The Technical Association of Refractories, Japan

Certified Reference Material Series for X-ray Fluorescence Analysis of Refractories

ＪＲＲＭ　１０１　(Fireclay Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MnO	CaO	MgO	Na_2O	K_2O
Certified value		88.67	8.11	0.314	0.302	0.116	1.062	0.217	1.014	0.165
Laboratories	L_1	88.79	8.09	0.305	0.302	0.118	1.058	0.219	0.983	0.170
	L_2	88.75	8.12	0.325	0.300	0.118	1.001	0.222	1.019	0.154
	L_3	88.46	8.02	0.308	0.290	0.117	1.087	0.218	0.986	0.176
	L_4	88.67	8.08	0.310	0.306	0.119	1.053	0.212	1.015	0.150
	L_5	88.77	8.14	0.320	0.304	0.110	1.134	0.214	1.073	0.162
	L_6	88.54	8.19	0.328	0.321	0.119	1.058	0.208	1.033	0.172
	L_7	88.71	8.09	0.308	0.292	0.119	1.008	0.230	1.010	0.170
	L_8	88.69	8.11	0.311	0.303	0.107	1.099	0.215	0.997	0.168
Average	$(\bar{\bar{X}})$	88.673	8.106	0.3144	0.3023	0.1159	1.0623	0.2173	1.0145	0.1652
Standard deviation (Reproducibility)	$s_{\bar{x}}$	0.131	0.0487	0.0085	0.0093	0.0046	0.0443	0.0069	0.0293	0.0092
(Reproducibility without laboratories)	$s_{I(T)}$ * 1	0.095	0.0267	0.0143	0.0105	0.0032	0.0390	0.0136	0.0060	0.0044
Uncertainty C (95%)	* 2	0.11	0.04	0.007	0.008	0.004	0.037	0.006	0.025	0.008

(Note) * 1 $s_{I(T)}$is intermediate precision without a time condition.　* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$　(ℓ = number of laboratories)

(1) List of laboratories : Krosaki Corporation, Kyushu Refractories Co.,Ltd., Kawasaki Refractories Co.,Ltd., The Industrial Technology Center of Okayama Prefecture, Asahi Glass Co.,Ltd., Harima Ceramic Co.,Ltd., Shinagawa Refractories Co.,Ltd., Toshiba Ceramics Co.,Ltd.

(2) Analytical techniques : JIS R 2212-1(Method for chemical analysis of refractory products — Part 1:Fireclay refractories)

(3) Analytical values : Each value is the average of two values obtained by two measurements on different days. These analysis values are shown converted into LOI (Loss on ignition) component free values from the February 22, 2008 v20080222 version on.

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

(5) Date of preparation : August, 1985

Prepared, and Values given and certified by

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The Technical Association of Refractories, Japan

Certified Reference Material Series for X-ray Fluorescence Analysis of Refractories

ＪＲＲＭ　１０２　(Fireclay Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MnO	CaO	MgO	Na_2O	K_2O
Certified value		80.55	13.81	3.982	0.454	0.015	0.049	0.673	0.304	0.145
Laboratories	L_1	80.58	13.73	3.992	0.446	0.014	0.064	0.708	0.288	0.148
	L_2	80.45	13.76	3.988	0.449	0.022	0.057	0.649	0.264	0.142
	L_3	80.37	13.95	3.987	0.458	0.016	0.066	0.681	0.324	0.164
	L_4	80.53	13.85	3.985	0.449	0.014	0.050	0.695	0.307	0.142
	L_5	80.63	13.65	3.934	0.467	0.014	0.048	0.687	0.316	0.144
	L_6	80.55	13.95	3.964	0.467	0.010	0.039	0.645	0.306	0.144
	L_7	80.54	13.81	3.999	0.430	0.016	0.041	0.658	0.308	0.144
	L_8	80.78	13.75	4.008	0.465	0.014	0.027	0.664	0.315	0.132
Average	$(\bar{\bar{X}})$	80.554	13.806	3.9821	0.4539	0.0150	0.0490	0.6734	0.3035	0.1450
Standard deviation (Reproducibility)	$s_{\bar{x}}$	0.086	0.109	0.0233	0.0127	0.0034	0.0132	0.0223	0.0188	0.0088
(Reproducibility without laboratories)	$s_{I(T)}$ * 1	0.142	0.048	0.0362	0.0101	0.0012	0.0039	0.0158	0.0085	0.0060
Uncertainty C (95%)	*2	0.070	0.090	0.020	0.011	0.003	0.011	0.019	0.016	0.007

(Note) * 1 $s_{I(T)}$is intermediate precision without a time condition.　* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$　(ℓ = number of laboratories)

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Certified Reference Material Series for X-ray Fluorescence Analysis of Refractories

ＪＲＲＭ　１０３　(Fireclay Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MnO	CaO	MgO	Na_2O	K_2O
Certified value		80.42	18.09	0.407	0.370	0.005	0.072	0.016	0.124	0.350
Laboratories	L_1	80.41	17.93	0.401	0.368	0.004	0.068	0.016	0.124	0.364
	L_2	80.36	18.17	0.406	0.366	0.009	0.082	0.018	0.112	0.343
	L_3	80.47	18.03	0.420	0.349	0.004	0.084	0.018	0.152	0.354
	L_4	80.59	18.06	0.419	0.374	0.004	0.070	0.016	0.122	0.338
	L_5	80.56	18.21	0.378	0.380	0.002	0.084	0.016	0.118	0.358
	L_6	80.07	18.18	0.425	0.384	0.003	0.064	0.015	0.115	0.351
	L_7	80.39	18.06	0.400	0.362	0.006	0.064	0.017	0.130	0.354
	L_8	80.47	18.06	0.408	0.377	0.005	0.056	0.014	0.122	0.335
Average	$(\overline{\overline{X}})$	80.415	18.088	0.4071	0.3700	0.0046	0.0715	0.0163	0.1244	0.3496
Standard deviation (Reproducibility)	$s_{\bar{x}}$	0.157	0.095	0.0146	0.0116	0.0020	0.0108	0.0015	0.0126	0.0102
(Reproducibility without laboratories)	$s_{I(T)}$ * 1	0.096	0.070	0.0094	0.0090	0.0011	0.0083	0.0016	0.0097	0.0142
Uncertainty C (95%)	*2	0.13	0.08	0.012	0.010	0.002	0.009	0.001	0.011	0.009

(Note) * 1 $s_{I(T)}$is intermediate precision without a time condition.　* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$ (ℓ = number of laboratories)

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The Technical Association of Refractories, Japan

Certified Reference Material Series for X-ray Fluorescence Analysis of Refractories

ＪＲＲＭ　１０４　(Fireclay Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MnO	CaO	MgO	Na_2O	K_2O
Certified value		67.36	22.52	3.245	2.944	0.017	0.258	0.070	0.300	3.049
Laboratories	L_1	67.74	22.48	3.237	2.958	0.018	0.278	0.076	0.292	3.133
	L_2	67.49	22.49	3.304	2.957	0.016	0.241	0.059	0.354	3.023
	L_3	67.13	22.51	3.205	2.941	0.016	0.278	0.076	0.298	2.965
	L_4	67.36	22.56	3.279	2.992	0.022	0.256	0.067	0.288	3.217
	L_5	67.23	22.64	3.245	2.972	0.016	0.269	0.078	0.301	2.945
	L_6	67.24	22.57	3.235	2.913	0.014	0.261	0.068	0.290	2.998
	L_7	67.18	22.39	3.205	2.980	0.016	0.251	0.074	0.288	3.130
	L_8	67.50	22.53	3.249	2.839	0.016	0.234	0.066	0.291	2.974
Average	$(\bar{\bar{X}})$	67.359	22.520	3.2449	2.9440	0.0168	0.2585	0.0705	0.3003	3.0488
Standard deviation (Reproducibility)	$s_{\bar{x}}$	0.189	0.072	0.0313	0.0486	0.0025	0.0162	0.0064	0.0221	0.0991
(Reproducibility without laboratories)	$s_{I(T)}$ * 1	0.118	0.062	0.0240	0.0340	0.0017	0.0128	0.0064	0.0068	0.0345
Uncertainty C (95%)	*2	0.16	0.06	0.026	0.041	0.002	0.014	0.005	0.019	0.083

(Note) * 1 $s_{I(T)}$is intermediate precision without a time condition.　* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$ (ℓ = number of laboratories)

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ＪＲＲＭ　１０５ａ　(Fireclay Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MnO	CaO	MgO	Na_2O	K_2O
Certified value		69.3$_3$	25.4$_1$	0.76$_8$	2.25$_4$	0.11$_9$	0.40$_8$	0.22$_3$	0.65$_3$	0.81$_9$
Laboratories	L_1	69.3$_6$	25.3$_4$	0.75$_3$	2.29$_3$	0.12$_3$	0.41$_7$	0.22$_5$	0.64$_4$	0.84$_0$
	L_2	69.7$_0$	25.4$_5$	0.79$_6$	2.22$_0$	0.12$_2$	—	—	0.69$_8$	0.77$_8$
	L_3	69.2$_4$	25.2$_6$	0.76$_4$	2.33$_6$	0.12$_2$	0.42$_5$	0.22$_6$	0.64$_8$	0.83$_0$
	L_4	69.2$_2$	25.3$_0$	0.75$_8$	2.26$_3$	0.11$_8$	0.40$_9$	0.22$_6$	0.65$_4$	0.81$_6$
	L_5	69.3$_2$	25.5$_1$	0.75$_6$	2.23$_3$	—	0.40$_3$	0.22$_3$	0.67$_2$	0.83$_4$
	L_6	69.3$_8$	25.5$_9$	0.76$_8$	2.22$_1$	0.11$_6$	0.40$_2$	0.22$_3$	0.64$_2$	0.87$_8$
	L_7	69.2$_6$	25.3$_2$	0.74$_2$	2.28$_1$	0.11$_5$	0.40$_7$	0.21$_5$	0.60$_4$	0.76$_6$
	L_8	69.2$_1$	25.5$_4$	0.80$_8$	2.28$_1$	0.12$_6$	0.39$_3$	0.22$_4$	0.65$_3$	0.85$_6$
	L_9	69.3$_2$	25.3$_9$	0.76$_6$	2.15$_5$	0.11$_2$	—	—	0.66$_0$	0.77$_0$
Average	$(\bar{\bar{X}})$	69.33$_4$	25.41$_1$	0.767$_9$	2.253$_7$	0.119$_3$	0.408$_0$	0.223$_1$	0.652$_8$	0.818$_7$
Standard (Reproducibility)	$s_{\bar{\bar{x}}}$	0.15$_1$	0.11$_6$	0.020$_9$	0.052$_5$	0.004$_8$	0.010$_2$	0.003$_9$	0.025$_0$	0.039$_6$
deviation (Reproducibility without laboratories)	$s_{I(T)}$ ＊1	0.12$_0$	0.03$_1$	0.016$_1$	0.016$_2$	0.002$_2$	0.006$_2$	0.004$_9$	0.013$_0$	0.007$_9$
Uncertainty C (95%) ＊2		0.1$_2$	0.0$_9$	0.01$_6$	0.04$_0$	0.00$_4$	0.00$_9$	0.00$_4$	0.01$_9$	0.03$_0$

(Note) ＊1 $s_{I(T)}$is intermediate precision without a time condition.　＊2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$　(ℓ = number of laboratories)

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ＪＲＲＭ　１０６　(Fireclay Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MnO	CaO	MgO	Na_2O	K_2O
Certified value		63.72	29.96	1.925	0.680	0.024	0.146	0.982	0.600	1.819
Laboratories	L_1	63.62	29.99	1.923	0.677	0.022	0.154	1.008	0.587	1.904
	L_2	63.83	29.90	1.978	0.678	0.030	0.160	0.944	0.565	1.806
	L_3	63.61	29.79	1.887	0.645	0.024	0.177	0.969	0.589	1.767
	L_4	63.75	29.77	1.914	0.683	0.024	0.132	1.019	0.591	1.809
	L_5	63.58	30.00	1.923	0.685	0.022	0.137	1.000	0.623	1.873
	L_6	63.85	30.17	1.965	0.695	0.016	0.140	0.906	0.613	1.853
	L_7	63.85	29.90	1.895	0.688	0.030	0.140	0.964	0.624	1.821
	L_8	63.70	30.16	1.916	0.692	0.022	0.124	1.046	0.609	1.721
Average	$(\bar{\bar{x}})$	63.724	29.960	1.9251	0.6804	0.0238	0.1455	0.9820	0.6001	1.8193
Standard deviation (Reproducibility)	$s_{\bar{x}}$	0.126	0.144	0.0312	0.0154	0.0045	0.0172	0.0452	0.0205	0.0581
(Reproducibility without laboratories)	$s_{I(T)}$ *1	0.116	0.089	0.0124	0.0119	0.0022	0.0204	0.0253	0.0161	0.0210
Uncertainty C (95%)	*2	0.11	0.12	0.026	0.013	0.004	0.014	0.038	0.017	0.049

(Note) ＊1　$s_{I(T)}$is intermediate precision without a time condition.　＊2　The half-width confidence interval $C(95\%) = t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$　(ℓ = number of laboratories)

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ＪＲＲＭ　１０７　(Fireclay Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MnO	CaO	MgO	Na_2O	K_2O
Certified value		55.4$_1$	37.1$_4$	2.20$_6$	1.15$_6$	0.01$_9$	0.71$_1$	0.49$_3$	0.21$_8$	2.57$_7$
Laboratories	L_1	55.4$_9$	37.0$_8$	2.21$_6$	1.16$_4$	0.01$_7$	0.72$_0$	0.51$_0$	0.23$_0$	2.69$_7$
	L_2	55.5$_4$	37.0$_2$	2.25$_2$	1.15$_1$	0.02$_0$	0.69$_5$	0.48$_2$	0.18$_9$	2.54$_6$
	L_3	55.2$_1$	37.1$_3$	2.17$_4$	1.16$_4$	0.02$_0$	0.71$_3$	0.48$_1$	0.23$_5$	2.44$_6$
	L_4	55.4$_9$	37.1$_7$	2.17$_0$	1.18$_1$	0.02$_6$	0.69$_9$	0.49$_0$	0.20$_5$	2.70$_4$
	L_5	55.3$_6$	37.1$_7$	2.25$_5$	1.17$_2$	0.01$_7$	0.70$_5$	0.50$_5$	0.21$_8$	2.78$_5$
	L_6	55.4$_3$	37.3$_4$	2.22$_4$	1.16$_6$	0.01$_6$	0.71$_5$	0.46$_0$	0.21$_6$	2.60$_5$
	L_7	55.5$_1$	37.2$_0$	2.14$_9$	1.12$_7$	0.02$_0$	0.68$_5$	0.50$_7$	0.23$_0$	2.33$_9$
	L_8	55.2$_2$	36.9$_9$	2.20$_4$	1.12$_6$	0.01$_6$	0.75$_6$	0.50$_7$	0.21$_8$	2.49$_3$
Average	$(\overline{\overline{X}})$	55.40$_6$	37.13$_8$	2.205$_5$	1.156$_4$	0.019$_0$	0.711$_0$	0.492$_8$	0.217$_6$	2.576$_9$
Standard deviation (Reproducibility)	$s_{\bar{x}}$	0.14$_1$	0.11$_2$	0.038$_4$	0.020$_3$	0.003$_5$	0.021$_4$	0.017$_5$	0.015$_1$	0.149$_5$
(Reproducibility without laboratories)	$s_{I(T)}$ * 1	0.11$_3$	0.06$_4$	0.034$_9$	0.016$_2$	0.001$_6$	0.013$_2$	0.009$_4$	0.011$_9$	0.012$_2$
Uncertainty C (95%)	*2	0.1$_2$	0.0$_9$	0.03$_2$	0.01$_7$	0.00$_3$	0.01$_8$	0.01$_5$	0.01$_3$	0.12$_5$

(Note) * 1 $s_{I(T)}$is intermediate precision without a time condition.　* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$　(ℓ = number of laboratories)

(1) List of laboratories : Krosaki Corporation, Kyushu Refractories Co.,Ltd., Kawasaki Refractories Co.,Ltd., The Industrial Technology Center of Okayama Prefecture, Asahi Glass Co.,Ltd., Harima Ceramic Co.,Ltd., Shinagawa Refractories Co.,Ltd., Toshiba Ceramics Co.,Ltd.

(2) Analytical techniques : JIS R 2212-1(Method for chemical analysis of refractory products — Part 1:Fireclay refractories)

(3) Analytical values : Each value is the average of two values obtained by two measurements on different days. These analysis values are shown converted into LOI (Loss on ignition) component free values from the February 22, 2008 v20080222 version on.

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

(5) Date of preparation : August, 1985

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The Technical Association of Refractories, Japan

Certified Reference Material Series for X-ray Fluorescence Analysis of Refractories

ＪＲＲＭ　１０８　(Fireclay Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MnO	CaO	MgO	Na_2O	K_2O
Certified value		55.38	40.14	1.549	1.055	0.020	0.277	0.270	0.207	0.810
Laboratories	L_1	55.31	39.96	1.556	1.076	0.020	0.288	0.278	0.211	0.807
	L_2	55.43	40.01	1.579	1.021	0.022	0.275	0.264	0.201	0.806
	L_3	55.31	40.29	1.531	1.001	0.022	0.295	0.276	0.214	0.829
	L_4	55.38	39.94	1.538	1.077	0.020	0.260	0.268	0.206	0.805
	L_5	55.29	40.09	1.552	1.074	0.020	0.284	0.272	0.214	0.813
	L_6	55.50	40.40	1.591	1.065	0.015	0.268	0.260	0.198	0.833
	L_7	55.28	40.13	1.508	1.087	0.024	0.266	0.269	0.212	0.799
	L_8	55.57	40.27	1.537	1.036	0.020	0.277	0.276	0.202	0.791
Average	$(\bar{\bar{X}})$	55.384	40.135	1.5490	1.0546	0.0204	0.2766	0.2704	0.2073	0.8104
Standard deviation (Reproducibility)	$s_{\bar{x}}$	0.104	0.163	0.0269	0.0313	0.0025	0.0118	0.0064	0.0065	0.0143
(Reproducibility without laboratories)	$s_{I(T)}$ * 1	0.177	0.064	0.0228	0.0267	0.0017	0.0048	0.0055	0.0076	0.0079
Uncertainty C (95%)	*2	0.09	0.14	0.022	0.026	0.002	0.010	0.005	0.005	0.012

(Note) * 1 $s_{I(T)}$is intermediate precision without a time condition.　* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$　(ℓ = number of laboratories)

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ＪＲＲＭ　１０９　(Fireclay Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MnO	CaO	MgO	Na_2O	K_2O
Certified value		54.30	41.30	0.893	1.964	0.011	0.146	0.126	0.307	0.794
Laboratories	L_1	54.39	41.14	0.952	1.983	0.011	0.144	0.131	0.308	0.787
	L_2	54.20	41.19	0.880	1.983	0.013	0.163	0.124	0.281	0.801
	L_3	54.26	41.22	0.909	1.944	0.013	0.174	0.130	0.316	0.791
	L_4	54.38	41.08	0.865	1.998	0.011	0.128	0.122	0.304	0.779
	L_5	54.24	41.36	0.873	2.029	0.013	0.156	0.132	0.309	0.799
	L_6	54.50	41.45	0.928	1.925	0.006	0.140	0.118	0.296	0.817
	L_7	54.18	41.32	0.865	1.937	0.012	0.147	0.125	0.328	0.789
	L_8	54.29	41.61	0.875	1.913	0.011	0.114	0.122	0.317	0.791
Average	$(\bar{x})$	54.305	41.296	0.8934	1.9640	0.0113	0.1458	0.1255	0.3074	0.7943
Standard deviation (Reproducibility)	$s_{\bar{x}}$	0.114	0.170	0.0325	0.0406	0.0023	0.0190	0.0051	0.0146	0.0116
(Reproducibility without laboratories)	$s_{I(T)}$ *1	0.150	0.080	0.0061	0.0340	0.0017	0.0055	0.0033	0.0066	0.0086
Uncertainty C (95%)	*2	0.10	0.14	0.027	0.034	0.002	0.016	0.004	0.012	0.010

(Note) ＊1　$s_{I(T)}$is intermediate precision without a time condition.　＊2　The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$　(ℓ = number of laboratories)

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ＪＲＲＭ　１１０　(Fireclay Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MnO	CaO	MgO	Na_2O	K_2O
Certified value		49.59	46.73	0.849	1.668	0.014	0.107	0.166	0.085	0.342
Laboratories	L_1	49.61	46.68	0.871	1.692	0.013	0.100	0.173	0.100	0.360
	L_2	49.46	46.84	0.793	1.723	0.019	0.120	0.162	0.072	0.312
	L_3	49.75	46.69	0.855	1.594	0.016	0.134	0.170	0.116	0.378
	L_4	49.61	46.51	0.843	1.700	0.018	0.094	0.164	0.088	0.332
	L_5	49.53	47.14	0.840	1.698	0.013	0.113	0.178	0.075	0.349
	L_6	49.79	46.76	0.876	1.652	0.010	0.101	0.154	0.065	0.341
	L_7	49.19	46.56	0.843	1.685	0.014	0.101	0.162	0.082	0.332
	L_8	49.79	46.64	0.870	1.598	0.012	0.095	0.167	0.080	0.331
Average	$(\bar{\bar{X}})$	49.591	46.728	0.8489	1.6678	0.0144	0.1073	0.1663	0.0848	0.3419
Standard deviation (Reproducibility)	$s_{\bar{x}}$	0.191	0.192	0.0263	0.0489	0.0029	0.0141	0.0072	0.0163	0.0204
(Reproducibility without laboratories)	$s_{I(T)}$ * 1	0.194	0.086	0.0117	0.0202	0.0009	0.0044	0.0052	0.0099	0.0159
Uncertainty C (95%)	*2	0.16	0.16	0.022	0.041	0.002	0.012	0.006	0.014	0.017

(Note) * 1 $s_{I(T)}$is intermediate precision without a time condition.　* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$　(ℓ = number of laboratories)

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