004
Ti	**0.080**	0.003
Co	**0.059**	0.001
As	**0.0078**	0.0007
Sn	**0.0234**	0.0007
Zn	**0.0194**	0.0011
Zr	**0.042**	0.002
B	**0.0036**	0.0002
Nb	**0.0099**	0.0007

PARTICIPATING LABORATORIES:

AIMEN, Spain
AZTERLAN, Spain
CASTCO, Hong Kong
DEGERFORS LAB. AB, Sweden
DUNAFERR Labor Nonprofit, Hungary
ENVIFORM, Czech Republic
GONTERMANN-PEIPERS, Germany
IMŻ, Poland
LIBERTY Ostrava, Czech Republic
MTL Chomutov, Czech Republic
SECO INDUSTRIES, Czech Republic
SSAB, Sweden
ŠKODA AUTO, Czech Republic
UNEX, Czech Republic
Z - GROUP OC. HRÁDEK, Czech Republic
ZPS - SLÉVÁRNA, Czech Republic

SPL-L3 - ANALYTICAL DATA:

Method	C	Method	Mn	Method	Si	Method	P	Method	S	Method	Cu	Method	Cr	Method	Ni	Method	Al	Method	Mo	Method	Mg
		ICP	1,343									AES	0,640	ICP	0,992						
		Photom.	1,357	Photom.	2,847			IR	0,0044*	ICP	0,652	ICP	0,641	AES	0,996			AES	0,048		
		AES	1,367	AES	2,874	Photom.	0,064	IR	0,0083	AES	0,668	AES	0,645	Gravim.	0,998			ICP	0,049		
AES	3,448	AES	1,373	AES	2,883	XRF	0,064	AES	0,0085	AES	0,671	AES	0,651	AES	1,003			AES	0,050		
AES	3,460	XRF	1,380	AES	2,899	ICP	0,068	IR	0,0089	AES	0,674	AES	0,653	AES	1,011			AES	0,051		
AES	3,462	XRF	1,381	XRF	2,948	XRF	0,068	IR	0,0093	ICP	0,675	AES	0,655	ICP	1,012			AES	0,052		
IR	3,472	XRF	1,396	Gravim.	2,954	AES	0,069	XRF	0,0093	AES	0,678	AES	0,655	AES	1,014			AES	0,052		
AES	3,472	AES	1,398	AES	2,954	XRF	0,069	IR	0,0095	AES	0,679	AES	0,655	AES	1,014			AES	0,052	AES	0,041
AES	3,476	AES	1,398	AES	2,972	AES	0,069	IR	0,0097	AES	0,680	AES	0,658	AES	1,014			AES	0,052	AES	0,043
AES	3,494	AES	1,399	AES	2,979	AES	0,070	XRF	0,0100	ICP	0,680	AES	0,661	AES	1,016	ICP	0,0210	AES	0,053	AES	0,044
IR	3,496	ICP	1,400	AES	2,980	AES	0,071	AES	0,0100	AES	0,681	AES	0,662	AES	1,017	AES	0,0216	AES	0,054	ICP	0,044
IR	3,496	AES	1,408	XRF	2,987	AES	0,071	AES	0,0101	AES	0,681	Titrim.	0,662	AES	1,020	AES	0,0216	AES	0,054	ICP	0,044
AES	3,503	AES	1,411	AES	2,988	AES	0,071	IR	0,0102	AES	0,682	XRF	0,663	AES	1,020	AES	0,0218	AES	0,055	AES	0,045
AES	3,514	ICP	1,418	AES	2,992	AES	0,071	XRF	0,0103	AES	0,689	AES	0,665	AES	1,021	AES	0,0220	ICP	0,055	AES	0,046
IR	3,517	AES	1,419	AES	3,001	AES	0,071	AES	0,0104	AES	0,690	ICP	0,666	XRF	1,023	AES	0,0224	AES	0,055	AES	0,046
IR	3,519	AES	1,420	AES	3,004	AES	0,072	IR	0,0104	AES	0,691	XRF	0,669	AES	1,023	AES	0,0230	AES	0,056	AES	0,046
IR	3,530	AES	1,422	AES	3,010	AES	0,073	AES	0,0105	XRF	0,691	AES	0,670	AES	1,029	AES	0,0238	ICP	0,056	AES	0,047
AES	3,531	AES	1,428	AES	3,020	AES	0,073	AES	0,0106	AES	0,692	AES	0,670	AES	1,033	ICP	0,0238	XRF	0,056	AES	0,047
AES	3,534	AES	1,430	AES	3,022	AES	0,074	AES	0,0108	XRF	0,693	AES	0,671	AES	1,034	AES	0,0239	XRF	0,056	AES	0,048
AES	3,535	AES	1,430	AES	3,023	AES	0,075	AES	0,0108	AES	0,695	AES	0,672	AES	1,034	AES	0,0240	AES	0,057	AES	0,048
XRF	3,560	AES	1,431	AES	3,039	AES	0,077	AES	0,0110	AES	0,700	AES	0,672	AES	1,035	AES	0,0240	AES	0,057	AES	0,049
IR	3,564	AES	1,432	AES	3,055	ICP	0,077	AES	0,0112	AES	0,700	AES	0,672	AES	1,036	AES	0,0241	AES	0,057	AES	0,049
AES	3,564	AES	1,435	XRF	3,060	AES	0,078	AES	0,0114	AES	0,702	AES	0,673	ICP	1,047	AES	0,0242	AES	0,058	AES	0,049
IR	3,571	AES	1,435	AES	3,062	AES	0,080	AES	0,0114	AES	0,703	AES	0,682	AES	1,047	AES	0,0246	AES	0,058	AES	0,049
AES	3,590	AES	1,436	AES	3,077	AES	0,080	AES	0,0119	AES	0,704	AES	0,682	XRF	1,048	AES	0,0250	XRF	0,059	AES	0,050
AES	3,603	AES	1,436	AES	3,079	AES	0,080	AES	0,0121	XRF	0,704	ICP	0,687	AES	1,052	AES	0,0266	AES	0,060	AES	0,050
AES	3,603	AES	1,444	ICP	3,089	AES	0,080	AES	0,0126	AES	0,705	XRF	0,698	XRF	1,054	AES	0,0270	AES	0,060	AES	0,052
IR	3,608	AES	1,456	AES	3,097	AES	0,081	AES	0,0128	AES	0,710	AES	0,700	AES	1,055	AES	0,0277	AES	0,060	AES	0,053
AES	3,616	AES	1,465	AES	3,100	AES	0,081	AES	0,0128	AES	0,714	AES	0,701	AES	1,057	ICP	0,0286	AES	0,060	AES	0,056
AES	3,659	AES	1,472	AES	3,191	AES	0,082	AES	0,0129	AES	0,724	AES	0,712	AES	1,063	AES	0,032*	Photom.	0,061	AES	0,057

	C	Mn	Si	P	S	Cu	Cr	Ni	Al	Mo	Mg
Value	**3,533**	**1,414**	**3,006**	**0,074**	**0,0106**	**0,690**	**0,669**	**1,027**	**0,0240**	**0,055**	**0,048**
s_M	0,055	0,031	0,076	0,005	0,0013	0,016	0,018	0,019	0,0021	0,004	0,004
U	**0,022**	**0,012**	**0,029**	**0,002**	**0,0005**	**0,006**	**0,007**	**0,007**	**0,0010**	**0,002**	**0,002**

Method	Ce	Method	W	Method	V	Method	Ti	Method	Co	Method	As	Method	Sn	Method	Zn	Method	Zr	Method	B	Method	Nb
						ICP	0,067														
				AES	0,336	AES	0,070														
				AES	0,339	ICP	0,070														
				AES	0,340	AES	0,071	XRF	0,052			ICP	0,0204								
				AES	0,345	AES	0,075	ICP	0,053			XRF	0,0208								
				AES	0,347	AES	0,076	AES	0,056			ICP	0,0210								
				AES	0,347	XRF	0,077	AES	0,056			AES	0,0229	AES	0,0159						
				AES	0,348	AES	0,078	AES	0,057			AES	0,0230	AES	0,0161					ICP	0,0077
				AES	0,348	AES	0,078	XRF	0,057			AES	0,0232	AES	0,0170					XRF	0,0083
				AES	0,349	AES	0,078	AES	0,057			AES	0,0232	AES	0,0170					AES	0,0090
		AES	0,0090	AES	0,350	AES	0,079	AES	0,058			AES	0,0232	AES	0,0174					AES	0,0090
ICP	0,030	ICP	0,0110	AES	0,350	AES	0,080	AES	0,059	AES	0,0056	AES	0,0233	AES	0,0179					AES	0,0090
AES	0,030	AES	0,0116	AES	0,351	ICP	0,081	ICP	0,059	AES	0,0063	AES	0,0233	AES	0,0189			AES	0,0032	AES	0,0094
AES	0,031	ICP	0,0120	AES	0,351	AES	0,081	AES	0,060	ICP	0,0070	AES	0,0234	XRF	0,0190			AES	0,0034	AES	0,0094
AES	0,031	AES	0,0120	XRF	0,351	AES	0,082	AES	0,060	ICP	0,0074	AES	0,0236	XRF	0,0194			AES	0,0034	AES	0,0098
AES	0,032	AES	0,0139	AES	0,353	XRF	0,082	AES	0,060	AES	0,0078	XRF	0,0237	AES	0,0195	AES	0,039	AES	0,0034	AES	0,0099
AES	0,033	XRF	0,0143	AES	0,355	AES	0,082	AES	0,060	AES	0,0078	AES	0,0238	AES	0,0198	AES	0,040	AES	0,0034	AES	0,0100
AES	0,034	AES	0,0146	AES	0,355	AES	0,082	AES	0,061	AES	0,0080	AES	0,0240	AES	0,0200	AES	0,041	AES	0,0034	AES	0,0102
AES	0,034	XRF	0,0150	AES	0,357	AES	0,083	ICP	0,062	XRF	0,0080	AES	0,0242	ICP	0,0205	AES	0,041	AES	0,0035	XRF	0,0103
AES	0,036	AES	0,0151	ICP	0,359	AES	0,085	AES	0,062	AES	0,0080	AES	0,0243	ICP	0,0216	AES	0,042	AES	0,0037	AES	0,0106
AES	0,037	AES	0,0152	AES	0,363	AES	0,086	AES	0,063	AES	0,0082	AES	0,0254	AES	0,0217	AES	0,042	AES	0,0039	AES	0,0118
AES	0,038	AES	0,0152	XRF	0,364	AES	0,088	AES	0,063	AES	0,0084	AES	0,0254	AES	0,0222	AES	0,042	AES	0,0040	AES	0,0119
AES	0,039	AES	0,0172	XRF	0,367	XRF	0,088	AES	0,064	XRF	0,0094	AES	0,0259	XRF	0,0226	AES	0,043	AES	0,0041	AES	0,0123
AES	0,040	AES	0,0208	AES	0,390*	AES	0,090	AES	0,065	AES	0,0100	AES	0,0347*	AES	0,0234	XRF	0,044	AES	0,0042	AES	0,0207*

	Ce	W	V	Ti	Co	As	Sn	Zn	Zr	B	Nb
Value	**0,034**	**0,0141**	**0,351**	**0,080**	**0,059**	**0,0078**	**0,0234**	**0,0194**	**0,042**	**0,0036**	**0,0099**
s_M	0,003	0,0029	0,008	0,006	0,003	0,0012	0,0014	0,0023	0,002	0,0003	0,0013
U	**0,002**	**0,0017**	**0,004**	**0,003**	**0,001**	**0,0007**	**0,0007**	**0,0011**	**0,002**	**0,0002**	**0,0007**

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 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 chill-casting and machining.

Supplied as discs 40 mm in diameter and approx. 18 mm of 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 29/4A** - 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.

Responsible person: Martin Bogumský

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