



# Czech Metrology Institute

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**Supervised by:** Section of Fundamental Metrology, Certification Body for Reference Materials (CORM)  
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## CERTIFICATE

0217-CM-2001-14

### CERTIFIED REFERENCE MATERIALS CZ 2001

Low alloy steel for solid sample spectrometry, CRM set 180 – 189 A, B, C, D, E

**First issue:** December 15, 2001 page 1 / 4  
**Valid till:** December 1, 2015  
**Recertified on:** January 1, 2014  
**Valid till:** January 1, 2020

**Prepared by:** vacuum melting and casting, followed by electro-slag remelting and rolling and forging the ingots to the bars of the ultimate diameter of 44 mm, and subdividing to the discs 13 or 25 mm high. The CRMs can be used in sets of ten or individually.

The set covers the typical concentration ranges of the alloying elements and impurities of low alloy steels. The composition of the individual CRMs was balanced to avoid excessive matrix influence while sufficiently covering the above ranges. Consequently the CRMs may not correspond with any particular steel grade.

**Intended:** for calibration and validation of methods of low alloy steel spectrometry from a plane of solid sample: Atomic Emission Spectrometry with spark, glow-discharge or laser excitation and X-ray Fluorescence Spectrometry.

**Production:** testing and characterization were carried out in accordance with the methodical procedure CORM ČMI 017-MP-C001 and in compliance with the ISO Guides 34, 35.

The producer shall ensure due conditions of storage and distribution and shall monitor the CRM parameters and feed-back from users during the entire validity period.

**Producer:** ALS Czech Republic, s.r.o. Na Harfě 336/9, 190 00 Praha 9, Czech Republic, [www.alsglobal.cz](http://www.alsglobal.cz)

**Responsible person:** Vladimír Nováček

**CORM deputy head:**

Ing. Jan Beránek



**Head of CORM:**

RNDr. Pavel Klenovský

Certified values (in bold) with uncertainty, and non-certified values, in m/m %

	C	Mn	Si	P	S	Cr	Ni	Mo	V	W	Cu	Al
180 B	<b>0.003</b> 0.002	<b>0.047</b> 0.001	<b>0.001</b> 0.001	<b>0.004</b> 0.001	<b>0.0038</b> 0.0003	<b>0.013</b> 0.001	<b>0.018</b> 0.001	<b>0.001</b> 0.001	<b>0.000</b> 0.001	<b>0.0001</b> 0.0001	<b>0.006</b> 0.001	<b>0.001</b> 0.001
181 B	<b>0.240</b> 0.008	<b>0.988</b> 0.022	<b>0.445</b> 0.013	<b>0.042</b> 0.002	<b>0.008</b> 0.001	<b>0.669</b> 0.011	<b>0.737</b> 0.011	<b>0.395</b> 0.009	<b>0.307</b> 0.006	<b>0.188</b> 0.005	<b>0.095</b> 0.003	<b>0.016</b> 0.001
181 C	<b>0.243</b> 0.009	<b>0.988</b> 0.022	<b>0.443</b> 0.013	<b>0.042</b> 0.002	<b>0.008</b> 0.001	<b>0.666</b> 0.011	<b>0.739</b> 0.011	<b>0.394</b> 0.009	<b>0.307</b> 0.006	<b>0.187</b> 0.005	<b>0.095</b> 0.003	<b>0.016</b> 0.001
181 D	<b>0.231</b> 0.008	<b>0.980</b> 0.022	<b>0.437</b> 0.013	<b>0.040</b> 0.002	<b>0.007</b> 0.001	<b>0.661</b> 0.011	<b>0.726</b> 0.011	<b>0.389</b> 0.009	<b>0.303</b> 0.006	<b>0.187</b> 0.005	<b>0.093</b> 0.003	<b>0.016</b> 0.001
182 B	<b>1.39</b> 0.02	<b>0.370</b> 0.008	<b>0.126</b> 0.008	<b>0.008</b> 0.001	<b>0.006</b> 0.001	<b>0.122</b> 0.002	<b>2.82</b> 0.03	<b>0.011</b> 0.001	<b>0.027</b> 0.002	<b>0.016</b> 0.004	<b>0.293</b> 0.007	<b>0.023</b> 0.001
182 C	<b>1.36</b> 0.02	<b>0.363</b> 0.008	<b>0.111</b> 0.008	<b>0.009</b> 0.001	<b>0.008</b> 0.001	<b>0.123</b> 0.002	<b>2.80</b> 0.03	<b>0.012</b> 0.001	<b>0.028</b> 0.002	<b>0.018</b> 0.004	<b>0.294</b> 0.007	<b>0.028</b> 0.002
183 C	<b>0.049</b> 0.003	<b>1.76</b> 0.03	<b>1.03</b> 0.02	<b>0.009</b> 0.001	<b>0.012</b> 0.001	<b>0.205</b> 0.010	<b>1.10</b> 0.02	<b>0.036</b> 0.003	<b>0.004</b> 0.002	<b>0.353</b> 0.008	<b>0.575</b> 0.014	<b>0.150</b> 0.005
183 D	<b>0.048</b> 0.003	<b>1.75</b> 0.02	<b>1.02</b> 0.02	<b>0.009</b> 0.001	<b>0.012</b> 0.001	<b>0.204</b> 0.010	<b>1.09</b> 0.02	<b>0.036</b> 0.003	<b>0.004</b> 0.002	<b>0.354</b> 0.008	<b>0.571</b> 0.009	<b>0.150</b> 0.005
183 E	<b>0.049</b> 0.003	<b>1.76</b> 0.02	<b>1.03</b> 0.02	<b>0.009</b> 0.001	<b>0.013</b> 0.001	<b>0.205</b> 0.010	<b>1.10</b> 0.02	<b>0.036</b> 0.003	<b>0.004</b> 0.002	<b>0.351</b> 0.008	<b>0.575</b> 0.013	<b>0.149</b> 0.005
184 A	<b>1.013</b> 0.012	<b>2.23</b> 0.03	<b>0.348</b> 0.008	<b>0.028</b> 0.002	<b>0.01</b> 0.001	<b>2.33</b> 0.02	<b>0.250</b> 0.008	<b>0.016</b> 0.004	<b>0.017</b> 0.003	<b>0.001</b> 0.001	<b>0.089</b> 0.002	<b>0.022</b> 0.002
185 A	<b>0.566</b> 0.009	<b>0.715</b> 0.004	<b>0.230</b> 0.005	<b>0.024</b> 0.001	<b>0.02</b> 0.001	<b>0.032</b> 0.003	<b>3.84</b> 0.04	<b>0.123</b> 0.006	<b>0.178</b> 0.006	<b>0.001</b> 0.001	<b>0.179</b> 0.003	<b>0.060</b> 0.002
186 C	<b>0.394</b> 0.007	<b>1.311</b> 0.016	<b>1.41</b> 0.02	<b>0.013</b> 0.001	<b>0.007</b> 0.001	<b>1.51</b> 0.02	<b>1.58</b> 0.02	<b>0.255</b> 0.008	<b>0.021</b> 0.002	<b>0.054</b> 0.004	<b>0.227</b> 0.005	<b>0.042</b> 0.002
186 D	<b>0.392</b> 0.007	<b>1.312</b> 0.016	<b>1.41</b> 0.02	<b>0.013</b> 0.001	<b>0.007</b> 0.001	<b>1.51</b> 0.02	<b>1.58</b> 0.02	<b>0.254</b> 0.008	<b>0.021</b> 0.002	<b>0.054</b> 0.004	<b>0.226</b> 0.005	<b>0.042</b> 0.002
187 A	<b>0.119</b> 0.004	<b>0.525</b> 0.007	<b>0.567</b> 0.023	<b>0.035</b> 0.001	<b>0.018</b> 0.001	<b>3.51</b> 0.04	<b>0.085</b> 0.004	<b>0.565</b> 0.008	<b>0.588</b> 0.008	<b>0.67</b> 0.02	<b>0.036</b> 0.003	<b>0.019</b> 0.002
187 C	<b>0.118</b> 0.004	<b>0.530</b> 0.007	<b>0.588</b> 0.023	<b>0.035</b> 0.002	<b>0.013</b> 0.002	<b>3.50</b> 0.04	<b>0.085</b> 0.004	<b>0.563</b> 0.008	<b>0.589</b> 0.008	<b>0.67</b> 0.02	<b>0.041</b> 0.003	<b>0.038</b> 0.002
187 D	<b>0.119</b> 0.004	<b>0.529</b> 0.007	<b>0.576</b> 0.023	<b>0.035</b> 0.002	<b>0.015</b> 0.002	<b>3.51</b> 0.04	<b>0.085</b> 0.004	<b>0.566</b> 0.008	<b>0.560</b> 0.008	<b>0.67</b> 0.02	<b>0.035</b> 0.003	<b>0.024</b> 0.002
188 A	<b>0.332</b> 0.010	<b>0.169</b> 0.004	<b>0.775</b> 0.016	<b>0.006</b> 0.001	<b>0.033</b> 0.002	<b>5.11</b> 0.05	<b>0.445</b> 0.008	<b>1.28</b> 0.02	<b>0.802</b> 0.008	<b>0.091</b> 0.005	<b>0.057</b> 0.003	<b>0.093</b> 0.003
189 A	<b>0.175</b> 0.006	<b>0.262</b> 0.004	<b>0.286</b> 0.007	<b>0.032</b> 0.002	<b>0.051</b> 0.002	<b>1.065</b> 0.014	<b>5.34</b> 0.02	<b>0.837</b> 0.009	<b>0.054</b> 0.006	<b>1.30</b> 0.02	<b>0.060</b> 0.003	<b>0.041</b> 0.002

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Certified values (in bold) with uncertainty, and non-certified values, in m/m %

	Ti	Zr	Co	B	Nb	Ta	Su	As	Sb	Pb	Bi	N
<b>180 B</b>	<b>0.000</b> 0.001	<b>0.000</b> 0.001	<b>0.003</b> 0.001	<b>0.0000</b> 0.0001	<b>0.0001</b> 0.0001	<b>0.0000</b> 0.0000	<b>0.0011</b> 0.0005	<b>0.001</b> 0.001	<b>0.004</b> 0.001	<b>0.0002</b> 0.0002	<b>0.0000</b> 0.0000	<b>0.0028</b> 0.005
<b>181 B</b>	<b>0.155</b> 0.008	<b>0.001</b> 0.001	<b>0.050</b> 0.003	<b>0.0076</b> 0.0005	<b>0.062</b> 0.003	<b>0.042</b> 0.003	<b>0.122</b> 0.004	<b>0.029</b> 0.001	<b>0.017</b> 0.001	<b>0.0005</b> 0.0002		<b>0.005</b> 0.005
<b>181 C</b>	<b>0.159</b> 0.008	<b>0.001</b> 0.001	<b>0.051</b> 0.003	<b>0.0076</b> 0.0005	<b>0.063</b> 0.003	<b>0.042</b> 0.003	<b>0.122</b> 0.005	<b>0.029</b> 0.001	<b>0.017</b> 0.001	<b>0.0005</b> 0.0002		<b>0.005</b> 0.005
<b>181 D</b>	<b>0.153</b> 0.008	<b>0.001</b> 0.001	<b>0.050</b> 0.003	<b>0.0071</b> 0.0005	<b>0.060</b> 0.003	<b>0.039</b> 0.003	<b>0.117</b> 0.004	<b>0.028</b> 0.001	<b>0.017</b> 0.001	<b>0.0005</b> 0.0002		<b>0.005</b> 0.005
<b>182 B</b>	<b>0.004</b> 0.002	<b>0.001</b> 0.001	<b>0.171</b> 0.004	<b>0.0003</b> 0.0001	<b>0.001</b> 0.001	<b>0.000</b> 0.001	<b>0.004</b> 0.001	<b>0.005</b> 0.001	<b>0.001</b> 0.001	<b>0.000</b> 0.001		<b>0.0049</b> 0.0003
<b>182 C</b>	<b>0.002</b> 0.002	<b>0.001</b> 0.001	<b>0.171</b> 0.004	<b>0.0003</b> 0.0001	<b>0.001</b> 0.001	<b>0.001</b> 0.001	<b>0.004</b> 0.001	<b>0.005</b> 0.001	<b>0.001</b> 0.001	<b>0.001</b> 0.001		<b>0.0049</b> 0.0003
<b>183 C</b>	<b>0.003</b> 0.001	<b>0.081</b> 0.007	<b>0.120</b> 0.003	<b>0.0005</b> 0.0001	<b>0.006</b> 0.001	<b>0.000</b> 0.000	<b>0.053</b> 0.003	<b>0.005</b> 0.001	<b>0.001</b> 0.001	<b>0.000</b> 0.000	<b>0.0000</b> 0.0001	<b>0.0040</b> 0.0004
<b>183 D</b>	<b>0.003</b> 0.001	<b>0.077</b> 0.004	<b>0.119</b> 0.003	<b>0.0005</b> 0.0001	<b>0.006</b> 0.001	<b>0.000</b> 0.000	<b>0.051</b> 0.002	<b>0.005</b> 0.001	<b>0.001</b> 0.001	<b>0.000</b> 0.000	<b>0.0000</b> 0.0001	<b>0.0036</b> 0.0004
<b>183 E</b>	<b>0.003</b> 0.001	<b>0.080</b> 0.007	<b>0.119</b> 0.003	<b>0.0005</b> 0.0001	<b>0.006</b> 0.001	<b>0.000</b> 0.000	<b>0.053</b> 0.003	<b>0.005</b> 0.001	<b>0.001</b> 0.001	<b>0.000</b> 0.000	<b>0.0000</b> 0.0001	<b>0.0040</b> 0.0004
<b>184 A</b>	<b>0.010</b> 0.002	<b>0.002</b> 0.002	<b>0.007</b> 0.002	<b>0.0005</b> 0.0002	<b>0.013</b> 0.001	<b>0.000</b> 0.001	<b>0.008</b> 0.001	<b>0.006</b> 0.001	<b>0.002</b> 0.001	<b>0.000</b> 0.000		<b>0.0104</b> 0.0005
<b>185 A</b>	<b>0.022</b> 0.001	<b>0.002</b> 0.001	<b>0.032</b> 0.001	<b>0.0116</b> 0.0014	<b>0.20</b> 0.01	<b>0.085</b> 0.005	<b>0.003</b> 0.001	<b>0.022</b> 0.002	<b>0.011</b> 0.001	<b>0.002</b> 0.001		<b>0.0051</b> 0.0004
<b>186 C</b>	<b>0.047</b> 0.004	<b>0.002</b> 0.002	<b>0.006</b> 0.002	<b>0.0009</b> 0.0001	<b>0.004</b> 0.001	<b>0.008</b> 0.001	<b>0.018</b> 0.001	<b>0.007</b> 0.001	<b>0.002</b> 0.001	<b>0.000</b> 0.000		<b>0.005</b> 0.005
<b>186 D</b>	<b>0.047</b> 0.004	<b>0.002</b> 0.002	<b>0.006</b> 0.002	<b>0.0009</b> 0.0001	<b>0.004</b> 0.001	<b>0.008</b> 0.001	<b>0.018</b> 0.001	<b>0.007</b> 0.001	<b>0.002</b> 0.001	<b>0.000</b> 0.000		<b>0.005</b> 0.005
<b>187 A</b>	<b>0.087</b> 0.005	<b>0.013</b> 0.001	<b>0.071</b> 0.003	<b>0.0006</b> 0.0002	<b>0.028</b> 0.003	<b>0.015</b> 0.002	<b>0.013</b> 0.001	<b>0.007</b> 0.007	<b>0.023</b> 0.002	<b>0.003</b> 0.001	<b>0.003</b> 0.001	<b>0.0122</b> 0.0007
<b>187 C</b>	<b>0.110</b> 0.005	<b>0.011</b> 0.001	<b>0.071</b> 0.003	<b>0.0006</b> 0.0002	<b>0.028</b> 0.003	<b>0.016</b> 0.002	<b>0.014</b> 0.001	<b>0.007</b> 0.007	<b>0.023</b> 0.002	<b>0.003</b> 0.001	<b>0.003</b> 0.001	<b>0.0153</b> 0.0021
<b>187 D</b>	<b>0.096</b> 0.005	<b>0.012</b> 0.002	<b>0.071</b> 0.003	<b>0.0006</b> 0.0002	<b>0.028</b> 0.003	<b>0.016</b> 0.002	<b>0.013</b> 0.001	<b>0.007</b> 0.007	<b>0.022</b> 0.002	<b>0.003</b> 0.001	<b>0.003</b> 0.001	<b>0.0120</b> 0.0009
<b>188 A</b>	<b>0.034</b> 0.003	<b>0.052</b> 0.003	<b>0.006</b> 0.001	<b>0.0047</b> 0.0004	<b>0.122</b> 0.003	<b>0.022</b> 0.002	<b>0.005</b> 0.001	<b>0.005</b> 0.005	<b>0.006</b> 0.002	<b>0.001</b> 0.001		<b>0.0076</b> 0.0004
<b>189 A</b>	<b>0.326</b> 0.010	<b>0.005</b> 0.001	<b>0.007</b> 0.002	<b>0.0030</b> 0.0003	<b>0.017</b> 0.002	<b>0.005</b> 0.005	<b>0.029</b> 0.002	<b>0.080</b> 0.003	<b>0.003</b> 0.003	<b>0.002</b> 0.001		<b>0.004</b> 0.004

<b>Homogeneity:</b>	of the certified constituents was tested by AES with spark excitation. Both within-sample homogeneity (random, radial trend) and between-sample homogeneity (axial trend along the successive bars) were evaluated. Their uncertainty contribution, when found significant, was combined to the ultimate uncertainty of the certified value.
<b>Stability:</b>	the CRM materials are stable by nature of their matrix.
<b>Storage:</b>	in a dry and non-corrosive environment is recommended.
<b>User instructions:</b>	<p>the working surface of the CRM must be prepared before the analysis in the same way as analysed samples, in accordance with the particular analyser manual. When determining low contents of C, Si, Al special care must be taken to avoid contamination of the analytical surface with residues of abrasives. Overheating of the analytical surface during grinding should be avoided.</p> <p>A single analysis area of at least 4 mm in diameter defines the minimum sample intake.</p> <p>There are no safety hazards in the storage and proper use of CRM.</p>
<b>Characterization:</b>	by interlaboratory experiment involving selected competent laboratories was made in compliance with ISO Guide 35.
<b>Traceability:</b>	of the certified values was established to the certified values of matrix-matching CRM of other producers (NIST, BS and others)
<b>Methods:</b>	of various analytical techniques were used including solid sample spectroscopy, combustion, thermoevolution and solution analysis.
<b>Participating laboratories:</b>	establishing the values of batches C, D, E traceable to the certified values of reference batches A:  <b>Enviform, a.s.</b> , Třinec, Czech Republic <b>ŽĎAS, a.s.</b> , Žďár nad Sázavou, Czech Republic <b>ZPS – Slévárna, a.s.</b> , Zlín, Malenovice, Czech Republic
<b>Certified values:</b>	<p>of the consecutive batches C, D, E were made traceable to the certified values of the respective reference batches A (cf. Certificate No: 017-CM-2001-01), which were based on an international collaborative study involving 27 laboratories in 8 countries. Traceability was established by three laboratories, with uncertainty contribution (repeatability) negligible compared to the uncertainty of the certified values.</p> <p>The validity term of the former batches A, B was prolonged by the expert assessment of the Czech Metrology Institute, with their original values unchanged. The certified values are tabulated in bold, rounded to the same digit as their uncertainty, shown below in regular</p>
<b>Non-certified values:</b>	tabulated without uncertainty statements did not meet all requirements for certification. They are intended for the matrix information only and may not be used for calibration.
<b>Uncertainty:</b>	Expanded uncertainty U with a coverage factor of $k=2$ at the 95% confidence interval.

End of the Certificate.

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