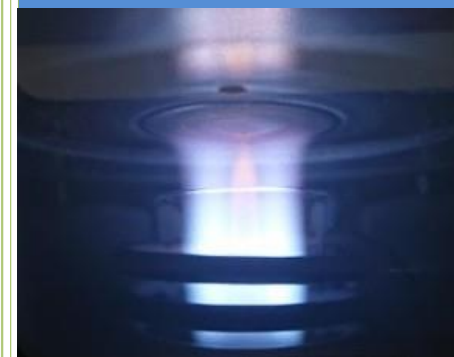


Certified Reference Materials 2020



Jernkontoret

 **NAREMA**

Contents

	Page		Page
Introduction	3		
1. LOW ALLOYED STEEL		Iron ores/powders	
JK 21	4	ECRM 688-1	11
ECRM 196-2	4	ECRM 689-1	11
Carbon Steel		JK 28	11
ECRM 197-1	4	JK 29A	12
JK 3B	5	JK 42A	12
JK 20A	5	JK 47A	12
2. HIGH ALLOYED STEEL		4. STEEL WITH SPECIAL ELEMENT SPECIFICATION	
ECRM 270-1	6	High alloyed steel	
ECRM 379-1	6	JK 25 (cerium)	13
Vanadium Steel		JK 36 (carbon, sulphur, nitrogen)	13
ECRM 274-1	7	JK 31 (oxygen)	13
Duplex Stainless Steel		JK 32 (oxygen)	13
ECRM 298-1	7	JK 34 (oxygen)	13
Chromium - nickel - molybdenum alloyed steel		5. FERRO ALLOYS	
JK 7B	8	Ferrosilicon	
Tool steel		JK 39	14
JK 12A	8	6. FLOURSPARS	
ECRM 268-1	8	JK D	14
Austenitic Stainless Steel		7. SETTING UP STANDARDS	
JK 27B	9	Ceramics	
3. SLAGS, INDUSTRIAL FLY ASHES and IRON ORES/POWDERS		CE 650A	15
Slags		Steel plate with a layer of electroless nickel (NiP alloy)	
ECRM 883-1	9	JK SUS NiP-1	15
JK S10	10	8. OUTSIDE-SOURCE REFERENCE MATERIALS	16
JK S11	10	Participating laboratories	22
Industrial fly ashes		CRM Ordering Procedure	25
ECRM 882-1	10		
JK 43	10		
JK 44	10		
JK 45	10		

Introduction

The production of reference materials in the ECRM- and JK-series is directed by the Nordic CRM Working Group (NCRMWG), with representatives from the Nordic Steel and Iron industry. In 2020 the members are:

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In 1938, the production of certified reference materials (CRMs) in the JK-series was initiated in a close co-operation between Jernkontoret (The Swedish Steel Producers' Association) and Metallografiska Institutet (The Metallographic Institute), and four years later in 1942 seven steel CRMs became commercially available. It was also decided that every CRM produced should be given a prefix, namely JK, the abbreviation of Jernkontoret.

Since its foundation back in 1747, Jernkontoret (JK) has been owned jointly by the Swedish steel companies. Jernkontoret represents Sweden's steel industry on issues that relate to education, trade policy, research and development, standardisation, energy and environment as well as taxes and levies. Jernkontoret also manages the joint Nordic research in the steel industry. In addition, Jernkontoret draws up statistical information relating to the industry and carries on research into the history of mining and metallurgy.

Oy Narema Ab was founded in 2019, as a consultancy agency and chemical analysis laboratory primarily supporting companies in the Nordic countries in the iron, steel and metal industries as well as mechanical industries. As of 1st of January 2020 the responsibility of the certification of Jernkontoret's reference materials were transferred from Swerim AB to Oy Narema Ab. Certification analyses are carried out in accordance with principles in the ISO Guides 30-35 and ISO 17034. In 1998 the Nordic CRM Working Group became a member of EURONORM CRM Producers Group.

Further information can be found on: www.narema.fi

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Euronorm CRM (ECRM) and CRM in the JK Series

Certified concentrations are given in bold text and in W/W %. Non-certified elements, i.e. elements only given as supplemental information, are normally given in italics and in µg/g, if not stated otherwise. The number of values for the supplemental concentrations varies from 1 to 13 individual determinations. Please, order the certificate from crm@narema.fi for detailed information.

1. LOW ALLOYED STEEL

JK 21 – chips, NW 150g

	C	Si	Mn	P	S	Cr	Ni	Mo	Co	V	Ti	Cu	Al_{Acid Sol}	Al_{Non-acid Sol}	Sn	Nb	N
JK 21	0.1741	0.36	1.46	0.0148	0.011	0.024	0.035	0.004	0.008	0.002	0.0008	0.045	0.032	0.005	0.006	0.0175	0.008

	As	Cd	Pb	Sb	Ta	W	Zn	Zr
JK 21	<i>100</i>	<i>1</i>	<i>10</i>	<i>10</i>	<i>10</i>	<i>6</i>	<i>7</i>	<i>10</i>

ECRM 196-2 – chips, NW 100g, discs 38 mm dia.

	C	Si	Mn	P	S	Cr	Mo	Ni	Al_{tot}	As	B	Co	Cu
ECRM 196-2	0.0060	1.808	0.364	0.00369	0.00065	0.0282	0.0142	0.0401	0.2167	0.00033	0.00014	0.0138	0.0057

	N	Sn	Ti	V	Ca	Mg	Zn
ECRM 196-2	0.00178	0.00047	0.00253	0.00368	0.00071	0.00075	0.00019

Carbon Steel

ECRM 197-1 – chips, NW 100g and disc, 38d x 25mm

	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	N	Al_{tot}	As	Co	Sn	Ti
ECRM 197-1	0.219	0.275	0.792	0.0073	0.0232	0.451	0.402	0.148	0.152	0.0114	0,0313	0.0083	0.0135	0.0097	0.0005

	V	Bi	Sb	Pb	Al_{acid sol}
ECRM 197-1	<i>50</i>	<i>0.1</i>	<i>18</i>	<i>3</i>	<i>0.027</i>

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1. LOW ALLOYED STEEL (continued)

Carbon Steel (continued)

JK 3B – chips, NW 150g

	C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	Co	Al_{tot}	Sn
JK 3B	0.742	0.251	0.803	0.0101	0.0071	0.0529	0.0591	0.0051	0.0054	0.0175	0.0048	0.0036	0.0044

	Pb	Ti	Sb	As	Ca	Zn	O	Mg	Ag	Bi	V
JK 3B	2	20	7	20	5	3	180	1	0.2	1	20

JK 20A-1 – chips, NW 150g

	C	S	N	V	W	Pb
JK 20A	1.263	0.0094	0.0027	0.161	1.75	0.160

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2. HIGH ALLOYED STEEL

ECRM 270-1 – chips, NW 100g and disc, 38d x 25mm

	C	Si	Mn	P	S	Cr	Mo	Ni	Co	Cu	N	V	Ce	La
ECRM 270-1	0.0742	1.517	0.540	0.0196	0.0007	20.88	0.2099	10.86	0.0685	0.1076	0.1417	0.0256	0.0487	0.0154

	Al	As	Ba	Dy	Er	Eu	Ga	Gd	Ge	Hf	Ho	Ir	Lu	Mg	Nd	Os	Pr	Pt	Rb
ECRM 270-1	<i>23</i>	<i>34</i>	<i>1.8</i>	<i>0.013</i>	<i>0.0045</i>	<i>< 0.01</i>	<i>21</i>	<i>< 1.3</i>	<i>6</i>	<i>0.02</i>	<i>< 0.002</i>	<i>0.2</i>	<i>< 0.002</i>	<i>9</i>	<i>76</i>	<i>0.4</i>	<i>29.5</i>	<i>0.1</i>	<i>6</i>

	Re	Rh	Ru	Sb	Sc	Sm	Sn	Ta	Tb	Th	Ti	Tl	Tm	U	W	Y	Yb	Zn	Zr
ECRM 270-1	<i>0.4</i>	<i>0.2</i>	<i>2</i>	<i>7</i>	<i>< 0.02</i>	<i>< 0.1</i>	<i>35</i>	<i>0.1</i>	<i>< 0.045</i>	<i>0.002</i>	<i>19</i>	<i>0.006</i>	<i>< 0.002</i>	<i>0.01</i>	<i>244</i>	<i>< 0.18</i>	<i>< 0.003</i>	<i>7.4</i>	<i>2</i>

ECRM 379-1 – chips, NW 100g and disc, 38d x 25mm

	C	Si	Mn	P	S	Cr	Mo	Ni	B	Co	Cu	N	Sn	V	Ca	Sb
ECRM 379-1	0.0121	0.393	1.804	0.0166	0.0006	26.79	3.290	30.83	0.00190	0.0390	0.984	0.0550	0.0021	0.0663	0.0033	0.00057

	Al	As	Nb	O	Pb	Ti	Bi	Fe	Ag	Ce	Cs	Ga	Ir	Mg	Nd	Os
ECRM 379-1	<i>246</i>	<i>28</i>	<i>28</i>	<i>27</i>	<i>0.38</i>	<i>14</i>	<i>0.01</i>	<i>356 000</i>	<i>0.7</i>	<i>0.1</i>	<i>0.01</i>	<i>23</i>	<i>0.1</i>	<i>6</i>	<i>0.6</i>	<i>0.07</i>

	Pr	Pt	Rb	Re	Rh	Ru	Sm	Ta	W	Y	Zr
ECRM 379-1	<i>0.2</i>	<i>0.04</i>	<i>4.3</i>	<i>2.4</i>	<i>0.4</i>	<i>1.4</i>	<i>0.6</i>	<i>0.04</i>	<i>91</i>	<i>0.1</i>	<i>3.3</i>

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2. HIGH ALLOYED STEEL (continued)

Vanadium Steel

ECRM 274-1 – chips, NW 100g and disc, 38d x 25mm

	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	N	V	W
ECRM 274-1	1.563	1.057	0.397	0.0148	0.0096	8.036	1.4551	0.077	0.0281	0.0769	4.010	0.0087

	O	Al_{tot}	Co	As	B	Pb	Sb	Sn	Ti
ECRM 274-1	<i>26</i>	<i>25</i>	<i>230</i>	<i>13</i>	<i>5</i>	<i>0.64</i>	<i>2</i>	<i>10</i>	<i>11</i>

Duplex Stainless Steel

ECRM 298-1 – chips, NW 100g and disc, 38d x 25mm

	C	Si	Mn	P	S	Cr	Mo	Ni	Al_{tot}	B	Co	Cu	N	Pb
ECRM 298-1	0.0146	0.262	0.398	0.0198	0.0006	24.72	3.799	7.056	0.0285	0.0021	0.055	0.201	0.263	0.00008

	Ti	V	Fe
ECRM 298-1	0.0014	0.0607	63.38

	Al_{acid sol}	As	Nb	Sn	W	Be	Bi	Ca	Ce	Ga	Ir	Mg	O	Pt	Sb	Ta	Te	U	Zn
ECRM 298-1	<i>240</i>	<i>34</i>	<i>37</i>	<i>44</i>	<i>180</i>	<i><0.5</i>	<i>0.06</i>	<i>20</i>	<i>0.4</i>	<i>23</i>	<i>0.2</i>	<i>8</i>	<i>36</i>	<i>0.3</i>	<i>7</i>	<i>0.2</i>	<i>3</i>	<i><0.05</i>	<i>10</i>

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2. HIGH ALLOYED STEEL (continued)

Chromium - nickel - molybdenum alloyed steel

JK 7B – chips, NW 150g

	C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	Al_{sol}	Al_{tot}	V
JK 7B	0.342	0.267	0.697	0.0057	0.0064	1.34	1.34	0.182	0.0050	0.021	0.010	0.014	0.004

Tool steel

JK 12A – chips, NW 150g

	C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	Co	V	W	Sn	Pb
JK 12A	0.886	0.30	0.312	0.020	0.023	4.04	0.191	4.85	0.0259	0.062	0.189	1.94	6.42	0.007	0.0004

ECRM 268-1 – chips, NW 150g and disc, 38d x 25mm

	C	Si	Mn	P	S	Cr	Mo	Ni	As	B	Co	Cu	N	Sn	V
ECRM 268-1	1.134	0.373	0.293	0.0209	0.0154	4.578	3.208	0.1437	0.0062	0.0009	0.0290	0.1232	2.030	0.0078	8.478

	W	Sb	<i>Nb</i>	<i>Ta</i>
ECRM 268-1	3.707	0.0017	<i>13</i>	<i>2</i>

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Austenitic Stainless Steel

JK 27B – chips, NW 150g and disc, 38d x 25mm

	C	Si	Mn	P	S	Cr	Mo	Ni	B	Co	Cu	N	Sn	V	W	Ca
JK 27B	0.0089	0.401	1.510	0.0298	0.0207	17.36	2.510	12.56	0.00072	0.142	0.265	0.0630	0.0068	0.057	0.031	0.0022

	Al	Pb	Ti	Zn	Ag	As	Ga	Re	Sb	Zr
JK 27B	<i>20</i>	<i>1</i>	<i>2</i>	<i>2</i>	<i>27</i>	<i>63</i>	<i>30</i>	<i>3</i>	<i>14</i>	<i>3</i>

3. SLAGS, INDUSTRIAL FLY ASHES and IRON ORES/POWDERS

Slags

ECRM 883-1 (blast furnace slag) - powder, NW 100g

In the following table, certified and non-certified concentrations are given in W/W %.

	Fe	Si	Ca	Mg	Al	Ti	Mn	P	S	Na	K	V
ECRM 883-1	0.9820	16.67	21.32	8.86	6.55	1.3331	0.546	0.0033	1.0885	0.316	0.393	0.122

	Cr	Ni	Mo	Ba	Sr	Zr
ECRM 883-1	0.0130	0.00053	< 0.001	0.0436	0.0380	0.0276

	As	B	Be	Bi	C	Cd	Ce	Co	Cs	Cu	F	Hf	Hg	Li
ECRM 883-1	<i>0.0001</i>	<i>0.0064</i>	<i>0.0006</i>	<i>0.000001</i>	<i>0.135</i>	<i>0.00002</i>	<i>0.014</i>	<i>0.00006</i>	<i>0.00003</i>	<i>0.0001</i>	<i>0.04</i>	<i>0.0008</i>	<i>0.000001</i>	<i>0.006</i>

	Nb	Pb	Rb	Sb	Sc	Se	Ta	Te	Th	U	W	Y	Zn
ECRM 883-1	<i>0.002</i>	<i>0.0001</i>	<i>0.001</i>	<i>0.000002</i>	<i>0.003</i>	<i>0.0004</i>	<i>0.0001</i>	<i>0.000003</i>	<i>0.008</i>	<i>0.001</i>	<i>0.00002</i>	<i>0.006</i>	<i>0.001</i>

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JK S10 and JK S 11 – powder, NW 100g

		F	CaF₂	Ca_{tot}	CaO	SiO₂	Al₂O₃	FeO	MnO	MgO	TiO₂	V₂O₅	C	P	P₂O₅	Cr₂O₃	S
JK S 10	<i>ESR-slag-low Al</i>	34.4	70.7	50.8	20.3	7.8	0.54	0.10	0.03	0.30	0.05	<i>< 100</i>	0.022	0.002	...	...	...
JK S 11	<i>AOD-slag</i>	7.9	...	...	60.0	26.8	2.85	0.2	0.12	4.7	0.95	<i>< 100</i>	...	...	<i>< 50</i>	0.17	0.30

Industrial fly ashes

ECRM 882-1 – powder, NW 100g

In the following table, certified and non-certified concentrations are given in W/W %.

	Fe	Ca	Al	Na	K	Zn	Pb	Cd	Cr	Ni	Cu	V	As	Bi	Sb	Hg
ECRM 882-1	22.20	10.11	0.375	0.697	0.960	28.49	1.324	0.0183	0.490	0.0263	0.218	0.0090	0.0054	0.0026	0.0116	0.000075

	Sn	Si	Mn	Mg	Cl	C	S	F
ECRM 882-1	<i>0.02</i>	<i>1.05</i>	<i>2</i>	<i>0.48</i>	<i>2.35</i>	<i>1.0</i>	<i>0.5</i>	<i>0.07</i>

JK 43 and JK 45 – powder, NW 15g

JK 44 – powder, NW 25g

In the following table, certified and non-certified concentrations are given in W/W %.

	Zn	Pb	Cd	Hg	Fe	Cr	Ni	Ca	Na	K	Al	V	Cu
JK 43	4.96	0.21	0.0023	0.00039	<i>20</i>	<i>8</i>	<i>2</i>	<i>12</i>	<i>0.5</i>	<i>0.3</i>	<i>0.2</i>	<i>0.02</i>	<i>0.2</i>
JK 44	27.3	2.74	0.0469	0.00028	<i>27</i>	<i>0.2</i>	<i>0.02</i>	<i>5</i>	<i>1</i>	<i>1.3</i>	<i>0.2</i>	<i>0.02</i>	<i>0.2</i>
JK 45	1.53	0.11	0.0047	0.000025	<i>40</i>	<i>0.3</i>	<i>0.05</i>	<i>7</i>	<i>7</i>	<i>0.4</i>	<i>0.1</i>	<i>0.1</i>	<i>0.01</i>

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Iron ores

ECRM 688-1 (magnetite) – powder, NW 100g

	Fe	Si	Ca	Mg	Al	Ti	Mn	P	Ni	Na	K	Co	Cu	V	Pb	Zn
ECRM 688-1	61.38	3.383	1.449	1.061	0.679	0.408	0.0457	0.337	0.0136	0.333	0.180	0.0096	0.0023	0.135	0.00025	0.0015

	As	B	Be	Ce	Cr	Ga	Gd	Hf	Hg	Ho	La	Lu	Nb	Nd	Pr	Rb	S	Sb	Sc	Se	Sm	Sn	Sr
ECRM 688-1	<i>11</i>	<i>5</i>	<i>1</i>	<i>55</i>	<i>21.7</i>	<i>36</i>	<i>3.5</i>	<i>0.4</i>	<i>0.5</i>	<i>0.7</i>	<i>26</i>	<i>0.3</i>	<i>1.6</i>	<i>26</i>	<i>7</i>	<i>9</i>	<i>468</i>	<i>0.1</i>	<i>7</i>	<i>0.7</i>	<i>4.6</i>	<i>3.3</i>	<i>19</i>

	Ta	Tb	Th	Tm	U	Y	Yb	Zr
ECRM 688-1	<i>0.1</i>	<i>0.6</i>	<i>14</i>	<i>0.3</i>	<i>2</i>	<i>19</i>	<i>2</i>	<i>15</i>

ECRM 689-1 – powder, NW 100g

	Fe	Ca	Mg	Al	Ti	Mn	P	Na	K	V	Ni	Zn	Co	Cu
ECRM 689-1	57.05	1.183	0.980	1.185	0.3264	0.1196	0.0706	0.638	0.462	0.1020	0.0195	0.0042	0.0103	0.0068

	<i>Si</i>	<i>S</i>	<i>F</i>	<i>Cr</i>	<i>C</i>	<i>Sn</i>	<i>Cl</i>	<i>GoI</i>
ECRM 689-1	<i>5</i>	<i>0.06</i>	<i>0.07</i>	<i>0.003</i>	<i>0.25</i>	<i>0.0003</i>	<i>0.015</i>	<i>1.5</i>

JK 28 – powder, NW 150g

	SiO₂	TiO₂	Al₂O₃	Fe	Fe₂O₃	FeO	MnO	CaO	MgO	P₂O₅	S	V₂O₅	Cu	Na₂O	K₂O	P
JK 28	4.20	0.20	0.60	65.86	91.46	2.42	0.059	0.30	0.30	0.102	0.004	0.21	0.002	0.11	0.12	0.045

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Iron ores

JK 29A and JK 42A (magnetite) – powder, NW 100g

	Fe	SiO₂	CaO	MgO	Al₂O₃	TiO₂	MnO	P	S	Na₂O	K₂O	V₂O₅	Cr	Ni	Zn	Co	Cu
JK 29A	71.36	0.33	0.082	0.223	0.232	0.292	0.0632	0.0059	0.0059	0.015	0.0087	0.266	0.0057	0.0167	0.0016	0.0106	0.0007
JK 42A	70.66	0.800	0.199	0.382	0.278	0.385	0.0506	0.0247	0.0082	0.043	0.0157	0.251	0.0010	0.0129	0.0015	0.0105	0.0007

	F	Pb	As	Sn	Cl	Ba	Gol	Zr	Ag	Au	B	Be	Bi	Cd	Ce	Cs	Ga	Ge	Hf	Hg	I
JK 29A	<i>40</i>	<i>< 10</i>	<i>< 3</i>	<i>2</i>	<i>30</i>	<i>3</i>	<i>3.2%</i>	<i>2</i>	<i>< 0.1</i>	<i>< 0.1</i>	<i>0.4</i>	<i>0.1</i>	<i>< 0.1</i>	<i>< 0.1</i>	<i>0.7</i>	<i>< 0.1</i>	<i>41</i>	<i>0.7</i>	<i>0.1</i>	<i>< 0.1</i>	<i>< 0.1</i>
JK 42A	<i>117</i>	<i>< 10</i>	<i>< 3</i>	<i>3</i>	<i>100</i>	<i>4</i>	<i>3.3%</i>	<i>4</i>	<i>< 0.1</i>	<i>< 0.1</i>	<i>1</i>	<i>0.2</i>	<i>< 0.1</i>	<i>< 0.1</i>	<i>9</i>	<i>< 0.1</i>	<i>37</i>	<i>0.8</i>	<i>0.1</i>	<i>< 0.1</i>	<i>< 0.1</i>

	Ir	La	Li	Mo	Nb	Rb	Sb	Sc	Se	Ta	Th	Tl	U	W	Y	Re	Os
JK 29A	<i>< 0.1</i>	<i>3</i>	<i>1.4</i>	<i>0.8</i>	<i>0.3</i>	<i>0.3</i>	<i>< 0.1</i>	<i>1.3</i>	<i>< 0.2</i>	<i>0.1</i>	<i>6</i>	<i>< 0.1</i>	<i>1.1</i>	<i>0.2</i>	<i>1.0</i>	<i>< 0.1</i>	<i>< 0.1</i>
JK 42A	<i>< 0.1</i>	<i>5</i>	<i>1</i>	<i>0.3</i>	<i>0.8</i>	<i>0.6</i>	<i>< 0.1</i>	<i>2</i>	<i>< 0.2</i>	<i>0.1</i>	<i>11</i>	<i>< 0.1</i>	<i>2</i>	<i>0.1</i>	<i>2</i>	<i>< 0.1</i>	<i>< 0.1</i>

Iron powder

JK 47A – powder, NW 35g

In the following table, certified and non-certified concentrations are given in W/W %.

	O	N	C	S
JK 47A	0.69	0.0062	0.370	<i>0.0090</i>

Certified concentrations are given in bold text and in W/W %. Non-certified elements, i.e. elements only given as supplemental information, are normally given in italics and in µg/g, if not stated otherwise. The number of values for the supplemental concentrations varies from 1 to 13 individual determinations. Please, order the certificate from crm@narema.fi for detailed information.

4. STEEL WITH SPECIAL ELEMENT SPECIFICATION

High alloyed steel

JK 25 (cerium) – chips, NW 150g

	Ce	Cr	La	Mn	Mo	Nd	Ni	Pr
JK 25	0.096	<i>22.3</i>	<i>0.015</i>	<i>1.7</i>	<i>0.1</i>	<i>0.015</i>	<i>11.3</i>	<i>0.006</i>

JK 36 (carbon, sulphur and nitrogen) – chips, NW 150g

	C	S	N
JK 36	0.0125	0.0126	0.0337

JK 31, JK 32 and JK 34 (oxygen) – rods, 10 x 400-500mm

In the following table, certified and non-certified concentrations are given in W/W %.

	O	C	Si	Mn	Cr	Ni	Al_{sol}	Al_{tot}
JK 31	0.0015	<i>1.03</i>	<i>0.32</i>	<i>0.36</i>	<i>...</i>	<i>...</i>	<i>0.020</i>	<i>0.021</i>
JK 32	0.0028	<i>1.02</i>	<i>0.32</i>	<i>0.30</i>	<i>1.38</i>	<i>...</i>	<i>0.008</i>	<i>0.011</i>
JK 34	0.0068	<i>0.13</i>	<i>0.31</i>	<i>1.40</i>	<i>...</i>	<i>...</i>	<i>0.047</i>	<i>0.051</i>

Certified concentrations are given in bold text and in W/W %. Non-certified elements, i.e. elements only given as supplemental information, are normally given in italics and in $\mu\text{g/g}$, if not stated otherwise. The number of values for the supplemental concentrations varies from 1 to 13 individual determinations. Please, order the certificate from crm@narema.fi for detailed information.

5. FERRO ALLOYS

Ferrosilicon

JK 39 – powder, NW 50g

	C	Si	Mn	P	Fe	Ti	Cu	Al_{tot}	Ca
JK 39	0.105	75.9	0.165	0.018	21.6	0.116	0.013	1.45	0.24

	B	Mg	Cr	Ni	Co	V	As	Zn
JK 39	<i>700</i>	<i>100</i>	<i>100</i>	<i>80</i>	<i>20</i>	<i>70</i>	<i>30</i>	<i>10</i>

6. FLOURSPARS

JK D – powder, NW 100g

In the following table, certified and non-certified concentrations are given in W/W %.

	F	CaF₂	SiO₂	P	S	Al₂O₃	Fe₂O₃	Pb
JK D	47.24	97.07	<i>1.5</i>	0.035	0.004	0.04	0.20	<i><0.001</i>

Certified concentrations are given in bold text and in W/W %. Non-certified elements, i.e. elements only given as supplemental information, are normally given in italics and in $\mu\text{g/g}$, if not stated otherwise. The number of values for the supplemental concentrations varies from 1 to 13 individual determinations. Please, order the certificate from crm@narema.fi for detailed information.

7. SETTING UP STANDARDS

Ceramics

CE 650A (high oxygen) – disc, 25d x 8mm

In the following table are the concentrations given in W/W %.

	O	Al	C_{tot}	Ti	Fe	W
CE 650A	<i>30</i>	<i>34</i>	<i>6</i>	<i>21</i>	<i>2.1</i>	<i>0.8</i>

Steel plate with a layer of electroless nickel (NiP alloy)

JK SUS NiP-1

This setting up standard is intended for calibration of depth profile measurements mainly by GD-OES. The layer has been applied on both sides of the steel plate.

In the following table are the concentrations given in W/W %.

	P	Pb	Ni
JK SUS NiP-1	<i>5.8 ± 0.2</i>	<i>0.26 ± 0.02</i>	<i>balance</i>

The layer thickness is given in μm

	Layer thickness
JK SUS NiP-1	<i>8.7 ± 0.5</i>

8. OUTSIDE-SOURCE REFERENCE MATERIALS

Listed below outside-source reference materials can be order from Swerim. Delivery time can be longer than inside source CRM's.

Certified concentrations are given in bold text and in W/W %. Non-certified elements, i.e. elements only given as supplemental information, are given in italics.

BUNDESANSTALT FÜR MATERIALFORSCHUNG UND -PRÜFUNG (BAM), Germany

Unalloyed Steel

	C	Si	Mn	P	S	Cr	Ni	Al_(Total)	As	Cu	N	Sn
EZRM 030-4	0.456	0.318	0.603	0.018	0.021	0.117	0.042	0.042	0.012	0.061	0.0051	0.0055
EZRM 036-1	0.858	0.194	0.327	0.0074	0.0095	<i>0.091</i>	<i>0.058</i>	<i>0.015</i>	0.023	0.065	0.0100	<i>0.006</i>
EZRM 077-3	0.1650	...	...	...	0.0162	...	...	...	...	...	0.00860	...
EZRM 079-2	0.596	0.247	0.743	0.0234	0.192	0.0382	0.022	0.021	0.004	0.046	0.0074	0.0037
EZRM 083-2	0.0315	0.00747	0.2160	0.0106	0.00561	0.0219	0.0116	0.0784	0.00177	0.0127	0.00157	0.00439

High Purity Iron (Certified concentrations are given in bold text and in µg/g. Non-certified elements, i.e. elements only given as supplemental information, are given in italics)

	C	Si	Mn	P	S	Cr	Mo	N
ECRM 098-1	5.1	0.8	4.8	<i>0.6</i>	3.1	57.1	8.5	2.4

Low Alloyed Steel

	C	Si	Mn	P	S	Cr	Mo	Ni	Al_(Total)	As	B	Cu	N	V	Ca
EZRM 180-1	0.197	0.362	1.286	0.0174	0.0249	1.250	...	0.096	...	0.030	...	0.115	0.0068	...	...
EZRM 182-1	0.790	0.368	0.389	0.0076	0.011	0.591	...	0.152	0.020	...	...	0.141	0.0102	0.177	...
EZRM 194-1	0.1532	0.431	1.188	0.0097	0.00059	0.733	0.2857	0.3417	0.0837	0.0042	0.0020	0.0751	0.0115	0.0243	0.0026

	Pb	Sb	Zn
EZRM 182-1	0.0039	0.0042	0.0015

High Alloyed Steel

	C	Si	Mn	P	S	Cr	Mo	Ni	Al_(Total)	As	B	Co	Cu	N	Sn	Ti
EZRM 226-1	0.416	0.514	0.434	0.0207	0.0094	13.67	0.024	0.139	...	<i>0.026</i>	...	<i>0.025</i>	...	0.0362	...	...
EZRM 284-2	0.0201	0.537	1.745	0.0258	0.0237	16.811	2.111	10.72	0.0027	0.0063	0.0026	0.0525	0.1831	0.0151	0.0047	0.191
EZRM 288-1	2.08	0.260	0.292	0.024	<i>0.0012</i>	12.00	0.103	0.298	0.012	<i>0.006</i>	...	0.018	0.060	0.0151	<i>0.0043</i>	0.020
EZRM 289-1	0.0489	0.531	1.016	0.0114	0.0027	14.63	1.102	24.68	0.199	...	0.0044	0.065	...	...	0.111	2.01
EZRM 297-1	0.0223	0.344	0.897	0.0135	0.0101	18.37	0.290	12.33	0.0195	0.0040	1.146	0.0413	0.204	0.0152	...	0.0072

	V	O	Nb	W	Sb	Sb	Ta
EZRM 226-1	0.022	...	...	...	...	...	...
EZRM 284-2	0.0425	0.0099	<i>0.003</i>	<i>0.02</i>	<i>0.0005</i>		<i>0.001</i>
EZRM 288-1	0.055	...	...	<i>0.68</i>	...	<i>0.0014</i>	...
EZRM 289-1	0.260	...	...	...	...	...	...
EZRM 297-1	0.0535	...	...	...	...	...	...

Certified concentrations are given in bold text and in W/W %. Non-certified elements, i.e. elements only given as supplemental information, are given in italics.

BUREAU OF ANALYSED SAMPLES Ltd. (BAS), UK

Unalloyed Steel

	C	Si	Mn	P	S	Cr	Mo	Ni	Co	Cu	N	Nb	V	Pb	Al	Al (acid sol)
ECRM 055-2	0.5199	0.3094	0.6866	0.0102	0.0205	0.3217	0.0960	0.3121	0.0257	0.2089	0.01069	...	0.00245	<0.001	< 0.01	...
ECRM 056-2	0.8181	0.2006	0.5073	0.0103	0.0093	0.0146	...	0.0218	...	0.0129	...	...	...	...	<0.001	0.00024
ECRM 058-2	0.424	0.1080	1.186	0.0098	0.1715	0.1211	0.0589	0.199	...	0.261	0.0107	...	...	...	...	...
ECRM 085-1	0.067	0.008	0.977	0.062	0.336	...	...	...	0.019	0.291	...	...	0.0021	0.0010	...	...
ECRM 090-1	1.054	0.281	0.226	0.0128	0.0095	0.121	0.0089	0.053	...	...	0.0146	0.00043	0.204	0.00239	...	...
ECRM 091-1	0.5185	...	...	...	...	0.312	0.0975	0.310	...	...	0.0111	...	...	...	...	...

	Ca	Ti	As	Bi	Cd	Ga	Hg	Sb	Sn	Se	Te	Tl	Zn	Zr	W
ECRM 055-2	<0.005	0.00104	0.0187	<0.0005	...	...	...	0.00376	0.0162	...	...	...	<i>0.00011</i>	<0.005	0.0166
ECRM 056-2
ECRM 058-2	0.0095	...	...	...	...	...	...	...	...	...	...	...	...
ECRM 085-1	0.0073	...	...	...	...	0.0025	...	...
ECRM 090-1	<0.00002	<0.00002	0.00228	<0.00001	0.0046	...	<0.0002	<0.0002	<0.0001	0.00209	...	...

Low Alloy Steel

	C	Si	Mn	P	S	Cr	Mo	Ni	Co	Cu	N	V	Pb	Al	B	Ca	Ti	Sn	Zn
BCS-CRM 115	0.6224	0.2078	0.682	0.0123	0.00093	0.0198	<i>0.003</i>	0.0196	<i>0.006</i>	0.009	0.0067	<i>0.001</i>	<i>0.0002</i>	0.0527	<0.0001	0.0058	0.0027	...	...
BCS-CRM 116	0.617	0.201	0.6756	0.0092	0.00176	0.0414	...	0.0155	...	...	0.0069	...	0.00012	0.0587	...	0.0036	0.00171	...	...
ECRM 195-1	0.756	0.466	0.571	0.0160	0.0121	1.568	0.768	0.327	...	0.0355	0.0100	0.312	0.0010	...	...	0.0017	...	...	0.0046
BCS-CRM 405	0.058	1.38	1.28	0.017	0.060	0.21	0.17	0.12	...	0.015	...	0.32	...	...	...	...	...	...	...
BCS-CRM 405/2	0.044	0.947	0.903	0.0095	0.058	0.206	0.025	0.102	...	0.022	...	0.411	...	0.330	...	...	...	<i>0.002</i>	<i>0.002</i>
BCS-CRM 407/2	0.490	0.66	0.195	0.038	0.0105	3.03	0.83	0.527	0.0068	0.397	...	0.19	...	0.040	...	...	...	...	...

Cast Iron

	C	Si	Mn	P	S	Cr	Mo	Ni	Cu
ECRM 451-2	2.059	2.092	1.079	0.0593	0.0315	1.097	...	14.01	6.26
ECRM 482-2	2.599	1.815	0.728	0.0974	0.0491	0.675	0.454	2.284	1.231

High Purity Iron (Certified concentrations are given in bold text and in µg/g. Non-certified elements, i.e. elements only given as supplemental information, are given in italics)

	C	Si	Mn	P	S	Cr	Mo	Ni	Al	As	B	Ca	Co	Cu	N	Sn	V	W	Sb	Ta	Zn
ECRM 088-2	6	52	89	48	70	244	<i>25</i>	275	<i>5</i>	...	...	7.2	61	163	<i>10</i>	...	2.9	...	...	...	...
ECRM 097-1	...	...	64	16	22	16	...	25	...	51	3	...	37	20	7	...	...	...	...	...	...
ECRM 097-2	...	28.5	120	53.8	4.3	213	37.0	241	...	28.1	1.2	...	139	79.3	29.4	4.3	1.1	38.6	1.2	1.5	1.4

High Alloyed Steel

	C	Si	Mn	P	S	Cr	Mo	Ni	Al	As	B	Co	Cu	N	Nb	Pb
ECRM 272-1	0.2815	0.420	0.600	0.0156	0.0197	11.927	0.0030	0.244	0.0046	0.0116	0.0018	0.0145	0.0192	0.0508	0.0028	<i>0.0004</i>
ECRM 276-1	0.399	1.034	0.365	0.0093	0.0189	4.975	1.134	0.203	...	...	...	...	0.183	0.0116	...	...
ECRM 295-1	0.0166	0.418	1.758	0.0167	0.0003	19.51	3.996	24.40	0.0203	0.0041	0.0018	0.0450	1.481	0.0615	...	...

	Sn	Ti	V	Sb	Ca	Fe	Zn
ECRM 272-1	<i>0.0008</i>	0.00096	0.0167	0.0007	0.00090	...	0.0031
ECRM 276-1	0.0133	...	0.296	...	...	...	...
ECRM 295-1	0.0025	...	0.0456	0.0007	...	48.36	...

Ferro Alloys

	C	Si	P	S	Cr	Mo	Ni	Cu	N	Ti	V	Fe
BCS-CRM 231/5	<i>0.209</i>	1.663	0.0289	<i>0.043</i>	...	61.70	...	0.270	...	...	...	...
BCS-CRM 231/6	<i>0.058</i>	0.722	0.0211	<i>0.031</i>	...	71.41	...	0.2230	...	...	...	...

Iron Ore

	Fe	Si	Ca	Mg	Al	Ti	Mn	P	S	Na	K	V	Cr	Ni	Co	Cu	Pb
ECRM 682-2	66.118	0.8332	...	0.0133	0.3252	0.0441	0.0311	0.0529	0.0140	...	...	0.0015	...	...	...	0.00049	0.00038
ECRM 690-1	66.70	0.881	0.269	0.815	0.198	0.229	0.0337	0.0085	...	0.0312	0.0158	0.1417	0.0113	0.0200	0.0089		

Tungsten Carbide

	C (total)	Fe
ECRM 783-1	6.1884	0.0022

Certified concentrations are given in bold text and in W/W %. Non-certified elements, i.e. elements only given as supplemental information, are given in italics.

CTIF and ArcelorMittal Maizières Research SA (ex “IRSID”)

Stainless Steel

	C	Si	Mn	P	S	Cr	Mo	Ni	As	Co	Cu	N	Nb	Sn	Ti	V	W
ECRM 269-1	0.0499	0.441	1.262	0.0313	0.0010	18.150	0.397	8.044	0.0061	0.1116	0.366	0.0460	0.0242	0.0099	0.0006	0.0991	0.0306

Cast iron

	C	Si	Mn	P	S	Cr	Mo	Ni	As	Co	Cu	N	Sn	Ti	V
ECRM 485-3	3.514	...	...	...	0.1488	...	...	...	...	...	...	0.0081	...	...	...
ECRM 487-2	3.5730	0.0031	0.0491	0.0065	0.0031	0.0248	0.0034	0.0219	0.0063	0.0151	0.0136	0.004	0.0045	0.0022	0.0117
ECRM 488-2	3.956	0.374	0.201	0.0111	0.1173	0.303	...	0.1247	...	...	0.0256	0.0052	0.0013	0.0636	0.0545
ECRM 490-1	4.813	<i>0.03</i>	10.83	0.0267	0.0040	0.0183	...	<i>0.02</i>	...	...	0.0088	0.0030	...	0.0035	0.0152
ECRM 491-1	3.616	...	...	...	0.0866	...	...	...	...	...	...	...	...	...	...
ECRM 492-1	3.258	...	...	...	0.0854	...	...	...	...	...	...	0.0048	...	...	...

Iron Ore

	Fe	Si	Ca	Mg	Al	Ti	Mn	P	S	Na	K	V	Cr	Ni	C	Zn
ECRM 685-1	91.103	0.7950	0.1395	0.2394	0.3197	0.2199	0.0415	0.0170	0.0031	0.0733	0.0418	0.1436	...	0.0175	1.487	...
ECRM 691-1	64.39	0.556	0.999	2.022	0.475	0.966	0.1724	0.0877	0.0632	0.0164	0.0504	0.0603	0.0095	0.0299	0.307	0.0195

	Pb	Co	Cu	Fe⁺⁺
ECRM 685-1	...	0.0133	...	...
ECRM 691-1	0.0008	...	0.0768	20.71

Participating laboratories

Australia

CSIRO, Urrbrae

Austria

Böhler Edelstahl GmbH, Kapfenberg

Umwelt- & Betriebsanalytik, voestalpine Stahl GmbH, Linz

voestalpine Stahl GmbH, Linz

Belgium

ArcelorMittal Gent - Stainless Steel, Gent

Belgian Nuclear Research Centre, Mol

Carsid Métallurgie Qualité, Marcinelle

Fabrique de Fer de Charleroi, Marchienne-au-Pont Gent

Nyrstar, Overpelt

OCAS, Zelzate

Umicore Precious Metals Refining, Hoboken

Brazil

ArceleorMittal, Tubarão

Canada

Corporation Scientifique Claisse, Quebec

China

Well Glow (Beijing) International Trading Ltd., Beijing

Czech Republic

TZ Chemical and Mechanical Testing Laboratories, Staré Město

Denmark

Det Danske Stålvalseværk A/S, Frederiksværk

Finland

Avesta Polarit Stainless Oy, Tornio

Ovako Oy, Imatra Stålverk, Imatra

Outokumpu Oy, Tornio

Rautaruukki Oy, Raahe

SSAB Europe Oy, Raahe

France

Aciéries Aubert et Duval, Les Ancizes

Alstom, Belfort

Arcelor Méditerranée, Fos

Arcelor Mittal, Dunkerque

Arcelor Mittal, Florange

ArcelorMittal Imphy, Imphy

ArcelorMittal Industeel Creusot

ArcelorMittal Isbergues Stainless, Isbergues

ArcelorMittal Maizières Research SA, Maizières-les-Metz

Ascométal, Fos-sur-Mer

Aubert & Duval, Les Ancizes

CNRS - Service Central d'Analyse, Vernaison

Creas, Amneville

CRPG, Vandoeuve-Les-Nancy

CTIF, Charleville

CTIF, Sèvres

Industeel France – Le Creusot, Le Creusot

Sylab, Metz Cedex

Germany

AG der Dillinger Hüttenwerke, Dillingen/Saar

A.M.C.O. united samplers and assayers GmbH, Duisburg

Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin

Chemad GmbH, Duisburg

Deutsche Edelstahlwerke GmbH, Witten

FEhS Institut für Baustoff-Forschung, Duisburg

GFE Fremat GmbH, Freiberg

H.C. Starck GmbH & Co. KG, Goslar

Heraeus Material Technology, Hanau
Industeel, Le Creusot
Institut de Sodure, Villepinte
Krupp Edelstahlprofile GmbH, Siegen
Leibniz Institute for Solid State and Materials Research, Dresden
Max-Planck-Institut für Eisenforschung GmbH, Düsseldorf
MRU, Muldenhütten Recycling und Umwelttechnik GmbH, Freiberg
Pont à Mousson S.A, Pont à Mousson
Recylex Harz-Metall GmbH, Goslar
SARM, Vandoeuvre-Les-Nancy
Serma Technologie CERM, Belfort
Sollac, Fos-sur-Mer
TechLab, Metz
Thyssen Krupp, Krefeld
Thyssen Krupp Stahl AG, Dortmund
Thyssen Krupp VDM, Werdohl
ThyssenKrupp Steel Europe AG, Duisburg
Ugine S.A. L'Ardoise
Ugine S.A., Isbergues
Ugine Savoie Imphy, Imphy
Ugine, Isbergues
Ugitech Laboratoire, Ugine
Weser-Metall GmbH, Nordenham

Hungary

ISD Dunaferr Zrt., Dunaújváros
Dunaferr Labor Nonprofit Ltd., Dunaújváros

Iceland

IceTec, Reykjavik

Italy

Centro Sviluppo Materiali, (CSM), Rome

Luxembourg

Luxcontrol, Esch-sur-Alzette

Norway

AS Norsk Jernverk, Mo i Rana
Bremanger Smelteverk, Svelgen, Saltenverk, Straummen
ELKEM-Spigerverket A/S,
Fiskaa Verk, Vaagsbygd
Molab A/S, Mo i Rana
Sintef Molab, Mo i Rana
Tinfors Jernverk A/S, Kvinesdal

Russia

Institute of Certified Reference Materials, Yekaterinburg

Spain

Acerinox S.A, Palmones
ArcelorMittal-Asturias, Bilbao
Centre Nacional de Investigaciones Metalúrgicas (CENIM), Madrid

Sweden

AB Bofors, Bofors
AB Ferrolegeringar, Trollhättan
AB Sandvik Coromant, Stockholm
AB Sandvik Materials Technology, Sandviken
ALS Scandinavia AB, Luleå
ASEA, Västerås
Avesta Jernverks AB, Avesta
Avesta Polarit AB, Avesta
Avesta Polarit, Degerfors Stainless, Degerfors
Avesta Sheffield AB, Avesta
Bodycote Powdermet AB, Surahammar
Degerfors Järnverk, Degerfors
Degerfors Laboratorium AB, Degerfors
Domnarvets Järnverk, Borlänge
Erasteel Kloster AB, Söderfors
ESAB AB, Göteborg
Fagersta AB, Fagersta

Fagersta BruksAB, Fagersta
Fundia Special Bar AB, Smedjebacken
Gränges Gruvor, Stråssa
Gränges Stål, Oxelösunds Järnverk, Oxelösund
Höganäs Sweden AB, Höganäs
Höganäs Halmstadsverken, Halmstad
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