



The SPL RM divide into four groups:

- CRM (with the status of national CRM)
- RM and QCM for quality control
- Hi Tec candidate materials to be ultimately certified by the user (instrument producers, big industrial labs etc.)

The following tables state the RM codes, certified values c and \pm interval of the expanded combined uncertainty U_c , respectively, both expressed in % m/m.

A consecutive replacement with slightly different figures, distinguished alphabetically in the code, is available for supply when the original batch is out of stock.

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CRM – certified reference materials

CRM SPL CZ 2015B-2024B (certified in Brammer Standard company)

| | 2015B | 2016B | 2017B | 2018B | 2019B | 2020B | 2021B | 2022B | 2023B | 2024B |
|---|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|
| C | 1.99 | 2.15 | 2.57 | 3.07 | 3.43 | 3.52 | 3.80 | 3.86 | 4.06 | 4.40 |
| | 0.01 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| S | 0.017 | 0.0047 | 0.095 | 0.014 | 0.017 | 0.043 | 0.043 | 0.085 | 0.114 | 0.047 |
| | 0.001 | 0.0007 | 0.003 | 0.001 | 0.001 | 0.002 | 0.002 | 0.002 | 0.003 | 0.002 |

Former CRM certified via Czech Metrological Institute

(Issued RM certificates after end of validity)

LOW ALLOY STEEL RM FOR C, S, N in a 250 g packing (SPL RM CZ 2025 in a 200g packing)

SPL RM CZ 2003 – 8 (CRM validity till 2022), SPL RM CZ 2025 A, 2026 A (CRM validity till 2022)

| | 2003 A | 2004 A | 2005 A | 2006 A | 2007 A | 2008 A | 2025 A* | 2026 A* |
|---|--------|--------|--------|--------|--------|--------|---------|---------|
| C | 0.0402 | 0.079 | 0.358 | 0.461 | 0.684 | 0.977 | 0.0020 | 0.068 |
| | 0.0008 | 0.001 | 0.004 | 0.002 | 0.006 | 0.003 | 0.0003 | 0.001 |
| S | 0.0316 | 0.0464 | 0.0250 | 0.0172 | 0.0106 | 0.0091 | 0.0018 | 0.255 |
| | 0.0006 | 0.0010 | 0.0005 | 0.0007 | 0.0004 | 0.0004 | 0.0002 | 0.005 |
| N | 0.0046 | 0.0038 | 0.0081 | 0.0066 | 0.0128 | 0.0066 | | |
| | 0.0002 | 0.0002 | 0.0002 | 0.0004 | 0.0004 | 0.0003 | | |

*2025 A pure iron powder (in a 200g packing)

*2026 A free-cutting steel

CAST IRON CRM FOR C, S in a 100 g packing

CRM CZ 2015 A - 2024 A (valid till 2022)

| | 2015 A | 2016 A | 2017 A | 2023 A |
|---|--------|--------|--------|--------|
| C | 1.996 | 2.053 | 2.463 | 4.029 |
| | 0.011 | 0.016 | 0.023 | 0.016 |
| S | 0.0157 | 0.0048 | 0.0755 | 0.0886 |
| | 0.0004 | 0.0004 | 0.0026 | 0.0028 |

CERTIFIED REFERENCE MATERIALS

CRM CZ 02033 and CRM CZ 20034

CRM CZ 02033 - Cast iron for solid sample spectrometry, CRM set 1-8 (valid till 2027)

Intended for calibration, validation and matrix-match verification 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.

Eight CRM 1–8 represent the most frequent unalloyed and low alloy cast iron types in sequence: unalloyed ductile iron, Ni-Cu ductile iron, vermicular iron (CGI), pig iron, malleable iron, Mn-Cr-V and Ni-Mo alloyed iron and plain grey iron.

Supplied in a set or as individual discs 40 mm in diameter and approximately 18 mm of total height, with two certified layers extending 6 mm upwards from either working surface. The discs are marked on the side by the CRM code and the certified layers' limits. When used to both limits, the remainder, which may contain minor structure defects, should be discarded.

| | C | Mn | Si | P | S | Cr | Ni | Cu | Mo | Mg | Ce |
|-----------|---------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|----|----|
| 4C | 4.06 0.02 | 0.250 0.002 | 0.423 0.005 | 0.054 0.002 | 0.038 0.002 | 0.080 0.002 | 0.084 0.001 | 0.085 0.002 | 0.002 0.001 | | |
| 5B | 2.42 0.04 | 0.812 0.005 | 1.32 0.02 | 0.033 0.001 | 0.073 0.003 | 0.061 0.001 | 0.188 0.003 | 0.031 0.001 | 0.089 0.002 | | |
| 6B | 2.95 0.04 | 1.15 0.01 | 3.23 0.04 | 0.095 0.003 | 0.020 0.002 | 1.36 0.002 | 0.026 0.001 | 0.272 0.003 | 0.005 0.001 | | |
| 7B | 3.61 0.03 | 0.304 0.003 | 1.82 0.02 | 0.021 0.002 | 0.020 0.002 | 0.536 0.005 | 1.28 0.01 | 0.036 0.001 | 0.96 0.01 | | |

| | V | Ti | Al | Sn | Sb | Bi | B | Zn | Pb | W | Co |
|-----------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 4C | 0.015 0.001 | 0.010 0.001 | 0.005 0.001 | 0.002 0.001 | 0.001 | | | 0.016 0.002 | 0.003 0.001 | | 0.035 0.002 |
| 5B | 0.005 0.001 | 0.007 0.001 | 0.062 0.001 | | | 0.020 0.003 | 0.014 0.001 | | | | |
| 6B | 0.083 0.002 | 0.068 0.003 | 0.007 0.001 | 0.140 0.004 | 0.049 0.003 | | | | | | |
| 7B | 0.007 0.001 | 0.015 0.001 | 0.022 0.001 | | | | | | | 0.045 0.004 | 0.050 0.002 |

Further non-certified values are: 0.008% As in 6B

| | C | Mn | Si | P | S | Cr | Ni | Cu | Mo | Mg | Ce |
|-----------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 4D | 4.19 0.03 | 0.112 0.002 | 0.259 0.004 | 0.050 0.002 | 0.041 0.002 | 0.056 0.001 | 0.063 0.002 | 0.084 0.002 | 0.024 0.001 | | |
| 4E | 4.45 0.04 | 0.034 0.002 | 0.090 0.005 | 0.023 0.001 | 0.006 0.001 | 0.030 0.001 | 0.049 0.002 | 0.005 0.001 | 0.002 0.001 | | |
| 5C | 2.30 0.02 | 0.704 0.004 | 1.40 0.02 | 0.027 0.001 | 0.091 0.003 | 0.085 0.002 | 0.188 0.003 | 0.013 0.001 | 0.104 0.002 | | |
| 6C | 3.11 0.03 | 1.25 0.01 | 3.25 0.03 | 0.097 0.003 | 0.019 0.002 | 1.33 0.01 | 0.021 0.001 | 0.273 0.003 | 0.006 0.001 | | |
| 7C | 3.55 0.03 | 0.389 0.004 | 1.73 0.02 | 0.028 0.002 | 0.026 0.002 | 0.542 0.004 | 1.26 0.01 | 0.016 0.001 | 0.966 0.010 | | |
| | V | Ti | Al | Sn | Sb | Bi | B | Zn | Pb | W | Co |
| 4D | 0.012 0.001 | 0.009 0.001 | 0.007 0.001 | 0.001 0.001 | | <i>0.002</i> | <i>0.0001</i> | 0.009 0.001 | 0.007 0.001 | | 0.003 0.001 |
| 4E | 0.015 0.001 | 0.011 0.001 | 0.003 0.001 | 0.001 0.001 | | <i>0.002</i> | | | <i>0.002</i> | | 0.033 0.001 |
| 5C | 0.054 0.002 | 0.008 0.001 | 0.103 0.003 | 0.002 0.001 | <i>0.002</i> | 0.007 0.002 | 0.0078 0.0003 | | | | 0.013 0.001 |
| 6C | 0.192 0.002 | 0.107 0.004 | 0.024 0.001 | 0.131 0.003 | 0.044 0.002 | | 0.0024 0.0002 | | 0.003 0.001 | 0.007 0.001 | 0.005 0.001 |
| 7C | 0.067 0.001 | 0.026 0.001 | 0.040 0.002 | 0.004 0.001 | | <i>0.002</i> | 0.0008 0.0002 | | | 0.037 0.002 | 0.048 0.001 |

Further non-certified values are 0.007% As in 3C, 0.012% As in 4D, 0.005% Te in 3C, 0.010% Te in 5C, 0.006% Te in 7C, 0.009% Zr in 5C
(valid till 2030)

CRM CZ 20034 - Cast iron for solid sample spectrometry, CRM set 11-17

(valid till 2029)

| | C | Mn | Si | P | S | Cr | Ni | Cu |
|------------|---------------------|-----------------------|-----------------------|-------------------------|-------------------------|-----------------------|-----------------------|-----------------------|
| 11A | 2.37 0.02 | 0.343 0.007 | 3.31 0.04 | 0.271 0.009 | 0.163 0.007 | 1.219 0.015 | 0.084 0.002 | 0.086 0.003 |
| 12A | 2.82 0.02 | 0.996 0.010 | 2.57 0.03 | 0.480 0.011 | 0.073 0.003 | 0.640 0.008 | 0.174 0.002 | 0.160 0.004 |
| 12B | 2.92 0.02 | 1.047 0.011 | 2.96 0.03 | 0.484 0.011 | 0.077 0.003 | 0.638 0.008 | 0.174 0.002 | 0.223 0.005 |
| 13B | 3.12 0.03 | 0.692 0.006 | 2.12 0.02 | 0.0243 0.0017 | 0.0041 0.0004 | 0.125 0.003 | 1.313 0.017 | 0.021 0.002 |
| 13C | 3.15 0.03 | 0.704 0.007 | 2.23 0.02 | 0.0261 0.0017 | 0.0044 0.0004 | 0.124 0.003 | 1.299 0.017 | 0.089 0.003 |
| 14C | 3.14 0.02 | 0.275 0.003 | 2.49 0.02 | 0.0162 0.0011 | 0.0081 0.005 | 0.045 0.002 | 0.030 0.002 | 0.585 0.008 |
| 16A | 3.80 0.03 | 1.292 0.012 | 1.00 0.01 | 0.171 0.006 | 0.0266 0.0014 | 0.374 0.006 | 0.390 0.004 | 0.332 0.007 |
| 16B | 3.78 0.03 | 1.327 0.013 | 1.00 0.01 | 0.170 0.006 | 0.0236 0.0014 | 0.378 0.006 | 0.388 0.005 | 0.332 0.007 |
| 16C | 3.87 0.03 | 1.311 0.013 | 0.95 0.01 | 0.173 0.006 | 0.0243 0.0014 | 0.332 0.006 | 0.376 0.005 | 0.345 0.007 |
| 17A | 4.30 0.04 | 0.494 0.005 | 0.170 0.008 | 0.115 0.005 | 0.0034 0.0004 | 0.200 0.004 | 2.38 0.03 | 0.082 0.004 |
| 17B | 4.38 0.04 | 0.501 0.005 | 0.178 0.009 | 0.089 0.005 | 0.0040 0.0004 | 0.200 0.005 | 2.34 0.03 | 0.111 0.005 |
| 17C | 4.08 0.04 | 0.503 0.005 | 0.150 0.008 | 0.104 0.005 | 0.0033 0.0004 | 0.178 0.005 | 2.32 0.03 | 0.037 0.002 |

| | Mo | Mg | Ce | V | Ti | Al | Sn | Sb |
|------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 11A | 1.130 0.019 | | | 0.184 0.004 | 0.028 0.002 | 0.046 0.002 | 0.070 0.003 | 0.013 0.003 |
| 12A | 0.114 0.002 | | | 0.340 0.005 | 0.085 0.003 | 0.077 0.003 | 0.041 0.003 | 0.046 0.004 |
| 12B | 0.117 0.002 | | | 0.326 0.005 | 0.071 0.003 | 0.077 0.003 | 0.042 0.003 | 0.046 0.004 |
| 13B | 0.364 0.007 | 0.054 0.003 | 0.011 0.002 | 0.048 0.002 | 0.012 0.001 | 0.019 0.001 | 0.014 0.001 | 0.002 |
| 13C | 0.360 0.007 | 0.064 0.004 | 0.011 0.002 | 0.043 0.002 | 0.015 0.001 | 0.022 0.001 | 0.014 0.001 | 0.002 |
| 14C | 0.646 0.009 | 0.017 0.002 | 0.019 0.003 | 0.013 0.001 | 0.018 0.001 | 0.007 0.001 | 0.025 0.002 | 0.020 0.003 |
| 16A | 0.203 0.004 | | | 0.021 0.001 | 0.073 0.002 | 0.007 0.001 | 0.125 0.006 | 0.011 0.002 |
| 16B | 0.202 0.004 | | | 0.029 0.001 | 0.070 0.002 | 0.007 0.001 | 0.121 0.006 | 0.011 0.002 |
| 16C | 0.195 0.004 | | | 0.027 0.001 | 0.057 0.002 | 0.004 0.001 | 0.125 0.006 | 0.010 0.002 |
| 17A | 0.030 0.002 | 0.007 0.001 | 0.003 0.001 | 0.086 0.003 | 0.016 0.001 | 0.002 0.001 | 0.002 0.001 | |
| 17B | 0.030 0.002 | 0.009 0.001 | 0.003 0.001 | 0.086 0.003 | 0.016 0.001 | 0.002 0.001 | 0.002 0.001 | |
| 17C | 0.030 0.002 | 0.007 0.001 | 0.003 0.001 | 0.076 0.003 | 0.015 0.001 | 0.002 0.001 | 0.002 0.001 | |

| | Bi | B | Zn | Pb | W | Co | Zr | As |
|------------|-----------------------|-------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 11A | 0.011 0.001 | 0.0018 0.0003 | | 0.017 0.003 | 0.005 | 0.005 0.001 | 0.007 0.001 | 0.005 0.001 |
| 12A | 0.005 0.001 | 0.036 0.002 | 0.003 0.001 | 0.007 0.001 | 0.011 0.002 | 0.004 0.001 | 0.002 | 0.022 0.002 |
| 12B | 0.006 0.001 | 0.047 0.002 | 0.004 0.001 | 0.009 0.001 | 0.007 0.002 | 0.008 0.001 | 0.002 | 0.024 0.002 |
| 13B | | | | | 0.003 | 0.024 0.001 | 0.023 0.003 | 0.002 0.001 |
| 13C | | | | | 0.003 | 0.024 0.001 | 0.02 | 0.002 0.001 |
| 14C | | 0.0123 0.0006 | 0.010 0.001 | | 0.003 | 0.009 0.001 | 0.013 0.001 | 0.035 0.004 |
| 16A | | 0.018 0.001 | 0.019 0.002 | 0.006 0.001 | 0.019 0.002 | 0.010 0.001 | 0.002 | 0.005 0.001 |
| 16B | | 0.018 0.001 | 0.020 0.002 | 0.007 0.001 | 0.019 0.002 | 0.010 0.001 | 0.002 | 0.005 0.001 |
| 16C | | 0.020 0.001 | 0.017 0.002 | 0.015 0.003 | 0.015 0.002 | 0.006 0.001 | 0.002 | 0.003 0.001 |
| 17A | 0.001 | 0.0002 | | 0.002 0.001 | 0.004 0.001 | 0.043 0.002 | | 0.007 0.001 |
| 17B | 0.001 | 0.0002 | | 0.002 0.001 | 0.004 0.001 | 0.043 0.002 | | 0.008 0.001 |
| 17C | 0.002 | 0.0006 | | 0.002 0.001 | 0.004 0.001 | 0.043 0.002 | | 0.005 0.001 |

Further non-certified values : Nb: 0.007% in 11A, 0.008% in 12A, 0.006% in 16A, 0.03% in 16B, Te: 0.005% in 11A, 0.01% in 11B, 0.006% in 16A, 16B and 0.007% in 16C

RM for spectrometry

fully compliant with the ISO Guide 35 definition of Reference Material – with the values confirmed and their uncertainties assessed.

Intended for calibration and the control of matrix-match and of the state of statistic regulation in the automated spectrometry of low alloy steel from a plane of solid sample. They may not substitute CRM in establishing traceability of the results. A single analysis area of at least 4 mm in diameter defines the minimum sample intake.

RM CI-SPL-17 – RM of cast iron for solid sample spectrometry, \varnothing 40 mm, h = 18 mm

| | C | Mn | Si | P | S | Cr | Ni | Cu | Mo | Mg | Ce | V |
|------------|-------------|--------------|-------------|--------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 31A | 3.54 | 0.041 | 2.10 | 0.025 | 0.006 | 0.019 | 0.538 | 0.005 | 0.004 | 0.070 | <i>0.004</i> | 0.008 |
| (ID-0A) | 0.04 | 0.002 | 0.02 | 0.001 | 0.001 | 0.001 | 0.004 | 0.001 | 0.001 | 0.003 | | 0.001 |
| 32A | 3.39 | 0.288 | 2.74 | 0.037 | 0.007 | 0.060 | 0.015 | 0.306 | 0.116 | 0.024 | <i>0.004</i> | 0.005 |
| (ID-1B) | 0.02 | 0.003 | 0.03 | 0.002 | 0.001 | 0.002 | 0.001 | 0.005 | 0.002 | 0.002 | | 0.001 |
| 34A | 3.48 | 0.980 | 2.29 | 0.105 | 0.008 | 0.102 | 0.493 | 0.230 | 0.072 | 0.026 | 0.008 | 0.073 |
| (ID-5B) | 0.03 | 0.010 | 0.02 | 0.003 | 0.001 | 0.002 | 0.004 | 0.004 | 0.002 | 0.002 | 0.002 | 0.002 |
| 36A | 3.02 | 0.057 | 2.13 | 0.026 | 0.010 | 0.014 | 0.011 | 0.007 | 0.004 | 0.012 | 0.007 | 0.021 |
| (IG-0A) | 0.02 | 0.002 | 0.02 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.002 |
| 37A | 3.07 | 0.211 | 3.30 | 0.025 | 0.023 | 0.328 | 0.106 | 0.149 | 0.325 | | | 0.122 |
| (IG-1B) | 0.02 | 0.003 | 0.03 | 0.001 | 0.001 | 0.002 | 0.002 | 0.003 | 0.004 | | | 0.003 |
| 38A | 3.39 | 0.401 | 2.37 | 0.067 | 0.036 | 0.141 | 0.306 | 0.510 | 0.101 | | | 0.061 |
| (IG-2B) | 0.03 | 0.004 | 0.02 | 0.002 | 0.002 | 0.002 | 0.003 | 0.006 | 0.002 | | | 0.002 |
| 39A | 3.70 | 0.812 | 1.90 | 0.160 | 0.045 | 0.488 | 0.032 | 0.298 | 0.203 | | | 0.232 |
| (IG-3B) | 0.03 | 0.011 | 0.02 | 0.003 | 0.002 | 0.003 | 0.001 | 0.005 | 0.003 | | | 0.004 |
| 40A | 3.38 | 0.042 | 1.98 | 0.021 | 0.0035 | 0.031 | 0.045 | 0.010 | 0.005 | 0.007 | 0.012 | 0.014 |
| (IG-4A) | 0.02 | 0.002 | 0.02 | 0.002 | 0.0005 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.002 | 0.001 |

| | Ti | Al | Sn | Sb | Bi | B | Zn | Pb | W | Co | Nb | N |
|-----------------------|--------------|--------------|--------------|--------------|--------------|---------------|--------------|--------------|--------------|--------------|--------------|---------------|
| 31A (ID-0A) | 0.007 | 0.005 | <i>0.003</i> | | | <i>0.0004</i> | | | <i>0.005</i> | 0.022 | | 0.0042 |
| | 0.001 | 0.001 | | | | | | | | 0.001 | | 0.0003 |
| 32A (ID-1B) | 0.044 | 0.029 | <i>0.012</i> | 0.023 | <i>0.007</i> | <i>0.0005</i> | 0.011 | 0.022 | <i>0.008</i> | <i>0.002</i> | | 0.0042 |
| | 0.001 | 0.001 | | 0.002 | | | 0.001 | 0.002 | | | | 0.0003 |
| 34A (ID-5B) | 0.044 | 0.010 | 0.051 | 0.007 | <i>0.005</i> | 0.0076 | 0.007 | <i>0.006</i> | 0.016 | 0.025 | 0.014 | 0.0041 |
| | 0.001 | 0.001 | 0.002 | 0.002 | | 0.0003 | 0.001 | | 0.002 | 0.001 | 0.001 | 0.0003 |
| 36A (IG-0A) | 0.021 | <i>0.003</i> | <i>0.002</i> | | <i>0.007</i> | 0.022 | <i>0.002</i> | 0.016 | | <i>0.004</i> | | 0.0038 |
| | 0.001 | | | | | 0.002 | | 0.002 | | | | 0.0003 |
| 37A (IG-1B) | 0.008 | 0.039 | 0.073 | | <i>0.002</i> | 0.0124 | <i>0.001</i> | <i>0.002</i> | 0.026 | 0.031 | | 0.0089 |
| | 0.001 | 0.002 | 0.002 | | | 0.0005 | | | 0.002 | 0.001 | | 0.0004 |
| 38A (IG-2B) | 0.012 | 0.034 | 0.032 | 0.018 | <i>0.002</i> | 0.0027 | 0.028 | <i>0.003</i> | <i>0.005</i> | 0.021 | 0.008 | 0.0100 |
| | 0.001 | 0.001 | 0.001 | 0.002 | | 0.0002 | 0.002 | | | 0.001 | 0.002 | 0.0004 |
| 39A (IG-3B) | <i>0.074</i> | 0.008 | <i>0.003</i> | 0.037 | 0.008 | 0.0195 | 0.035 | 0.017 | | <i>0.002</i> | | 0.0037 |
| | | 0.001 | | 0.002 | 0.002 | 0.0006 | 0.003 | 0.002 | | | | 0.0003 |
| 40A (IG-4A) | 0.015 | 0.096 | <i>0.004</i> | | | 0.0008 | <i>0.002</i> | | | 0.027 | | 0.0063 |
| | 0.001 | 0.003 | | | | 0.0002 | | | | 0.001 | | 0.0004 |

Further non-certified values are: 0.041% As in 37A, 0.025% As in 32A, 0.016% As in 33A, 0.008% As in 41A, 0.008% Te in 33A, 0.007% Te in 37A and 39A.

CI-SPL-22 Reference Materials 44A-53A

| | C | Mn | Si | P | S | Cr | Ni | Cu | Mo | Mg | Ce | V | Ti |
|----------------------------|-------------|--------------|-------------|--------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 44A (1H) | 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 |
| | 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 (1J) | 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 |
| | 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 (2H) | 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 |
| | 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 (2J) | 3.82 | 0.084 | 1.07 | 0.137 | 0.011 | 0.016 | 0.606 | 0.82 | <i>0.002</i> | 0.035 | 0.010 | 0.007 | 0.027 |
| | 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 (3E) | 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 |
| | 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 (3F) | 3.12 | 0.328 | 2.06 | 0.038 | 0.009 | 0.300 | 0.132 | 0.384 | 0.475 | 0.007 | <i>0.005</i> | 0.081 | 0.024 |
| | 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 (8E) | 3.39 | 0.529 | 2.14 | 0.179 | 0.055 | 0.137 | 0.113 | 0.151 | 0.045 | - | - | 0.015 | 0.030 |
| | 0.02 | 0.005 | 0.02 | 0.004 | 0.002 | 0.002 | 0.002 | 0.003 | 0.001 | | | 0.001 | 0.001 |
| 51A (8F) | 3.46 | 0.405 | 1.63 | 0.147 | 0.044 | 0.075 | 0.111 | 0.152 | 0.037 | - | - | 0.017 | 0.033 |
| | 0.03 | 0.005 | 0.02 | 0.004 | 0.003 | 0.001 | 0.002 | 0.003 | 0.001 | | | 0.001 | 0.001 |
| 52A (14D) | 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 |
| | 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 (15D) | 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 |
| | 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 (1H) | 0.046 | 0.026 | 0.018 | 0.009 | 0.0037 | 0.009 | 0.017 | 0.018 | 0.024 | <i>0.014</i> | <i>0.007</i> | - |
| | 0.002 | 0.002 | 0.002 | 0.001 | 0.0003 | 0.002 | 0.002 | 0.002 | 0.002 | | | |
| 45A (1J) | 0.078 | 0.034 | - | - | 0.022 | - | 0.005 | 0.015 | 0.031 | - | <i>0.015</i> | - |
| | 0.003 | 0.002 | | | 0.002 | | 0.001 | 0.002 | 0.001 | | | |
| 46A (2H) | 0.026 | 0.014 | 0.024 | 0.005 | 0.0021 | 0.018 | 0.021 | 0.008 | - | <i>0.012</i> | <i>0.004</i> | <i>0.003</i> |
| | 0.001 | 0.001 | 0.002 | 0.001 | 0.0002 | 0.002 | 0.002 | 0.001 | | | | |
| 47A (2J) | 0.024 | 0.016 | 0.026 | - | <i>0.0005</i> | 0.027 | 0.012 | 0.004 | <i>0.002</i> | - | <i>0.010</i> | - |
| | 0.001 | 0.001 | 0.002 | | | 0.002 | 0.001 | 0.001 | | | | |
| 48A (3E) | 0.021 | 0.010 | - | - | 0.0045 | - | 0.015 | - | 0.025 | - | - | <i>0.021</i> |
| | 0.001 | 0.001 | | | 0.0002 | | 0.001 | | 0.001 | | | |
| 49A (3F) | 0.064 | 0.011 | <i>0.007</i> | - | 0.0075 | <i>0.003</i> | 0.008 | 0.013 | 0.094 | <i>0.005</i> | - | 0.020 |
| | 0.003 | 0.001 | | | 0.0005 | | 0.001 | 0.001 | 0.003 | | | 0.001 |
| 50A (8E) | 0.004 | 0.068 | 0.011 | 0.011 | <i>0.0008</i> | - | 0.004 | <i>0.006</i> | 0.029 | - | - | - |
| | 0.001 | 0.002 | 0.002 | 0.002 | | | 0.001 | | 0.001 | | | |
| 51A (8F) | 0.006 | 0.072 | 0.012 | <i>0.008</i> | - | <i>0.002</i> | 0.006 | <i>0.005</i> | 0.035 | - | - | <i>0.007</i> |
| | 0.001 | 0.002 | 0.002 | | | | 0.001 | | 0.001 | | | |
| 52A (14D) | 0.011 | 0.032 | 0.014 | 0.011 | 0.0082 | 0.004 | <i>0.003</i> | <i>0.004</i> | 0.010 | <i>0.003</i> | 0.015 | 0.041 |
| | 0.001 | 0.001 | 0.001 | 0.001 | 0.0004 | 0.001 | | | 0.001 | | 0.001 | 0.003 |
| 53A (15D) | 0.047 | 0.007 | 0.066 | <i>0.007</i> | 0.0046 | <i>0.004</i> | - | 0.010 | 0.032 | - | - | <i>0.004</i> |
| | 0.002 | 0.001 | 0.006 | | 0.0003 | | | 0.001 | 0.001 | | | |

RM of steel for solid sample spectrometry

SPL 300A-307A - SET OF LOW ALLOY STEELS for solid sample spectrometry, combustion and wet-way methods

Solid sample with a diameter of 37 mm and a height of 25 mm, or 100 g of steel chips.

| | C | Mn | Si | P | S | Cu | Cr | Ni | Al | Mo |
|-------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| 300A | 0.0033 0.0004 | 0.0390 0.0011 | 0.0032 0.0005 | 0.0035 0.0003 | 0.0021 0.0003 | 0.0080 0.0006 | 0.0092 0.0005 | 0.0075 0.0010 | 0.0017 0.0005 | 0.0015 0.0002 |
| 301A | 0.176 0.004 | 0.902 0.012 | 0.384 0.008 | 0.0322 0.0012 | 0.0260 0.0012 | 0.154 0.003 | 0.831 0.009 | 0.751 0.009 | 0.0136 0.0008 | 0.440 0.006 |
| 302A | 0.118 0.002 | 0.471 0.008 | 0.691 0.012 | 0.051 0.002 | 0.0096 0.0006 | 0.790 0.012 | 3.04 0.02 | 0.126 0.004 | 0.175 0.005 | 0.758 0.009 |
| 303A | 1.37 0.02 | 1.45 0.02 | 1.22 0.02 | 0.0122 0.0009 | 0.0069 0.0004 | 0.102 0.003 | 0.225 0.006 | 2.60 0.03 | 0.277 0.007 | 0.0455 0.0020 |
| 304A | 0.369 0.008 | 0.121 0.003 | 0.854 0.012 | 0.0274 0.0010 | 0.062 0.002 | 0.066 0.002 | 0.434 0.007 | 5.04 0.04 | 0.0327 0.0013 | 0.131 0.003 |
| 305A | 0.299 0.006 | 0.208 0.004 | 0.188 0.008 | 0.0073 0.0008 | 0.0468 0.0014 | 0.342 0.005 | 1.31 0.02 | 0.393 0.008 | 0.0046 0.0004 | 1.32 0.02 |
| 306A | 0.759 0.008 | 2.29 0.03 | 1.63 0.02 | 0.0167 0.0005 | 0.0083 0.0005 | 0.551 0.008 | 0.107 0.003 | 1.355 0.016 | 0.0178 0.0009 | 0.283 0.006 |
| 307A | 0.563 0.003 | 0.704 0.009 | 0.572 0.009 | 0.0219 0.0009 | 0.0055 0.0005 | 0.243 0.005 | 0.541 0.008 | 0.545 0.007 | 0.0906 0.0022 | 0.096 0.002 |

| | W | V | Ti | Co | As | Sn | B | Nb | Sb | Pb |
|-------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| 300A | <i>0.0017</i> | <i>0.0011</i> | <i>0.0004</i> | 0.0022 0.0003 | 0.0027 0.0003 | <i>0.0008</i> | <i>0.0002</i> | | <i>0.0015</i> | <i>0.0007</i> |
| 301A | 0.275 0.006 | 0.262 0.005 | 0.107 0.004 | 0.0498 0.0009 | 0.0060 0.0004 | 0.0875 0.0012 | 0.0054 0.0002 | 0.0559 0.0009 | 0.0190 0.0013 | 0.0059 0.0004 |
| 302A | 0.787 0.017 | 0.422 0.005 | 0.0111 0.0007 | 0.0966 0.0020 | 0.0064 0.0009 | 0.0180 0.0004 | 0.0074 0.0005 | 0.080 0.003 | 0.035 0.005 | 0.035 0.003 |
| 303A | 0.442 0.016 | 0.090 0.003 | 0.0626 0.0018 | 0.0166 0.0013 | 0.0037 0.0008 | 0.0598 0.0018 | 0.0070 0.0004 | 0.0154 0.0005 | 0.0115 0.0020 | 0.0054 0.0007 |
| 304A | 1.319 0.023 | 0.170 0.003 | 0.175 0.005 | 0.034 0.002 | 0.0194 0.0013 | 0.0302 0.0007 | 0.0041 0.0002 | 0.0176 0.0011 | 0.008 0.002 | 0.033 0.003 |
| 305A | 0.132 0.004 | 0.795 0.011 | 0.0082 0.0009 | 0.159 0.003 | 0.031 0.002 | 0.0093 0.0006 | 0.0048 0.0002 | 0.222 0.003 | 0.015 0.002 | 0.0262 0.0011 |
| 306A | 0.0266 0.0018 | 0.0559 0.0018 | 0.0508 0.0015 | 0.0259 0.0008 | 0.080 0.003 | 0.0074 0.0005 | 0.0079 0.0003 | 0.0118 0.0010 | 0.0073 0.0009 | 0.026 0.003 |
| 307A | 0.0518 0.0015 | 0.0377 0.0008 | 0.0297 0.0010 | 0.0353 0.0008 | 0.0275 0.0009 | 0.0027 0.0004 | 0.0024 0.0002 | 0.0412 0.0008 | 0.0067 0.0006 | 0.0083 0.0006 |

| | Zr | Zn | N | Bi | Ce | Ca | Ta | Other elements (informative values) |
|-------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|--|
| 300A | | <i>0.0007</i> | 0.0028 <i>0.0006</i> | | | | <i>0.003</i> | |
| 301A | <i>0.0013</i> | <i>0.0011</i> | 0.0098 <i>0.0004</i> | <i>0.001</i> | 0.0134 <i>0.0021</i> | <i>0.0003</i> | 0.036 <i>0.005</i> | <i>Te 0.006 La 0.002</i> <i>Se 0.007 Nd 0.002</i> |
| 302A | 0.0157 <i>0.0011</i> | 0.0264 <i>0.0025</i> | 0.026 <i>0.002</i> | <i>0.002</i> | 0.0202 <i>0.0033</i> | 0.0012 <i>0.0002</i> | 0.033 <i>0.003</i> | <i>La 0.005</i> <i>Nd 0.007</i> |
| 303A | 0.171 <i>0.008</i> | 0.0135 <i>0.0023</i> | 0.0072 <i>0.0005</i> | 0.0094 <i>0.0027</i> | 0.0126 <i>0.0027</i> | 0.0018 <i>0.0003</i> | <i>0.005</i> | <i>Mg</i> <i>0.0005</i> <i>Te 0.002</i> |
| 304A | 0.057 <i>0.003</i> | | 0.0081 <i>0.0004</i> | <i>0.002</i> | <i>0.004</i> | | | <i>Ge 0.014</i> |
| 305A | 0.0059 <i>0.0006</i> | 0.0031 <i>0.0007</i> | 0.0104 <i>0.0003</i> | <i>0.005</i> | <i>0.003</i> | | <i>0.010</i> | <i>Ag 0.009</i> |
| 306A | 0.0093 <i>0.0011</i> | 0.0150 <i>0.0015</i> | 0.0136 <i>0.0006</i> | 0.0033 <i>0.0009</i> | <i>0.004</i> | 0.0012 <i>0.0003</i> | 0.029 <i>0.003</i> | <i>Se 0.008 Nd 0.009</i> <i>La 0.008 Ag 0.012</i> |
| 307A | 0.0479 <i>0.0016</i> | 0.0058 <i>0.0008</i> | 0.0065 <i>0.0008</i> | <i>0.002</i> | 0.0062 <i>0.0014</i> | 0.0005 <i>0.0001</i> | 0.007 <i>0.002</i> | <i>Se 0.009 Mg</i> <i>0.003</i> <i>Ge 0.005 Ag 0.006</i> |

RM LA 0 – LA 5

- sample of 37 mm in diameter, height 25 mm

| RM | C | Mn | Si | P | S | Cu | Cr | Ni |
|-------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| LA-0A | 0.006 ±0.0015 | 0.045 ±0.005 | 0.0015 ±0.0003 | 0.005 ±0.0005 | 0.005 ±0.0003 | 0.012 ±0.001 | 0.022 ±0.002 | 0.028 ±0.002 |
| LA-0B | 0.0036 ±0.0011 | 0.0380 ±0.0014 | <i>0.0043</i> | 0.0037 ±0.0007 | 0.0023 ±0.0003 | 0.0074 ±0.0005 | 0.0091 ±0.0016 | 0.0070 ±0.0009 |
| LA-1B | 0.005 ±0.001 | 0.13 ±0.006 | 0.020 ±0.002 | 0.004 ±0.001 | 0.017 ±0.002 | 0.01 ±0.002 | 0.042 ±0.003 | 0.014 ±0.002 |
| LA-2F | 0.058 ±0.002 | 0.370 ±0.003 | 1.514 ±0.017 | 0.071 ±0.002 | 0.053 ±0.002 | 0.547 ±0.005 | 0.171 ±0.002 | 2.029 ±0.020 |
| LA-3G | 0.626 ±0.004 | 0.687 ±0.010 | 1.296 ±0.011 | 0.0472 ±0.0010 | 0.0351 ±0.0011 | 0.236 ±0.004 | 1.377 ±0.007 | 1.019 ±0.010 |
| LA-4C | 0.95 ±0.012 | 1.63 ±0.025 | 0.07 ±0.01 | 0.021 ±0.003 | 0.012 ±0.001 | 0.056 ±0.002 | 1.78 ±0.03 | 0.045 ±0.004 |
| LA-4D | 1.143 ±0.005 | 1.266 ±0.009 | 0.181 ±0.005 | 0.0289 ±0.0011 | 0.0091 ±0.0002 | 0.066 ±0.004 | 1.831 ±0.021 | 0.367 ±0.007 |
| LA-5C | 0.439 ±0.007 | 1.873 ±0.012 | 0.394 ±0.008 | 0.0179 ±0.0011 | 0.0088 ±0.0008 | 0.138 ±0.002 | 3.815 ±0.026 | 2.591 ±0.020 |

| RM | Al | Mo | W | V | Ti | Co | As | Sn |
|-------|--------------------------|--------------------------|--------------------------|------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| LA-0A | 0.0015 ±0.0005 | 0.0044 ±0.0010 | | | 0.001 ±0.0003 | 0.002 ±0.0003 | 0.0015 | 0.001 |
| LA-0B | 0.0010 ±0.0005 | 0.0016 | | | | 0.0017 | 0.0024 ±0.0004 | 0.0013 |
| LA-1B | 0.003 ±0.001 | 0.007 ±0.001 | 0.010 ±0.002 | 0.004 ±0.001 | 0.001 | 0.002 | 0.002 | 0.001 |
| LA-2F | 0.178 ±0.003 | 0.669 ±0.003 | 0.315 ±0.008 | 0.289 ±0.003 | 0.412 ±0.008 | 0.271 ±0.003 | 0.100 ±0.004 | 0.094 ±0.002 |
| LA-3G | 0.047 ±0.002 | 0.326 ±0.005 | 0.105 ±0.004 | 0.232 ±0.002 | 0.143 ±0.004 | 0.127 ±0.003 | 0.051 ±0.004 | 0.031 ±0.001 |
| LA-4C | 0.048 ±0.003 | 0.008 ±0.001 | 0.008 ±0.001 | 0.010 ±0.002 | 0.002 ±0.001 | 0.006 ±0.002 | 0.003 ±0.001 | 0.006 ±0.001 |
| LA-4D | 0.067 ±0.002 | 0.136 ±0.004 | 0.0251 ±0.0025 | 0.103 ±0.002 | 0.0154 ±0.0007 | 0.0370 ±0.0013 | 0.0104 ±0.0016 | 0.0142 ±0.0010 |
| LA-5C | 0.081 ±0.003 | 0.867 ±0.011 | 0.631 ±0.008 | 0.536 ±0.006 | 0.048 ±0.001 | 0.088 ±0.002 | 0.026 ±0.002 | 0.031 ±0.001 |

| RM | B | Nb | Pb | Sb | Zr | Ca | Ta | Zn | N |
|-------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|--------------------------|-----------------------|-------------------------|--------------------------|
| LA-0A | | | 0.001 | 0.0007 | | | | | 0.0023 ±0.0002 |
| LA-0B | | | | | | | | | 0.0027 ±0.0005 |
| LA-1B | 0.010 ±0.001 | 0.001 | 0.0007 | 0.002 | 0.002 | 0.0016 ±0.0003 | | | 0.003 ±0.0004 |
| LA-2F | 0.0084 0.0003 | 0.291 0.005 | 0.067 0.003 | 0.064 0.004 | 0.0053 0.0007 | 0.0041 0.0003 | 0.087 0.006 | 0.0042 0.0010 | 0.0078 0.0002 |
| LA-3G | 0.0039 ±0.0002 | 0.0711 ±0.0015 | 0.0098 ±0.0005 | 0.0242 ±0.0036 | 0.068 ±0.003 | 0.0016 ±0.0002 | | | 0.0115 ±0.0010 |
| LA-4C | 0.0005 ±0.0001 | 0.053 ±0.004 | | | | | | | 0.012 ±0.001 |
| LA-4D | | 0.0046 ±0.0009 | 0.0401 ±0.0035 | | | | | | 0.0064 ±0.0005 |
| LA-5C | | 0.057 0.002 | 0.0156 0.0011 | 0.018 ±0.003 | | | | <i>0.013</i> | 0.0248 0.0012 |

RM CM and SP

- sample of 35 - 43 mm in diameter. Height 25 mm or an agreed option.

| RM | C | Mn | Si | P | S | Cu | Cr | Ni | Al | Mo | W | V |
|--------|---------------|--------------|--------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| CM-1D | 0.735 | 1.800 | 0.341 | 0.0218 | 0.0268 | 0.186 | 0.456 | 0.547 | 0.0245 | 0.100 | 0.063 | 0.089 |
| | 0.005 | 0.015 | 0.006 | 0.0004 | 0.0011 | 0.003 | 0.007 | 0.006 | 0.0011 | 0.002 | 0.002 | 0.002 |
| CM-2B | 0.247 | 0.894 | 1.950 | 0.082 | 0.0114 | 0.994 | 1.538 | 1.205 | 0.0464 | 0.332 | 0.223 | 0.109 |
| | 0.004 | 0.007 | 0.040 | 0.002 | 0.0007 | 0.019 | 0.015 | 0.014 | 0.0011 | 0.011 | 0.013 | 0.005 |
| CM-3A | 0.295 | 0.37 | 0.27 | 0.016 | 0.0013 | 0.16 | 1.87 | 1.82 | 0.05 | 0.33 | 0.015 | 0.007 |
| | 0.013 | 0.01 | 0.02 | 0.002 | 0.0003 | 0.005 | 0.04 | 0.04 | 0.002 | 0.01 | 0.003 | 0.002 |
| CM-4B | 0.72 | 0.50 | 0.80 | 0.023 | 0.012 | 0.40 | 2.23 | 1.40 | 0.025 | 0.33 | 0.116 | 0.18 |
| | 0.02 | 0.01 | 0.02 | 0.003 | 0.002 | 0.01 | 0.03 | 0.03 | 0.002 | 0.01 | 0.005 | 0.01 |
| CM-5D | 1.140 | 1.425 | 0.521 | 0.0284 | 0.0277 | 0.157 | 2.455 | 0.451 | 0.086 | 0.137 | 0.028 | 0.113 |
| | 0.006 | 0.007 | 0.007 | 0.0011 | 0.0007 | 0.002 | 0.018 | 0.006 | 0.003 | 0.003 | 0.003 | 0.002 |
| CM-6A | 0.52 | 0.37 | 0.27 | 0.016 | 0.058 | 0.05 | 0.37 | 0.19 | 0.02 | 0.04 | 0.04 | 0.05 |
| | 0.015 | 0.013 | 0.014 | 0.002 | 0.003 | 0.003 | 0.01 | 0.006 | 0.002 | 0.003 | 0.003 | 0.003 |
| CM-7A | 0.05 | 1.17 | 0.56 | 0.011 | 0.016 | 0.09 | 0.10 | 0.05 | 0.13 | 0.015 | 0.01 | 0.012 |
| | 0.005 | 0.02 | 0.016 | 0.002 | 0.002 | 0.003 | 0.006 | 0.003 | 0.01 | 0.002 | 0.002 | 0.001 |
| CM-8B | 0.185 | 1.95 | 0.112 | 0.015 | 0.014 | 0.081 | 1.22 | 0.032 | 0.0028 | 0.011 | <i>0.009</i> | 0.0078 |
| | 0.006 | 0.02 | 0.003 | 0.001 | 0.001 | 0.003 | 0.02 | 0.002 | 0.0006 | 0.001 | | 0.0005 |
| CM-9B | 0.17 | 2.27 | 0.89 | 0.008 | 0.010 | 0.04 | 1.36 | 0.023 | 0.049 | <i>0.002</i> | | 0.006 |
| | 0.01 | 0.03 | 0.02 | 0.002 | 0.002 | 0.003 | 0.01 | 0.003 | 0.003 | | | 0.001 |
| CM-12C | 0.0389 | 0.275 | 3.770 | 0.0103 | 0.0110 | 0.175 | 0.081 | 0.046 | 0.145 | 0.0128 | <i>0.004</i> | 0.0271 |
| | 0.0017 | 0.003 | 0.150 | 0.0006 | 0.0004 | 0.004 | 0.002 | 0.002 | 0.005 | 0.0011 | | 0.0014 |
| CM-14C | 0.586 | 1.723 | 1.352 | 0.0169 | 0.0266 | 0.365 | 1.316 | 1.141 | 0.226 | 0.432 | 0.0238 | 0.325 |
| | 0.005 | 0.009 | 0.014 | 0.0009 | 0.0006 | 0.004 | 0.008 | 0.008 | 0.005 | 0.005 | 0.0019 | 0.004 |
| CM-15C | 0.075 | 1.13 | 0.006 | 0.063 | 0.32 | 0.141 | 0.052 | 0.072 | | 0.021 | | |
| | 0.006 | 0.04 | 0.002 | 0.003 | 0.01 | 0.004 | 0.003 | 0.004 | | 0.003 | | |
| CM-16B | 0.421 | 0.762 | 0.574 | 0.0508 | 0.0376 | 0.296 | 0.635 | 0.733 | 0.128 | 0.424 | 0.141 | 0.272 |
| | 0.002 | 0.003 | 0.005 | 0.0011 | 0.0006 | 0.002 | 0.004 | 0.004 | 0.003 | 0.003 | 0.002 | 0.002 |
| CM-17A | 0.142 | 0.524 | 0.612 | 0.0310 | 0.0175 | 0.201 | 9.58 | 0.520 | 0.0089 | 1.116 | 0.099 | 0.247 |
| | 0.003 | 0.006 | 0.009 | 0.0010 | 0.0012 | 0.004 | 0.05 | 0.015 | 0.0012 | 0.017 | 0.004 | 0.005 |
| CM-18A | 0.143 | 1.792 | 0.903 | 0.0182 | 0.0119 | 2.393 | 20.59 | 20.44 | 0.0344 | 2.282 | 0.097 | 0.113 |
| | 0.003 | 0.018 | 0.021 | 0.0015 | 0.0009 | 0.041 | 0.12 | 0.09 | 0.0027 | 0.037 | 0.007 | 0.004 |
| CM-19A | 0.361 | 0.783 | 1.588 | 0.0440 | 0.0182 | 0.986 | 13.12 | 15.27 | 0.0788 | 1.023 | 0.311 | 1.235 |
| | 0.008 | 0.010 | 0.015 | 0.0020 | 0.0008 | 0.031 | 0.11 | 0.16 | 0.0045 | 0.018 | 0.022 | 0.055 |
| CM-20A | 0.63 | 0.594 | 1.74 | 0.0383 | 0.020 | 0.237 | 0.97 | 1.007 | 0.076 | 0.365 | 0.104 | 0.225 |
| | 0.01 | 0.005 | 0.02 | 0.0015 | 0.001 | 0.008 | 0.01 | 0.015 | 0.002 | 0.007 | 0.007 | 0.004 |
| CM-23A | 0.917 | 0.803 | 0.934 | 0.0609 | 0.0348 | 0.234 | 3.064 | 0.230 | 0.323 | 0.816 | 0.104 | 0.157 |
| | 0.004 | 0.010 | 0.020 | 0.0035 | 0.0011 | 0.005 | 0.022 | 0.007 | 0.011 | 0.010 | 0.005 | 0.006 |
| CM-25A | 0.097 | 0.781 | 0.656 | 0.0036 | 0.0051 | 0.0040 | 0.0248 | 0.0214 | 0.0030 | | 0.0048 | 0.0161 |
| | 0.002 | 0.004 | 0.008 | 0.0006 | 0.0004 | 0.0004 | 0.0006 | 0.0006 | 0.0006 | | 0.0020 | 0.0006 |
| SP-1B | 0.050 | 1.67 | 0.505 | 0.039 | 0.30 | 0.47 | 17.42 | 8.32 | <i>0.003</i> | 0.40 | 0.032 | 0.060 |
| | 0.002 | 0.03 | 0.017 | 0.003 | 0.02 | 0.01 | 0.12 | 0.16 | | 0.01 | 0.003 | 0.004 |
| SP-2C | 1.40 | 14.50 | 0.29 | 0.037 | 0.016 | 0.35 | 1.56 | 0.050 | 0.030 | 0.050 | 0.033 | 0.051 |
| | 0.03 | 0.21 | 0.02 | 0.003 | 0.002 | 0.03 | 0.03 | 0.003 | 0.002 | 0.002 | 0.005 | 0.003 |
| SP-2D | 1.369 | 26.90 | 0.558 | 0.0725 | 0.0031 | 0.106 | 1.507 | 0.388 | 0.0043 | 0.391 | 0.083 | 0.178 |
| | 0.009 | 0.32 | 0.012 | 0.0018 | 0.0009 | 0.005 | 0.008 | 0.007 | 0.0013 | 0.009 | 0.007 | 0.004 |
| SP-3C | 0.30 | 0.43 | 0.84 | 0.026 | 0.011 | 0.185 | 16.42 | 5.31 | 0.095 | 0.26 | 0.12 | 0.19 |
| | 0.02 | 0.03 | 0.04 | 0.003 | 0.003 | 0.011 | 0.11 | 0.07 | 0.010 | 0.01 | 0.01 | 0.01 |
| SP-3D | 0.171 | 0.34 | 0.71 | 0.021 | 0.015 | 0.73 | 16.44 | 5.36 | 0.037 | 0.25 | 0.12 | 0.11 |
| | 0.007 | 0.02 | 0.03 | 0.003 | 0.003 | 0.04 | 0.23 | 0.15 | 0.003 | 0.01 | 0.01 | 0.01 |
| SP-4C | 0.34 | 1.66 | 1.75 | 0.020 | 0.010 | 0.056 | 22.1 | 37.1 | 0.011 | 0.105 | <i>0.01</i> | 0.059 |
| | 0.02 | 0.04 | 0.04 | 0.004 | 0.002 | 0.007 | 0.1 | 0.2 | 0.003 | 0.008 | | 0.005 |
| BO-2B | 0.515 | 0.745 | 0.309 | 0.0093 | 0.0016 | 0.100 | 0.212 | 0.057 | 0.0196 | 0.006 | <i>0.005</i> | <i>0.001</i> |
| | 0.010 | 0.011 | 0.007 | 0.0007 | 0.0003 | 0.005 | 0.004 | 0.002 | 0.0008 | 0.001 | | |

| RM | Ti | Co | As | Sn | B | Nb | Pb | Sb | Zr | Ca | Ta | N |
|--------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------|----------------|--------------|---------------|
| CM-1D | 0.054 | 0.029 | | 0.0144 | 0.0017 | 0.050 | | 0.0112 | | | | 0.0124 |
| | 0.004 | 0.001 | | 0.0009 | 0.0002 | 0.004 | | 0.0008 | | | | 0.0005 |
| CM-2B | 0.342 | 0.454 | 0.120 | 0.091 | 0.0010 | <i>0.58</i> | 0.087 | 0.020 | 0.013 | | | 0.0062 |
| | 0.008 | 0.022 | 0.017 | 0.003 | 0.0001 | | 0.008 | 0.004 | 0.002 | | | 0.0007 |
| CM-3A | 0.006 | 0.012 | 0.005 | 0.007 | 0.0002 | 0.006 | | | | | | 0.007 |
| | 0.0003 | 0.002 | 0.002 | 0.002 | 0.0001 | 0.001 | | | | | | 0.001 |
| CM-4B | 0.12 | 0.115 | 0.015 | 0.028 | 0.017 | 0.071 | 0.022 | 0.052 | | Zn 0.007 | | 0.013 |
| | 0.01 | 0.004 | 0.001 | 0.002 | 0.001 | 0.002 | 0.003 | 0.002 | | 0.001 | | 0.001 |
| CM-5D | 0.040 | 0.0237 | 0.0243 | 0.0200 | 0.0021 | 0.035 | 0.0134 | | 0.072 | | | 0.0168 |
| | 0.001 | 0.0005 | 0.0012 | 0.0007 | 0.0002 | 0.002 | 0.0014 | | 0.003 | | | 0.0009 |
| CM-6A | 0.03 | 0.03 | 0.025 | 0.017 | 0.015 | 0.028 | 0.017 | 0.03 | 0.04 | | | 0.009 |
| | 0.003 | 0.005 | 0.002 | 0.002 | 0.001 | 0.002 | 0.001 | 0.003 | 0.003 | | | 0.001 |
| CM-7A | 0.14 | 0.007 | 0.005 | 0.008 | 0.0003 | 0.004 | 0.0014 | 0.0003 | 0.042 | | | 0.01 |
| | 0.005 | 0.001 | 0.001 | 0.002 | 0.0001 | 0.001 | | | 0.003 | | | 0.002 |
| CM-8B | 0.0008 | 0.007 | 0.0035 | 0.0126 | 0.0023 | <i>0.002</i> | <i>0.003</i> | <i>0.004</i> | <i>0.002</i> | | | 0.0075 |
| | 0.0002 | 0.001 | 0.0003 | 0.0007 | 0.0003 | | | | | | | 0.0004 |
| CM-9B | 0.002 | 0.004 | 0.002 | 0.003 | 0.004 | 0.06 | 0.002 | 0.003 | 0.003 | | | |
| | 0.001 | 0.001 | | 0.001 | 0.001 | 0.01 | 0.001 | 0.001 | 0.001 | | | |
| CM-12C | 0.0128 | 0.0044 | 0.0030 | 0.0055 | 0.0033 | 0.0066 | | | | 0.0010 | | 0.0056 |
| | 0.0004 | 0.0006 | 0.0007 | 0.0010 | 0.0002 | 0.0005 | | | | 0.0002 | | 0.0005 |
| CM-14C | 0.420 | 0.0306 | 0.0165 | 0.048 | 0.0249 | 0.248 | 0.0090 | 0.0170 | 0.037 | | | 0.0092 |
| | 0.008 | 0.0009 | 0.0006 | 0.002 | 0.0015 | 0.007 | 0.0009 | 0.0018 | 0.002 | | | 0.0005 |
| CM-15C | | <i>0.01</i> | | | | | 0.29 | | | | | |
| | | | | | | | 0.01 | | | | | |
| CM-16B | 0.121 | 0.058 | 0.065 | 0.0289 | 0.0128 | 0.094 | 0.0294 | 0.0282 | 0.102 | 0.00033 | Bi 0.045 | 0.0154 |
| | 0.002 | 0.001 | 0.001 | 0.0003 | 0.0004 | 0.002 | 0.0015 | 0.0008 | 0.005 | 0.00004 | Zn 0.0156 | 0.0002 |
| CM-17A | 0.0236 | 0.0329 | 0.0105 | 0.0109 | 0.0060 | | 0.0177 | | | | | 0.0743 |
| | 0.0016 | 0.0022 | 0.0014 | 0.0011 | 0.0005 | | 0.0032 | | | | | 0.0040 |
| CM-18A | | 0.097 | | | | | | | | | | 0.0848 |
| | | 0.005 | | | | | | | | | | 0.0029 |
| CM-19A | 0.254 | 0.222 | | 0.0283 | <i>0.091</i> | 0.091 | | | | <i>0.0036</i> | | <i>0.021</i> |
| | 0.009 | 0.007 | | 0.0030 | | 0.004 | | | | | | |
| CM-20A | 0.175 | 0.124 | 0.073 | 0.033 | 0.0071 | 0.074 | 0.015 | 0.025 | 0.083 | | Zn 0.007 | 0.0086 |
| | 0.008 | 0.002 | 0.005 | 0.001 | 0.0004 | 0.003 | 0.002 | 0.001 | 0.004 | | 0.001 | 0.0012 |
| CM-23A | 0.154 | 0.510 | 0.0146 | 0.059 | 0.0129 | 0.628 | 0.0034 | 0.137 | 0.137 | 0.0004 | <i>0.051</i> | 0.0149 |
| | 0.004 | 0.008 | 0.0011 | 0.002 | 0.0014 | 0.021 | 0.0005 | 0.011 | 0.010 | 0.0002 | Zn 0.025 | 0.0007 |
| CM-25A | | | | | | | | | | | | 0.0061 |
| | | | | | | | | | | | | 0.0004 |
| SP-1B | <i>0.002</i> | 0.161 | <i>0.003</i> | 0.013 | 0.0007 | 0.012 | | | | | | 0.063 |
| | | 0.003 | | 0.001 | 0.0002 | 0.002 | | | | | | 0.005 |
| SP-2C | 0.014 | 0.044 | <i>0.005</i> | 0.037 | <i>0.003</i> | | | | | | | 0.027 |
| | 0.001 | 0.003 | | 0.003 | | | | | | | | 0.001 |
| SP-2D | 0.0213 | 0.0432 | <i>0.0031</i> | <i>0.0026</i> | <i>0.0008</i> | 0.0163 | | | | | | 0.0203 |
| | 0.0012 | 0.0019 | | | | 0.0014 | | | | | | 0.0009 |
| SP-3C | <i>0.17</i> | 0.041 | 0.03 | 0.02 | 1.67 | <i>0.04</i> | | | | | | |
| | | 0.004 | | | 0.03 | | | | | | | |
| SP-3D | 0.088 | 0.033 | <i>0.03</i> | <i>0.04</i> | 2.45 | <i>0.04</i> | | | | | | |
| | 0.008 | 0.004 | | | 0.03 | | | | | | | |
| SP-4C | 0.031 | 0.065 | | | | 0.022 | | | | Fe 36.6 | | <i>0.04</i> |
| | 0.003 | 0.007 | | | | 0.002 | | | | | | |
| BO-2B | 0.0017 | 0.0055 | 0.0057 | 0.0062 | | | | | | <i>0.0008</i> | | 0.004 |
| | 0.0003 | 0.0005 | 0.0005 | 0.0005 | | | | | | | | 0.001 |

RM of silicon steel SST – (1A, 2A, 3A, 4A)

- sample of 37 mm in diameter. Height 25 mm or an agreed option, **steel chips on request.**

| | C | Mn | Si | P | S | Cu | Cr | Ni |
|---------------|-----------------------|-----------------------|---------------------|-----------------------|-------------------------|-----------------------|-----------------------|-----------------------|
| SST-1A | 0.072 0.003 | 0.062 0.004 | 2.57 0.04 | 0.041 0.002 | 0.0043 0.0004 | 0.654 0.013 | 0.209 0.005 | 0.155 0.004 |
| SST-2A | 0.083 0.003 | 0.160 0.004 | 3.07 0.04 | 0.026 0.002 | 0.0089 0.0008 | 0.205 0.006 | 0.138 0.004 | 0.066 0.002 |
| SST-3A | 0.035 0.003 | 0.221 0.005 | 3.27 0.05 | 0.007 0.002 | 0.0093 0.001 | 0.096 0.004 | 0.043 0.002 | 0.061 0.002 |

| | Al | Mo | W | V | Ti | Co | As | Sn |
|---------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| SST-1A | 0.061 0.003 | <i>0.002</i> | | 0.006 0.002 | 0.004 0.001 | 0.005 0.001 | 0.002 0.001 | 0.110 0.006 |
| SST-2A | 0.010 0.002 | 0.054 0.002 | 0.019 0.002 | 0.024 0.002 | 0.016 0.002 | 0.022 0.002 | | 0.055 0.004 |
| SST-3A | 0.009 0.002 | 0.036 0.002 | 0.016 0.002 | 0.041 0.002 | 0.009 0.001 | 0.038 0.003 | 0.003 0.001 | 0.015 0.002 |

| | B | Pb | Sb | Zr | Zn | N |
|---------------|-------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------------------|
| SST-1A | 0.0003 0.0001 | <i>0.002</i> | <i>0.002</i> | | | 0.0059 0.0005 |
| SST-2A | 0.0089 0.0006 | 0.015 0.003 | 0.008 0.002 | 0.017 0.002 | 0.011 0.003 | 0.0078 0.0007 |
| SST-3A | 0.0019 0.0004 | 0.013 0.002 | | | 0.011 0.003 | 0.0088 0.0012 |

QCM for spectrometry

The quality control materials comply with the latest ISO Guide 35 definition of the Reference Material. They are primarily intended for quality control of the automated analysers.

The current three flexible sets of alloy (SL, HS), special (SP) and custom-made (CM) steel QCM for spectrometry cover a broad range of elements/concentrations relevant to the contemporary steel production.

The combination of the individual QCM may be tailored to fit for any particular task of the spectrometric steel analysis.

QCM SL 1 – SL 6, HS 1 – HS 2

- sample of 35 - 43 mm in diameter, height 25 mm or an agreed option

| QCM | C | Mn | Si | P | S | Cu | Cr | Ni | Al | Mo |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|------|
| SL-1A | 0.078 | 0.46 | 1.39 | 0.024 | 0.011 | 0.09 | 13.4 | 0.23 | 0.86 | 0.03 |
| SL-2A | 0.015 | 1.84 | 0.64 | 0.025 | 0.027 | 0.50 | 16.9 | 11.0 | 0.005 | 2.03 |
| SL-3A | 0.043 | 1.73 | 0.53 | 0.024 | 0.002 | 0.22 | 24.6 | 19.6 | 0.007 | 0.38 |
| SL-4A | 1.38 | 2.85 | 2.28 | 0.038 | 0.017 | 0.75 | 26.3 | 2.04 | 0.12 | 0.92 |
| SL-6A | 0.17 | 0.24 | 0.23 | 0.015 | 0.029 | 0.22 | 6.8 | 32.3 | 0.26 | 0.13 |
| HS-1A | 0.72 | 0.28 | 0.28 | 0.023 | 0.011 | 0.08 | 4.15 | 0.14 | 0.03 | 0.06 |
| HS-2A | 1.24 | 0.27 | 0.24 | 0.024 | 0.017 | 0.08 | 4.15 | 0.21 | 0.035 | 3.75 |
| QCM | W | V | Ti | Co | As | Sn | Nb | N | B | Ta |
| SL-1A | 0.1 | 0.017 | 0.004 | 0.02 | | 0.01 | | 0.025 | | |
| SL-2A | 0.03 | 0.075 | 0.06 | 0.09 | 0.008 | 0.01 | | 0.04 | 0.002 | |
| SL-3A | 0.03 | 0.066 | 0.003 | 0.06 | | 0.006 | 0.013 | 0.065 | 0.002 | |
| SL-4A | 0.35 | 0.54 | 0.8 | 0.11 | | 0.02 | 1.11 | | 0.0013 | |
| SL-6A | 1.74 | 0.15 | 1.8 | 0.69 | 0.004 | 0.006 | 0.36 | | | |
| HS-1A | 17.5 | 1.33 | 0.003 | 4.7 | | 0.02 | | | | |
| HS-2A | 9.3 | 3.4 | 0.003 | 9.9 | | 0.01 | | | | |

QCM SP

- sample of 35 - 43 mm in diameter, height 25 mm or an agreed option

| QCM | C | Mn | Si | P | S | Cu | Cr | Ni | Al | Mo |
|-------|------|------|------|-------|-------|-------|------|------|------|------|
| SP-3B | 0.27 | 0.29 | 0.72 | 0.023 | 0.008 | 0.62 | 15.1 | 5.65 | 0.08 | 0.24 |
| SP-8B | 2.37 | 0.86 | 1.40 | 0.022 | 0.012 | 0.075 | 37.6 | 2.72 | 0.13 | 0.10 |
| QCM | W | V | Ti | Co | As | Sn | B | Nb | Pb | Sb |
| SP-3B | 0.12 | 0.10 | 0.13 | 0.02 | | 0.01 | 0.88 | | | |
| SP-8B | 0.05 | 0.13 | 0.13 | 0.075 | 0.05 | 0.06 | 0.03 | 0.04 | | |

QCM CM

- sample of 35 - 43 mm in diameter, height 25 mm or an agreed option

| QCM | C | Mn | Si | P | S | Cu | Cr | Ni |
|-------|-------|-------|------|-------|--------|-------|-------|-------|
| CM-5B | 1.09 | 1.28 | 0.39 | 0.021 | 0.012 | 0.13 | 2.07 | 0.23 |
| QCM | Al | Mo | W | V | Ti | Co | As | Sn |
| CM-5B | 0.083 | 0.10 | 0.03 | 0.06 | 0.02 | 0.022 | 0.018 | 0.012 |
| QCM | B | Nb | Pb | Sb | N | Zr | Ta | Zn |
| CM-5B | 0.002 | 0.015 | 0.01 | 0.006 | 0.0135 | 0.09 | | |

REFERENCE MATERIALS OF SOLID FUEL AND ASH for thermodynamic, chemical and technological properties

The SF and SFA Reference Materials comply with the ISO Guide 35 definition of the Reference Material.

Intended for quality control and validation of methods for gross calorific content measurement, elemental analysis of C, N, H, S content and determination of the conventional of volatile matter and ash content. For this, the values in the set are evenly distributed over the entire application ranges.

Supplied in 50g packing.

| Certified dry-basis values in bold with \pm uncertainty shown below in regular | | | | | | | | |
|---|-------------------------|----------|-----------------------|-------------|-------------|--------------|---------------------|--------------|
| Property | Gross calorific content | | Elemental composition | | | | Volatile matter | Ash |
| | | | C | H | N | S | | |
| Unit | kJ/kg | BTU/Lb | Mass fraction wt. % | | | | Mass fraction wt. % | |
| SF-01-14 BROWN COAL Uc | 14617 | 6284 | 36.40 | 3.31 | 0.60 | 1.33 | 31.72 | 44.90 |
| | ± 49 | ± 21 | ± 0.30 | ± 0.07 | ± 0.04 | ± 0.03 | ± 0.17 | ± 0.14 |
| SF-02-14 BLACK COAL Uc | 33090 | 14226 | 91.84 | 2.09 | 0.65 | 0.16 | 13.10 | 2.80 |
| | ± 58 | ± 25 | ± 0.46 | ± 0.10 | ± 0.04 | ± 0.01 | ± 0.18 | ± 0.06 |
| SF-03-14 BLACK COAL Uc | 32060 | 13783 | 96.30 | 0.21 | 0.32 | 0.14 | 1.15 | 2.98 |
| | ± 115 | ± 49 | ± 0.50 | ± 0.06 | ± 0.04 | ± 0.01 | ± 0.15 | ± 0.03 |
| SF-04-14 BLACK COAL Uc | 34618 | 14883 | 85.53 | 4.59 | 1.35 | 0.48 | 22.95 | 4.43 |
| | ± 80 | ± 34 | ± 0.45 | ± 0.10 | ± 0.04 | ± 0.01 | ± 0.22 | ± 0.06 |
| SF-05-14 COKE Uc | 30410 | 13074 | 90.40 | 0.20 | 0.98 | 0.45 | 1.28 | 7.84 |
| | ± 110 | ± 47 | ± 0.44 | ± 0.06 | ± 0.03 | ± 0.01 | ± 0.12 | ± 0.04 |
| SF-06-14 BLACK COAL Uc | 23990 | 10314 | 58.28 | 3.51 | 3.80 | 3.13 | 26.84 | 27.21 |
| | ± 93 | ± 40 | ± 0.36 | ± 0.05 | ± 0.05 | ± 0.05 | ± 0.23 | ± 0.11 |
| SF-07-14 BROWN COAL Uc | 21023 | 9173 | 50.97 | 4.26 | 1.05 | 2.52 | 38.80 | 28.73 |
| | ± 140 | ± 37 | ± 0.28 | ± 0.08 | ± 0.04 | ± 0.04 | ± 0.20 | ± 0.05 |
| SFA-01-14 BLACK COAL ASH Uc | | | 3.10 | | | 0.029 | | 96.60 |
| | | | ± 0.19 | | | ± 0.008 | | ± 0.17 |