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Certificate No 01-22, Reference materials of cast iron CI-SPL-22

for solid sample spectrometry

Intended for calibration, matrix-match verification and statistical process control of cast iron spectrometric analysis from a plane of solid sample: Atomic Emission Spectrometry with spark, glow-discharge or laser excitation, and X-ray Fluorescence Spectrometry. They may not substitute CRM in a statement of metrological traceability.

User instructions A single analysis area of at least 4 mm in diameter defines the minimum sample intake. A mean of at least three independent measurements is required for every metrological operation. Storage of the RM in dry and non-corrosive environment is recommended. There are no safety hazards in the storage and proper use of RM.

Supplied in a set or as individual discs 40 mm in diameter and approximately 18 mm thick. The reference values and/or approximative reference values are valid for both plan-parallel sides (working surfaces) into depth of 6mm.. The discs are marked on the side by the RM batch code and the limits to which reference and/or approximative reference values apply. **When used to both limits, the remainder, which may contain minor structure defects, should be discarded.**

Characterised by inter-laboratory study of the expert laboratories listed below 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, CZ 02033, CZ 20034, ČKD 241-249, Brammer Standard).
Certified values were made traceable to the values of corresponding certified reference materials of CRM CZ 02033 and CZ 20034. The values are rounded to the same number of significant digits, as their uncertainty value.

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.

Reference 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.

Indicative values in regular without the uncertainty statement are intended for the matrix information.

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Participating laboratories
ENVIFORM, Czechia ; **LIBERTY Ostrava**, Czechia ; **MS UTILITIES & SERVICES**, Czechia ; **SECO INDUSTRIES**, Czechia ; **SES Inspekt**, Slovakia ; **US STEEL KOŠICE - Labortest**, Slovakia ; **ZPS - SLÉVÁRNA**, Czechia ; **ŽĎAS**, Czechia

Participating laboratories for used certified reference materials CZ 02033 - 1-8 - ARCELORMITTAL Ostrava, Czechia ; BESKYD, Czechia ; BRAMMER STANDARD COMPANY, USA ; ENVIFORM, Czechia ; ICRM, Russia ; IMŻ, Poland ; KIDAO LABORATORIES, India ; LITHEA, Czechia ; OBLF, Germany ; SECO GROUP, Czechia ; TECHLAB, France ; UNEX, Czechia ; US STEEL Košice - Labortest, Slovakia ; VÍTKOVICE Testing Center, Czechia ; VOLVO Powertrain Corp., Sweden ; WELL GROUP Scientific, P.R. China ; ZPS Slévárna, Czechia ; ŽĎAS, Czechia
Participating laboratories for used certified reference materials CZ 20034 - 11-17 - ARCELORMITTAL OSTRAVA, Czechia ; BESKYD, Czechia ; BRAMMER STANDARD COMPANY, USA ; ENVIFORM, Czechia ; INSTITUTE FOR CRM, Russia ; IMŻ, Poland ; KIDAO LABORATORIES, India ; LITHEA, Czechia ; METAL AND QUALITY, PJSC, Ukraine ; OBLF, Germany ; SECO GROUP, Czechia ; TECHLAB, France ; UNEX, Czechia ; US STEEL KOŠICE - LABORTEST, Slovakia ; VÍTKOVICE TESTING CENTER, Czechia ; VOLVO POWERTRAIN CORP., Sweden ; WELL GROUP SCIENTIFIC, P.R. China ; ZPS SLÉVÁRNA, Czechia ; ŽĎAS, Czechia

CI-SPL-22 Reference Materials

44A - 53A - VALUES IN wt. %

Reference values in bold, with ± uncertainty interval below in regular.
Indicative values in regular, without uncertainty statement.
Empty boxes indicate values at or below limit of determination

	C	Mn	Si	P	S	Cr	Ni	Cu	Mo	Mg	Ce	V	Ti
44A	**3.20**	**0.711**	**2.51**	**0.033**	**0.005**	**0.063**	**0.521**	**0.018**	**0.174**	**0.015**	**0.005**	**0.014**	**0.084**
(1H)	0.03	0.005	0.03	0.002	0.001	0.002	0.006	0.001	0.003	0.001	0.002	0.001	0.002
45A	**3.33**	**0.778**	**2.83**	**0.031**	**0.010**	**0.058**	**0.405**	**0.008**	**0.182**	**0.066**	**0.032**	**0.022**	**0.079**
(1J)	0.03	0.005	0.02	0.002	0.001	0.002	0.004	0.001	0.004	0.003	0.003	0.001	0.001
46A	**3.66**	**0.098**	**1.42**	**0.109**	**0.010**	**0.014**	**0.628**	**0.86**	**0.011**	**0.047**	**0.005**	**0.008**	**0.046**
(2H)	0.03	0.002	0.02	0.003	0.001	0.001	0.005	0.02	0.001	0.002	0.001	0.001	0.002
47A	**3.82**	**0.084**	**1.07**	**0.137**	**0.011**	**0.016**	**0.606**	**0.82**	*0.002*	**0.035**	**0.010**	**0.007**	**0.027**
(2J)	0.04	0.002	0.02	0.003	0.001	0.001	0.005	0.02		0.002	0.001	0.001	0.001
48A	**3.63**	**0.338**	**2.15**	**0.025**	**0.006**	**0.128**	**0.043**	**0.407**	**0.482**	**0.019**	**0.009**	**0.016**	**0.030**
(3E)	0.03	0.003	0.03	0.001	0.001	0.002	0.001	0.005	0.006	0.002	0.002	0.001	0.002
49A	**3.12**	**0.328**	**2.06**	**0.038**	**0.009**	**0.300**	**0.132**	**0.384**	**0.475**	**0.007**	*0.005*	**0.081**	**0.024**
(3F)	0.02	0.003	0.03	0.002	0.001	0.004	0.003	0.004	0.006	0.002		0.003	0.001
50A	**3.39**	**0.529**	**2.14**	**0.179**	**0.055**	**0.137**	**0.113**	**0.151**	**0.045**	-	-	**0.015**	**0.030**
(8E)	0.02	0.005	0.02	0.004	0.002	0.002	0.002	0.003	0.001			0.001	0.001
51A	**3.46**	**0.405**	**1.63**	**0.147**	**0.044**	**0.075**	**0.111**	**0.152**	**0.037**	-	-	**0.017**	**0.033**
(8F)	0.03	0.005	0.02	0.004	0.003	0.001	0.002	0.003	0.001			0.001	0.001
52A	**3.03**	**0.301**	**2.38**	**0.021**	**0.0094**	**0.025**	**0.021**	**0.607**	**0.621**	**0.008**	**0.012**	**0.023**	**0.029**
(14D)	0.02	0.003	0.02	0.001	0.0005	0.001	0.001	0.009	0.009	0.001	0.002	0.001	0.001
53A	**3.56**	**0.052**	**1.60**	**0.053**	**0.0097**	**0.071**	**0.687**	**1.357**	**0.002**	**0.032**	**0.023**	**0.013**	**0.035**
(15D)	0.03	0.002	0.02	0.003	0.0005	0.002	0.008	0.018	0.001	0.002	0.003	0.001	0.002

	Al	Sn	Sb	Bi	B	Zn	Pb	W	Co	Nb	Zr	As
44A	**0.046**	**0.026**	**0.018**	**0.009**	**0.0037**	**0.009**	**0.017**	**0.018**	**0.024**	*0.014*	*0.007*	-
(1H)	0.002	0.002	0.002	0.001	0.0003	0.002	0.002	0.002	0.002			
45A	**0.078**	**0.034**	-	-	**0.022**	-	**0.005**	**0.015**	**0.031**	-	*0.015*	-
(1J)	0.003	0.002			0.002		0.001	0.002	0.001			
46A	**0.026**	**0.014**	**0.024**	**0.005**	**0.0021**	**0.018**	**0.021**	**0.008**	-	*0.012*	*0.004*	*0.003*
(2H)	0.001	0.001	0.002	0.001	0.0002	0.002	0.002	0.001				
47A	**0.024**	**0.016**	**0.026**	-	*0.0005*	**0.027**	**0.012**	**0.004**	*0.002*	-	*0.010*	-
(2J)	0.001	0.001	0.002			0.002	0.001	0.001				
48A	**0.021**	**0.010**	-	-	**0.0045**	-	**0.015**	-	**0.025**	-	-	*0.021*
(3E)	0.001	0.001			0.0002		0.001		0.001			
49A	**0.064**	**0.011**	*0.007*	-	**0.0075**	*0.003*	**0.008**	**0.013**	**0.094**	*0.005*	-	**0.020**
(3F)	0.003	0.001			0.0005		0.001	0.001	0.003			0.001
50A	**0.004**	**0.068**	**0.011**	**0.011**	*0.0008*	-	**0.004**	*0.006*	**0.029**	-	-	-
(8E)	0.001	0.002	0.002	0.002			0.001		0.001			
51A	**0.006**	**0.072**	**0.012**	*0.008*	-	*0.002*	**0.006**	*0.005*	**0.035**	-	-	*0.007*
(8F)	0.001	0.002	0.002				0.001		0.001			
52A	**0.011**	**0.032**	**0.014**	**0.011**	**0.0082**	**0.004**	*0.003*	*0.004*	**0.010**	*0.003*	**0.015**	**0.041**
(14D)	0.001	0.001	0.001	0.001	0.0004	0.001			0.001		0.001	0.003
53A	**0.047**	**0.007**	**0.066**	*0.007*	**0.0046**	*0.004*	-	**0.010**	**0.032**	-	-	*0.004*
(15D)	0.002	0.001	0.006		0.0003			0.001	0.001			