ECSC - CECA - EGKS

EUROPEAN COAL AND STEEL COMMUNITY
COMMUNAUTÉ EUROPÉENNE DU CHARBON ET DE L'ACIER
EUROPÄISCHE GEMEINSCHAFT FÜR KOHLE UND STAHL
CERTIFIED REFERENCE MATERIAL
CERTIFICATE OF CHEMICAL ANALYSIS
EURO - CRM No. 776-1 FIREBRICK

LABORATORY MEANS (4 values)
mass content in % related to the dried (105°C) sample

Line No.	Si	Ti	Al	Fe	Ca	Mg	K	Na	Li	Cr	Ba	P	Zr
1	–	–	–	0.9695	0.1955	0.2700	–	0.3325	0.0079	0.0118	–	0.0228	*0.0269*
2	29.08	0.9400	15.31	0.9805	0.2065	0.2752	2.275	0.3395	0.0079	0.0123	0.0902	0.0235	*0.0272*
3	29.10	0.9425	15.38	0.9825	0.2075	0.2760	2.360	0.3396	0.0080	0.0135	0.0975	0.0236	*0.0282*
4	29.11	0.9450	15.39	0.9825	0.2100	0.2765	2.372	0.3495	0.0081	0.0137	0.0985	0.0239	*0.0298*
5	29.14	0.9562	15.40	0.9848	0.2108	0.2775	2.374	0.3555	0.0084	0.0140	0.1000	0.0245	*0.0308*
6	29.16	0.9587	15.41	0.9895	0.2146	0.2802	2.380	0.3555	0.0084	0.0142	0.1005	0.0245	*0.0330*
7	29.20	0.9610	15.42	0.9895	0.2180	0.2810	2.400	0.3568	0.0084	0.0150	0.1060	0.0246	*0.0344*
8	29.21	0.9622	15.42	0.9902	0.2192	0.2849	2.404	0.3575	0.0085	0.0151	0.1100	0.0248	
9	29.26	0.9662	15.45	0.9940	0.2200	0.2875	2.410	0.3600	0.0088	0.0154	0.1106	0.0262	
10	29.27	0.9708	15.45	0.9973	0.2202	0.2882	2.412	0.3602	0.0090	0.0158	0.1120	0.0270	
11	29.33	0.9724	15.46	0.9992	0.2216	0.2891	2.419	0.3611	0.0091	0.0158	0.1130	0.0279	
12	29.35	0.9725	15.47	1.0008	0.2220	0.2892	2.440	0.3625	0.0100	0.0158	0.1132	0.0282	
13	29.36	0.9742	15.52	1.0032	0.2225	0.2922	2.445	0.3625	0.0100	0.0158	0.1175	0.0300	
14	29.37	0.9760	15.53	1.0035	0.2236	0.2926	2.449	0.3650	0.0105	0.0158	0.1187	0.0305	
15	29.39	0.9770	15.58	1.0070	0.2238	0.2938	2.462	0.3652	–	0.0160	0.1228	0.0306	
16	29.47	0.9800	15.60	1.0106	0.2250	0.2940	2.468	0.3718		0.0163	0.1254	0.0314	
17	29.54	0.9830	15.61	1.0198	0.2320	0.2950	2.468	0.3750		0.0170	–	0.0328	
18	29.55	0.9835	15.65	1.0205	0.2400	0.2950	2.468	0.3784		0.0175			
19	29.58	0.9842	15.68	1.0225	0.2421	0.3006	2.475	0.3800		0.0178			
20	29.62	0.9878	15.74	1.0350	0.2500	0.3075	2.488	0.3821		0.0193			
21	29.64	0.9918		–	–	–	2.500	0.3940					
M_M	**29.34**	**0.9692**	**15.50**	**0.9991**	**0.2212**	**0.2873**	**2.423**	**0.3621**	**0.0088**	**0.0154**	**0.1091**	**0.0269**	*0.030*
s_M	0.18	0.0151	0.12	0.0166	0.0128	0.0095	0.054	0.0150	0.0008	0.0018	0.0101	0.0032	

M_M: Mean of the intralaboratory means. s_M: Standard deviation of the intralaboratory means.

The laboratory mean values have been examined statistically to eliminate any outlying values. Where a "—" appears in the table it indicates that an outlying value has been omitted.

NOTE: The loss of ignition at 1000°C has been found to be approximately 0.3% m/m.

CERTIFIED VALUES
mass content in %

	Si	Ti	Al	Fe	Ca	Mg	K	Na	Li	Cr	Ba	P
M_M	**29.34**	**0.969**	**15.50**	**0.999**	**0.221**	**0.287**	**2.42**	**0.362**	**0.009**	**0.015**	**0.109**	**0.027**
s_M	0.18	0.015	0.12	0.017	0.013	0.010	0.05	0.015	0.001	0.002	0.010	0.003

All values are 'total' element content

DESCRIPTION OF THE SAMPLE

This sample consists of material passing sieve of aperture size 125 μm. It is supplied only in bottles containing 100g.

This reference material prepared and issued by:
BUREAU OF ANALYSED SAMPLES LIMITED
Newham Hall, Middlesbrough, England
MAY, 1983
On behalf of: The Commission of Co-ordination of the Nomenclature of Metallurgical Products — Commission of European Communities.

ECRM 776-1

LABORATORY MEANS (4 values) EXPRESSED AS OXIDES
mass content in % related to the dried (105°C) sample

Line No.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Li_2O	Cr_2O_3	BaO	P_2O_5	ZrO_2
1	–	–	–	1.386	0.2735	0.4477	–	0.4482	0.0170	0.0172	–	0.0522	*0.0363*
2	62.21	1.568	28.93	1.402	0.2889	0.4564	2.740	0.4576	0.0170	0.0180	0.1007	0.0538	*0.0367*
3	62.25	1.572	29.06	1.405	0.2903	0.4577	2.843	0.4578	0.0172	0.0197	0.1089	0.0541	*0.0381*
4	62.28	1.576	29.08	1.405	0.2938	0.4585	2.857	0.4711	0.0174	0.0200	0.1100	0.0548	*0.0402*
5	62.34	1.595	29.10	1.408	0.2949	0.4602	2.860	0.4792	0.0181	0.0205	0.1116	0.0561	*0.0416*
6	62.38	1.599	29.12	1.415	0.3003	0.4646	2.867	0.4792	0.0181	0.0208	0.1122	0.0561	*0.0446*
7	62.47	1.603	29.14	1.415	0.3050	0.4660	2.891	0.4810	0.0181	0.0219	0.1183	0.0564	*0.0465*
8	62.49	1.605	29.14	1.416	0.3067	0.4724	2.896	0.4819	0.0183	0.0221	0.1228	0.0568	
9	62.60	1.612	29.19	1.421	0.3078	0.4768	2.903	0.4853	0.0189	0.0225	0.1235	0.0600	
10	62.62	1.619	29.19	1.426	0.3081	0.4779	2.905	0.4855	0.0194	0.0231	0.1250	0.0619	
11	62.75	1.622	29.21	1.429	0.3100	0.4794	2.914	0.4868	0.0196	0.0231	0.1262	0.0639	
12	62.79	1.622	29.23	1.431	0.3106	0.4796	2.939	0.4886	0.0215	0.0231	0.1264	0.0646	
13	62.81	1.625	29.32	1.434	0.3113	0.4845	2.945	0.4886	0.0215	0.0231	0.1312	0.0687	
14	62.83	1.628	29.34	1.435	0.3129	0.4852	2.950	0.4920	0.0226	0.0231	0.1325	0.0699	
15	62.87	1.630	29.44	1.440	0.3131	0.4872	2.966	0.4923	–	0.0234	0.1371	0.0701	
16	63.05	1.635	29.48	1.445	0.3148	0.4875	2.973	0.5012		0.0238	0.1400	0.0709	
17	63.20	1.640	29.49	1.458	0.3246	0.4892	2.973	0.5055		0.0248		0.0752	
18	63.22	1.641	29.57	1.459	0.3358	0.4892	2.973	0.5101		0.0256			
19	63.28	1.642	29.63	1.462	0.3392	0.4985	2.981	0.5122		0.0260			
20	63.37	1.648	29.74	1.480	0.3498	0.5099	2.997	0.5151		0.0282			
21	63.41	1.654		–	–	–	3.012	0.5311					
M_M	**62.76**	**1.617**	**29.28**	**1.429**	**0.3096**	**0.4764**	**2.919**	**0.4881**	**0.0189**	**0.0225**	**0.1218**	**0.0616**	*0.041*
s_M	0.39	0.025	0.22	0.024	0.0180	0.0158	0.065	0.0202	0.0018	0.0026	0.0113	0.0073	

M_M: Mean of the intralaboratory means. **s_M**: Standard deviation of the intralaboratory means.

The laboratory mean values have been examined statistically to eliminate any outlying values. Where a "–" appears in the table it indicates that an outlying value has been omitted.

NOTE: The loss of ignition at 1000°C has been found to be approximately 0.3% m/m.

CERTIFIED VALUES
mass content in %

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Li_2O	Cr_2O_3	BaO	P_2O_5
M_M	**62.76**	**1.62**	**29.28**	**1.43**	**0.310**	**0.476**	**2.92**	**0.488**	**0.019**	**0.022**	**0.122**	**0.062**
s_M	0.39	0.03	0.22	0.02	0.018	0.016	0.07	0.020	0.002	0.003	0.011	0.007

PARTICIPATING LABORATORIES

ARBED Division d'Esch Belval,Esch-sur-Alzette (Luxembourg)
ARBED Saarstahl GmbH, Völklingen-Saar 1 (Germany)
British Ceramic Research Association, Stoke-on-Trent (UK)
British Steel Corporation, Corby Works (UK)
Bundesanstalt für Materialprüfung (BAM), Berlin-Dahlem (Germany)
Centro Sperimentale Metallurgico (CSM), Rome (Italy)
Cockerill, Seraing (Belgium)
English Clays, Lovering Pochin & Co. Ltd., St. Austell (UK)
GR-Stein Refractories Ltd., Worksop (UK)
Hoesch Hüttenwerke AG, Dortmund 1 (Germany)
Hoogovens Group BV, IJmuiden (Holland)
Institut de Recherches de la Sidérurgie Française (IRSID), Maizières-les-Metz (France)
Mannesmannröhren-Werke AG, Hüttenwerke Huckingen, Duisburg 25 (Germany)
Ridsdale and Co. Ltd., Middlesbrough (UK)
SACILOR, Amneville (France)
Société Metallurgique Hainaut-Sambre, Couillet (Belgium)
SOLLAC, Florange (France)
SOLMER, Fos-sur-Mer (France)
Stahlwerke Peine-Salzgitter AG, Salzgitter 41, (Germany)
Stahlwerke Röchling-Burbach GmbH, Völklingen-Saar 1 (Germany)
Thyssen AG, Duisburg 11 (Germany)
USINOR, Dunkerque (France)

METHODS USED

ECRM 776-1

Element	Line Number	Methods
Si	2 - 3 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 17 - 20 - 21	Gravimetric, dehydration with perchloric acid
	4 - 13	Gravimetric, dehydration with hydrochloric acid
	12 - 14 - 16 - 18 - 19	XRF, fused bead technique, synthetic calibration
	15	Gravimetric, coagulation with polyethylene oxide
Ti	2 - 7 - 15	Photometric with diantipyrylmethane
	3 - 4 - 9 - 14 - 18 - 19	Photometric with chromotropic acid
	5 - 17 - 21	Photometric with hydrogen peroxide
	6 - 12	FAAS
	8 - 10 - 11 - 13 - 16 - 20	XRF, fused bead technique, synthetic calibration
Al	2	Bromometric titration, precipitation with 8 hydroxyquinoline
	3 - 10 - 11 - 20	FAAS
	4 - 7 - 8 - 12 - 14 - 16	XRF, fused bead technique, synthetic calibration
	5	Gravimetric as aluminium phosphate
	6 - 17 - 19	Gravimetric, as oxide
	9 - 13 - 15 - 18	Complexometric titration
Fe	1 - 6 - 13 - 17	FAAS
	2	Photometric with thiocyanate
	3 - 9 - 11 - 15 - 18 - 20	Photometric with 1:10 phenanthroline
	4 - 8 - 10 - 12 - 14 - 16	XRF, fused bead technique, synthetic calibration
	5	Photometric with sulphosalicylic acid
	7	Photometric with $\alpha\,\alpha'$-bipyridyl
	19	Photometric with thioglycollic acid
Ca	1 - 2 - 3 - 6 - 7 - 8 - 9 - 10 - 13 - 15 - 18 - 19 - 20	FAAS
	4 - 16	Titrimetric with permanganate, precipitation as oxalate
	5 - 11 - 12 - 14 - 17	XRF, fused bead technique, synthetic calibration
Mg	1 - 2 - 3 - 4 - 5 - 6 - 7 - 9 - 10 - 11 - 12 - 14 - 17 - 18 - 19	FAAS
	8 - 15 - 16 - 20	XRF, fused bead technique, synthetic calibration
	13	Gravimetric, precipitation as magnesium ammonium phosphate
K	2 - 3 - 7 - 8 - 10 - 11 - 15 - 16 - 17 - 19	FAAS
	4 - 6 - 9 - 13 - 18 - 21	FAES
	5 - 12 - 14	XRF, fused bead technique, synthetic calibration
	20	ICP AES
Na	1 - 2 - 6 - 7 - 8 - 9 - 10 - 12 - 13 - 14 - 16 - 19	FAAS
	3 - 4 - 5 - 15 - 17 - 20 - 21	FAES
	11	ICP AES
	18	XRF, fused bead technique, synthetic calibration
Li	1 - 2 - 3 - 4 - 5 - 9 - 13	FAES
	6 - 7 - 8 - 10 - 11 - 12 - 14	FAAS
Cr	1 - 2 - 3 - 13 - 17	Photometric with diphenylcarbazide
	4 - 18 - 20	XRF, fused bead technique, synthetic calibration
	5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 15 - 16 - 19	FAAS
	14	ICP AES

METHODS USED

ECRM 776-1

Element	Line Number	Methods
Ba	2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 15	FAAS
	11	Gravimetric, precipitation as barium sulphate
	12 - 14 - 16	XRF, fused bead technique, synthetic calibration
	13	ICP AES
P	1 - 5	Photometric as phosphovanadomolybdate with extraction
	2 - 12 - 15	Photometric as phosphovanadomolybdate
	3 - 6 - 8	XRF, fused bead technique, synthetic calibration
	4 - 7 - 11 - 13 - 14 - 16 - 17	Photometric as molybdenum blue
	9 - 10	Photometric as molybdenum blue with extraction
Zr	1	Photometric with xylenol orange
	2 - 7	XRF, fused bead technique, synthetic calibration
	3 - 5	ICP AES
	4 - 6	Photometric with arsenazo III

Abbreviations:

XRF : X-Ray fluorescence spectrometry
FAAS : Flame atomic absorption spectrometry
FAES : Flame atomic emission spectrometry
ICP AES : Inductively coupled plasma atomic emission spectrometry

FURTHER INFORMATION

For information regarding the preparation and certification of Euro-CRMs (Certified Reference Materials) and sources of supply please refer to ECSC Information Circular No. 1 available from the Institution responsible for standardization in your country. (In the UK this is the BSI, 2 Park Street, London. W1A 2BS.)

Pour tous renseignements sur les Euro-MRC (Matériaux de Référence Certifies) se reporter à la Circulaire d'information No. 1 de la CECA, diffusée par les organismes nationaux de normalisation.

Wegen Erläuterungen über Euro-ZRM (Zertifiziertes Referenzmaterial) siehe Mitteilung Nr. 1 der EGKS, zu beziehen durch die nationalen Normenorganisationen.