2006.04.18(v20190301)

The Technical Association of Refractories, Japan

Certified Reference Material for Carbon Analysis of C/SiC Refractories

J R R M 1 0 0 1(Silicon Carbide, SiC 100)

Results of Analyses

Unit : mass%

	Certified value		Approximate value								
Component	Total Carbon	Free Carbon	Residue after HF treatment	Alumi-nium	Iron	Tita-nium	Cal-cium	Magne-sium	Free Silicon	Oxygen	Nitro-gen
Chemical Symbol	**C_{Total}**	**C_{Free}**	**SiC_{HF}**	**Al**	**Fe**	**Ti**	**Ca**	**Mg**	**Si_{Free}**	**O**	**N**
Certified and Aproximate	**29,81**	**0,04**	**99,58**	**0,008**	**0,044**	**0,0035**	**<0,001**	**<0,001**	**0,06**	**0,048**	**0,030**
Laboratory L_1	29,78	.....	99,58	0,0069	0,0418	0,0032	0,0004	0,0002	0,038	0,0457	0,024
L_2	29,78	0,043	.....	0,0068	0,0438	0,0032	0,0000	0,0000	0,067	.....	.....
L_3	29,82	0,041	99,45	.....	.....	.....	.....	.....	.....	.....	.....
L_4	29,88	0,036	99,60	.....	.....	.....	.....	.....	.....	.....	.....
L_5	29,75	0,030	99,58	0,0096	0,0464	0,0036	0,0004	0,0004	0,051	.....	.....
L_6	29,80	.....	99,66	.....	.....	.....	.....	.....	.....	.....	.....
L_7	29,82	0,039	99,65	0,0090	0,0482	0,0042	0,0001	0,0001	0,090	0,0575	0,036
L_8	29,74	.....	99,50	.....	.....	.....	.....	.....	0,080	.....	.....
L_9	29,78	0,036	.....	.....	.....	.....	.....	.....		.....	.....
L_{10}	29,80	0,054	99,62	0,0076	0,0424	0,0033	<0,001	<0,0005	.....	.....	.....
L_{11}	29,92	0,04	.....	.....	.....	.....	.....	.....	.....	0,0502	0,0294
L_{12}	.....	.....	.....	.....	.....	.....	.....	.....	.....	0,0454	.....
L_{13}	.....	.....	.....	.....	.....	.....	.....	.....	.....	0,0436	.....
Average $(\overline{\overline{X}})$	29,806	0,0399	99,58	0,008	0,0445	0,0035	.....	.....	0,065	0,0485	0,0298
Standard deviation											
Reproducibility $s_{\bar{\bar{x}}}$	0,055	0,0072	0,072	0,0013	0,0027	0,0004	.....	.....	0,025	0,0058	.....
Reproducibility $s_{I(T)}$ *1 within laboratory	0,040	0,0032	0,044	0,0002	0,0034	0,0002	.....	.....	0,003	0,0006	.....
Uncertainty $C(95\%)$ *2	0,04	0,01	0,06	0,002	0,003	0,0005	.....	.....	0,03	0,007	.....

(Note) *1 $s_{I(T)}$ is time-differenet intermediate precision standard deviation.

*2 The half-width confidence interval $C(95\%) = t_{I-1,0.05} \times s_{\bar{\bar{x}}} / \sqrt{I}$ (I : number of laboratories)

(1) Laboratories ; Krosaki Corporation(now, Kurosaki Harima Corporation), Kawasaki Refractories Co., Ltd., Nihon Tokushu Rozai Co., Ltd., Taiko Refractories Co., Ltd., Asahi Glass Co., Ltd., Harima Ceramic Co., Ltd. (now, Kurosaki Harima Corporation), Shinagawa Refractories Co., Ltd., Toshiba Ceramics Co., Ltd., TYK Corporation, Showa Denko K.K., Horiba, Ltd., Japan Analyst Corporation, Shimadzu Corporation

(2) Analytical methods ; JIS R 2011(Methods for chemical analysis of refractories containing carbon and/or silicon-carbide))

① F.C : determined by method using mass gain correction owing to oxidation of SiC.

② SiC_{HF} : filtrate residue which is ignited at 780~800℃ for 40 min after HF (H_2SO_4) treatment.

③ Metal element except Al were decomposed HF+H_2SO_4) decompsition in pressure vessel and determined by ICP-AES and AAS. Al was fused with sodium carbonate, treated by HF+H_2SO_4 and determined by ICP-AES.

(3) Each analytical value is the average of two values obtained by two measurements on different days.

(4) Outlier tests were carried out by Grubbs test method. The samples rejected by Grubbs tests were discussed in view of analytical techniques and it was decided whether they should be adopted or not.

(5) Date of preparation : December, 1993

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The Technical Association of Refractories, Japan

Certified Reference Material for Carbon Analysis of C/SiC Refractories

J R R M 1 0 0 2(Carbon Containing Material, C 5)

Results of Analyses

Unit : mass%

	Certified value		Approximate value
Component	Total Carbon	Free Carbon	Loss on Ignition
Chemical Symbol	**T.C**	**F.C**	**LOI**
Certified and Aproximate	**5,03**	**4,98**	**5,11**
Laboratory L_1	5,025	4,974	5,169
L_2	5,078	5,028	5,081
L_3	5,018	5,040	.....
L_4	4,997	4,944	5,086
L_5	4,964	4,928	5,164
L_6	5,040	4,985	5,112
L_7	5,023	4,897	5,058
L_8	5,040	5,020	.....
L_9	5,106	4,997	5,088
Average $\bar{\bar{X}}$	5,032 3	4,979 2	5,108 3
Standard deviation			
Reproducibility $s_{\bar{X}}$	0,041 8	0,048 3	0,042 8
Reproducibility within laboratory $s_{I(T)}$ *1	0,022 9	0,033 1	0,029 7
Uncertainty $C(95\%)$ *2	0, 04	0,04	0,04

(Note) *1 $s_{I(T)}$ is time-differenet intermediate precision standard deviation.

*2 The half-width confidence interval $C(95\%) = t_{l-1,0.05} \times s_{\bar{X}} / \sqrt{l}$ (l : number of laboratories)

(1) List of laboratories: Krosaki Harima Corporation, JFE Refractories Corporation, TaikoRefractories Co., Ltd., Asahi Glass Ceramics Co., Ltd., Shinagawa Refractoties Co., Ltd., TYK Corporation, Okayama Ceramics Research Foundation, Horiba, Ltd., LECO Japan Corporation

(2) Analytical methods ; JIS R 2011(Methods for chemical analysis of refractories containing carbon and/or silicon-carbide))

(3) Each analytical value is the average of two values obtained by two measurements on different days.

(4) Outlier tests were carried out by Grubbs test method. The samples rejected by Grubbs tests were discussed in view of analytical techniques and it was decided whether they should be adopted or not.

(5) Date of preparation :November, 2004

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The Technical Association of Refractories, Japan

Certified Reference Material for Carbon Analysis of C/SiC Refractories

J R R M 1 0 0 3 (Carbon Containing Material, C 10)

Results of Analyses

Unit : mass%

	Certified value		Approximate value
Component	Total Carbon	Free Carbon	Loss on Ignition
Chemical Symbol	**T.C**	**F.C**	**LOI**
Certified and Aproximate	**10,06**	**10,01**	**10,11**
Laboratory L_1	10,02	9,980	10,21
L_2	10,10	9,954	10,08
L_3	10,05	10,09	.....
L_4	10,05	9,980	10,14
L_5	10,06	9,985	10,12
L_6	10,12	10,07	10,07
L_7	10,02	10,03	10,09
L_8	10,02	10,10	.....
L_9	10,08	9,922	10,03
Average $\bar{\bar{X}}$	10,058	10,012	10,106
Standard deviation			
Reproducibility $s_{\bar{X}}$	0,036 9	0,063 8	0,057 8
Reproducibility within laboratory $s_{I(T)}$ *1	0,032 7	0,036 1	0,015 4
Uncertainty $C(95\%)$ *2	0,03	0,05	0,06

(Note) *1 $s_{I(T)}$ is time-differenet intermediate precision standard deviation.

*2 The half-width confidence interval $C(95\%) = t_{I-1,0.05} \times s_{\bar{X}} / \sqrt{I}$ (I : number of laboratories)

(1) List of laboratories: Krosaki Harima Corporation, JFE Refractories Corporation, TaikoRefractories Co., Ltd., Asahi Glass Ceramics Co., Ltd., Shinagawa Refractoties Co., Ltd., TYK Corporation, Okayama Ceramics Research Foundation, Horiba, Ltd., LECO Japan Corporation

(2) Analytical methods ; JIS R 2011(Methods for chemical analysis of refractories containing carbon and/or silicon-carbide))

(3) Each analytical value is the average of two values obtained by two measurements on different days.

(4) Outlier tests were carried out by Grubbs test method. The samples rejected by Grubbs tests were discussed in view of analytical techniques and it was decided whether they should be adopted or not.

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The Technical Association of Refractories, Japan

Certified Reference Material for Carbon Analysis of C/SiC Refractories

J R R M 1 0 0 4 (Carbon Containing Material, C 20)

Results of Analyses

Unit : mass%

	Certified value		Approximate value
Component	Total Carbon	Free Carbon	Loss on Ignition
Chemical Symbol	**T.C**	**F.C**	**LOI**
Certified and Aproximate	**20,04**	**19,92**	**20,01**
Laboratory L_1	19,98	19,83	20,02
L_2	19,94	19,90	20,04
L_3	19,98	20,02	.....
L_4	20,04	19,91	20,06
L_5	19,98	19,76	20,02
L_6	20,08	19,97	19,98
L_7	20,12	20,08	20,04
L_8	20,18	19,94	.....
L_9	20,04	19,84	19,92
Average $\bar{\bar{X}}$	20,038	19,917	20,011
Standard deviation			
Reproducibility $s_{\bar{X}}$	0,080	0,100	0,051
Reproducibility within laboratory $s_{I(T)}$ *1	0,045	0,094	0,033
Uncertainty $C(95\%)$ *2	0,07	0,08	0,05

(Note) *1 $s_{I(T)}$ is time-differenet intermediate precision standard deviation.

*2 The half-width confidence interval $C(95\%) = t_{I-1,0.05} \times s_{\bar{X}} / \sqrt{I}$ (I : number of laboratories)

(1) List of laboratories: Krosaki Harima Corporation, JFE Refractories Corporation, TaikoRefractories Co., Ltd., Asahi Glass Ceramics Co., Ltd., Shinagawa Refractoties Co., Ltd., TYK Corporation, Okayama Ceramics Research Foundation, Horiba, Ltd., LECO Japan Corporation

(2) Analytical methods ; JIS R 2011(Methods for chemical analysis of refractories containing carbon and/or silicon-carbide))

(3) Each analytical value is the average of two values obtained by two measurements on different days.

(4) Outlier tests were carried out by Grubbs test method. The samples rejected by Grubbs tests were discussed in view of analytical techniques and it was decided whether they should be adopted or not.

(5) Date of preparation :November, 2004

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The Technical Association of Refractories, Japan

Certified Reference Material for Carbon Analysis of C/SiC Refractories

J R R M 1 0 0 5 (Carbon Containing Material, C 30)

Results of Analyses

Unit : mass%

	Certified value		Approximate value
Component	Total Carbon	Free Carbon	Loss on Ignition
Chemical Symbol	**T.C**	**F.C**	**LOI**
Certified and Aproximate	**29,93**	**29,81**	**29,95**
Laboratory L_1	29,88	29,70	30,06
L_2	29,97	29,74	29,96
L_3	29,87	29,89	.....
L_4	29,92	29,72	29,96
L_5	30,02	29,73	30,04
L_6	29,84	30,03	29,84
L_7	29,94	29,82	29,91
L_8	29,94	29,81	.....
L_9	30,01	29,88	29,90
Average $\bar{\bar{X}}$	29,932	29,813	29,953
Standard deviation			
Reproducibility $s_{\bar{X}}$	0,062	0,107	0,077
Reproducibility within laboratory $s_{I(T)}$ *1	0,088	0,145	0,086
Uncertainty $C(95\%)$ *2	0,05	0,09	0,08

(Note) *1 $s_{I(T)}$ is time-differenet intermediate precision standard deviation.

*2 The half-width confidence interval $C(95\%) = t_{I-1,0.05} \times s_{\bar{X}} / \sqrt{I}$ (I : number of laboratories)

(1) List of laboratories: Krosaki Harima Corporation, JFE Refractories Corporation, TaikoRefractories Co., Ltd., Asahi Glass Ceramics Co., Ltd., Shinagawa Refractoties Co., Ltd., TYK Corporation, Okayama Ceramics Research Foundation, Horiba, Ltd., LECO Japan Corporation

(2) Analytical methods ; JIS R 2011(Methods for chemical analysis of refractories containing carbon and/or silicon-carbide))

(3) Each analytical value is the average of two values obtained by two measurements on different days.

(4) Outlier tests were carried out by Grubbs test method. The samples rejected by Grubbs tests were discussed in view of analytical techniques and it was decided whether they should be adopted or not.

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Certified Reference Material for Carbon Analysis of C/SiC Refractories

J R R M 1 0 0 6 (Carbon Containing Material, C 50)

Results of Analyses

Unit : mass%

	Certified value		Approximate value
Component	Total Carbon	Free Carbon	Loss on Ignition
Chemical Symbol	**T.C**	**F.C**	**LOI**
Certified and Aproximate	**49,99**	**49,97**	**49,95**
Laboratory L_1	49,86	49,95	50,17
L_2	50,07	49,91	50,04
L_3	50,10	49,97	.....
L_4	50,19	49,93	50,02
L_5	49,96	50,00	49,97
L_6	49,86	49,93	49,96
L_7	49,93	50,12	49,92
L_8	50,20	50,01	.....
L_9	49,76	49,88	49,59
Average $\bar{\bar{X}}$	49,992	49,967	49,953
Standard deviation			
Reproducibility $s_{\bar{X}}$	0,155	0,069	0,179
Reproducibility within laboratory $s_{I(T)}$ *1	0,144	0,192	0,105
Uncertainty $C(95\%)$ *2	0,12	0,06	0,08

(Note) *1 $s_{I(T)}$ is time-differenet intermediate precision standard deviation.

*2 The half-width confidence interval $C(95\%) = t_{I-1,0.05} \times s_{\bar{X}} / \sqrt{I}$ (I : number of laboratories)

(1) List of laboratories: Krosaki Harima Corporation, JFE Refractories Corporation, TaikoRefractories Co., Ltd., Asahi Glass Ceramics Co., Ltd., Shinagawa Refractoties Co., Ltd., TYK Corporation, Okayama Ceramics Research Foundation, Horiba, Ltd., LECO Japan Corporation

(2) Analytical methods ; JIS R 2011(Methods for chemical analysis of refractories containing carbon and/or silicon-carbide))

(3) Each analytical value is the average of two values obtained by two measurements on different days.

(4) Outlier tests were carried out by Grubbs test method. The samples rejected by Grubbs tests were discussed in view of analytical techniques and it was decided whether they should be adopted or not.

(5) Date of preparation :November, 2004

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Certified Reference Material for Carbon Analysis of C/SiC Refractories

J R R M 1 0 0 7 (Carbon Containing Material, C 10-SiC 90)

Results of Analyses

Unit : mass%

	Certified value		Approximate value
Component	Total Carbon	Free Carbon	Silicon Carbide
Chemical Symbol	**T.C**	**F.C**	**SiC**
Certified and Aproximate	**36,75**	**10,01**	**89,29**
Laboratory L_1	36,72	9,988	89,26
L_2	36,74	10,032	89,18
L_3	36,78	9,966	89,52
L_4	36,77	10,002	89,36
L_5	36,84	9,930	89,82
L_6	36,74	10,042	89,14
L_7	36,70	10,055	88,95
L_8	36,81	10,160	88,97
L_9	36,66	9,889	89,37
Average $\bar{\bar{X}}$	36,751	10,007	89,286
Standard deviation			
Reproducibility $s_{\bar{X}}$	0,054	0,079	0,273
Reproducibility within laboratory $s_{I(T)}$ *1	0,102	0,032	0,347
Uncertainty $C(95\%)$ *2	0,05	0,07	0,22

(Note) *1 $s_{I(T)}$ is time-differenet intermediate precision standard deviation.

*2 The half-width confidence interval $C(95\%) = t_{l-1,0.05} \times s_{\bar{X}} / \sqrt{l}$ (l : number of laboratories)

(1) List of laboratories: Krosaki Harima Corporation, JFE Refractories Corporation, TaikoRefractories Co., Ltd., Asahi Glass Ceramics Co., Ltd., Shinagawa Refractoties Co., Ltd., TYK Corporation, Okayama Ceramics Research Foundation, Horiba, Ltd., LECO Japan Corporation

(2) Analytical methods ; JIS R 2011(Methods for chemical analysis of refractories containing carbon and/or silicon-carbide)) Silicon Carbide values are calculated by the following equation; SiC=3.3383 · (T.C-F.C)

(3) Each analytical value is the average of two values obtained by two measurements on different days.

(4) Outlier tests were carried out by Grubbs test method. The samples rejected by Grubbs tests were discussed in view of analytical techniques and it was decided whether they should be adopted or not.

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The Technical Association of Refractories, Japan

Certified Reference Material for Carbon Analysis of C/SiC Refractories

J R R M 1 0 0 8 (Carbon Containing Material, C 5–SiC 30)

Results of Analyses

Unit : mass%

	Certified value		Approximate value
Component	Total Carbon	Free Carbon	Silicon Carbide
Chemical Symbol	**T.C**	**F.C**	**SiC**
Certified and Aproximate	**14,12**	**5,21**	**29,74**
Laboratory L_1	14,17	5,286	29,66
L_2	14,09	5,264	29,46
L_3	14,12	5,264	29,54
L_4	14,13	5,161	29,96
L_5	14,07	5,152	29,77
L_6	14,09	5,250	29,48
L_7	14,08	5,106	29,98
L_8	14,16	5,244	29,77
L_9	14,17	5,174	30,04
Average $\bar{\bar{X}}$	14,12	5,211 2	29,74
Standard deviation			
Reproducibility $s_{\bar{X}}$	0,039	0,063 5	0,218
Reproducibility within laboratory $s_{I(T)}$ *1	0,032	0,016 8	0,133
Uncertainty $C(95\%)$ *2	0,03	0,05	0,17

(Note) *1 $s_{I(T)}$ is time-differenet intermediate precision standard deviation.

*2 The half-width confidence interval $C(95\%) = t_{l-1,0.05} \times s_{\bar{X}} / \sqrt{l}$ (l : number of laboratories)

(1) List of laboratories: Krosaki Harima Corporation, JFE Refractories Corporation, TaikoRefractories Co., Ltd., Asahi Glass Ceramics Co., Ltd., Shinagawa Refractoties Co., Ltd., TYK Corporation, Okayama Ceramics Research Foundation, Horiba, Ltd., LECO Japan Corporation

(2) Analytical methods ; JIS R 2011(Methods for chemical analysis of refractories containing carbon and/or silicon-carbide)) Silicon Carbide values are calculated by the following equation; SiC=3.3383 · (T.C–F.C)

(3) Each analytical value is the average of two values obtained by two measurements on different days.

(4) Outlier tests were carried out by Grubbs test method. The samples rejected by Grubbs tests were discussed in view of analytical techniques and it was decided whether they should be adopted or not.

(5) Date of preparation :November, 2004

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Certified Reference Material for Carbon Analysis of C/SiC Refractories

J R R M 1 0 0 9 (C/SiC Containing Material, C 40-SiC6)

Results of Analyses

Unit : mass%

	Certified value		Approximate value
Component	Total Carbon	Free Carbon	Silicon Carbide
Chemical Symbol	**T.C**	**F.C**	**SiC**
Certified and Aproximate	**39,43**	**37,67**	**6,18**
Laboratory L_1	39,36	37,54	6,176
L_2	39,40	37,92	6,219
L_3	39,30	37,61	6,238
L_4	39,42	37,62	6,171
L_5	39,15	37,62	6,052
L_6	39,56	37,83	6,091
L_7	39,53	37,71	6,076
L_8	39,29	37,82	.....
L_9	39,84	37,33	6,412
Average $\bar{\bar{X}}$	39,428	37,667	6,179 4
Standard deviation Reproducibility $s_{\bar{X}}$	0,201	0,178	0,116
Reproducibility within laboratory $s_{I(T)}$ *1	0,115	0,152	0,054
Uncertainty $C(95\%)$ *2	0,16	0,14	0,09

(Note) *1 $s_{I(T)}$ is time-differenet intermediate precision standard deviation.

*2 The half-width confidence interval $C(95\%) = t_{l-1,0.05} \times s_{\bar{X}} / \sqrt{l}$ (l : number of laboratories)

(1) List of laboratories: Krosaki Harima Corporation, JFE Refractories Corporation, TaikoRefractories Co., Ltd., Asahi Glass Ceramics Co., Ltd., Shinagawa Refractoties Co., Ltd., TYK Corporation, Okayama Ceramics Research Foundation, Horiba, Ltd., LECO Japan Corporation

(2) Analytical methods ; JIS R 2011(Methods for chemical analysis of refractories containing carbon and/or silicon-carbide)) The C values for Silicon Carbide values were determinated from the remain sample for F.C determination, and were calculated by the following equation; SiC=3.3383・T.C

(3) Each analytical value is the average of two values obtained by two measurements on different days.

(4) Outlier tests were carried out by Grubbs test method. The samples rejected by Grubbs tests were discussed in view of analytical techniques and it was decided whether they should be adopted or not.

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