

The Technical Association of Refractories, Japan

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

J R R M 7 0 1 (Alumina-Zirconia-Silica Refractory)
Results of Analyses

Unit : mass%

Constituent	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	Na ₂ O	K ₂ O	Cr ₂ O ₃	ZrO ₂ (+HfO ₂)	HfO ₂	ZrO ₂ * ₃	Uncertified value		
													MnO	P ₂ O ₅	
Certified value	28.4 ₇	10.1 ₀	2.01 ₀	4.96 ₅	2.07 ₅	0.47 ₇	1.84 ₇	0.02 ₄	1.01 ₁	48.9 ₆	0.85 ₀	48.1 ₁	0.00 ₇	0.02 ₇	
Laboratories	L ₁	28.2 _{8 p}	10.1 _{6 e}	2.01 _{8 i}	4.96 _{8 i}	2.09 _{4 i}	0.45 _{6 i}	1.86 _{8 a}	0.03 _{1 a}	1.00 _{9 i}	48.6 _{0 m}	0.83 _{0 x}	—	0.00 _{8 i}	0.02 _{2 c}
	L ₂	28.4 _{4 p}	10.1 _{0 e}	2.03 _{4 c}	4.94 _{4 i}	2.05 _{4 i}	0.47 _{5 i}	1.84 _{2 f}	0.02 _{6 f}	0.98 _{9 i}	48.8 _{1 m}	0.83 _{7 i}	—	0.00 _{8 i}	0.03 _{7 c}
	L ₃	28.4 _{2 h}	10.3 ₀	1.98 _{0 c}	4.98 _{6 c}	2.08 _{1 a}	0.47 _{6 a}	1.84 _{2 a}	0.02 _{1 a}	0.99 _{2 a}	49.2 _{6 m}	0.82 _{7 x}	—	—	—
	L ₄	28.3 _{0 p}	10.0 _{2 e}	2.02 _{5 i}	4.96 _{1 i}	2.13 _{5 i}	0.50 _{5 i}	1.85 _{8 a}	0.02 _{6 a}	1.00 _{7 i}	49.1 _{5 m}	0.85 _{5 i}	—	0.00 _{9 i}	—
	L ₅	28.6 _{0 h}	10.0 _{9 e}	1.99 _{9 c}	4.95 _{3 c}	2.00 _{9 a}	0.48 _{3 a}	1.83 _{8 a}	0.01 _{9 a}	1.05 _{2 a}	48.9 _{3 m}	0.85 _{3 x}	—	0.00 _{4 a}	0.02 _{2 c}
	L ₆	28.5 _{3 h}	10.0 _{0 e}	2.02 _{8 c}	4.98 _{6 i}	2.09 _{1 i}	0.48 _{7 i}	1.86 _{2 a}	0.02 _{4 a}	1.01 _{1 i}	48.7 _{2 m}	0.87 _{0 i}	—	0.00 _{6 i}	0.03 _{0 c}
	L ₇	28.6 _{7 p}	10.0 _{9 e}	1.98 _{4 c}	4.94 _{1 x}	2.04 _{1 a}	0.44 _{6 a}	1.80 _{9 a}	0.02 _{0 a}	1.03 _{9 a}	49.0 _{0 g}	0.86 _{5 i}	—	—	—
	L ₈	28.5 _{0 p}	10.0 _{4 v}	2.00 _{8 c}	4.97 _{9 c}	2.09 _{4 a}	0.48 _{6 a}	1.86 _{0 a}	0.02 _{2 a}	0.98 _{8 a}	49.1 _{5 m}	0.86 _{6 x}	—	0.00 _{7 c}	0.02 _{2 c}
Average (\bar{X})	28.46 ₈	10.10 ₀	2.009 ₅	4.965 ₁	2.075 ₃	0.476 ₈	1.847 ₄	0.023 ₆	1.010 ₉	48.95 ₆	0.850 ₄	48.10 ₆	0.007 ₀	0.026 ₆	
Standard deviation	(Reproducibility) s_x	0.13 ₀	0.09 ₆	0.020 ₆	0.019 ₂	0.039 ₂	0.018 ₄	0.019 ₆	0.003 ₉	0.023 ₆	0.21 ₀	0.017 ₀	—	0.001 ₇	0.006 ₈
	(Reproducibility without laboratories) $s_{I(T)}$ * ₁	0.10 ₀	0.08 ₃	0.010 ₁	0.008 ₅	0.011 ₂	0.005 ₆	0.019 ₅	0.002 ₂	0.006 ₅	0.12 ₈	0.007 ₀	—	0.000 ₉	0.005 ₇
Uncertainty C (95%) * ₂	0.1 ₁	0.0 ₈	0.01 ₇	0.01 ₆	0.03 ₃	0.01 ₅	0.01 ₆	0.00 ₃	0.02 ₀	0.1 ₈	0.01 ₄	0.1 ₈ * ₄	0.00 ₂	0.00 ₈	

(Note) *₁ $s_{I(T)}$ is intermediate precision without a time condition.*₂ The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_x / \sqrt{\ell}$ (ℓ = number of laboratories)*₃ $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$ *₄ $s_{ZrO_2} = \sqrt{(s_{ZrO_2(HfO_2)})^2 + (s_{HfO_2})^2}$

- (1) List of laboratories : Krosaki Corporation, Kawasaki Refractories Co.,Ltd., Yotai Refractories Co.,Ltd., Asahi Glass Co.,Ltd., Harima Ceramic Co.,Ltd., Shinagawa Refractories Co.,Ltd., Toshiba Ceramics Co.,Ltd., Toshiba Monofrax Co.,Ltd.
- (2) Analytical techniques : JIS R 2013(Method for chemical analysis of refractory containing alumina, zirconia and silica) a:AAS, c:colorimetry, e:Ionexchange-chelatometry, f:flametry, g:Cupfron Gravimetry, h:dehydration+colorimetry, i:ICP-AES, m:Mandelic acid Gravimetry, p:coagulation+colorimetry, v:Cupfron Separation-chelatometry, x:XRF
- (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 : June, 1996

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

J R R M 7 0 2 (Alumina-Zirconia-Silica Refractory)
Results of Analyses

Unit : mass%

Constituent	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	Na ₂ O	K ₂ O	Cr ₂ O ₃	ZrO ₂ (+HfO ₂)	HfO ₂	ZrO ₂ *3	Uncertified value		
													MnO	P ₂ O ₅	
Certified value	10.0 _i	38.2 _i	0.37 ₄	0.21 _i	1.55 ₅	1.98 ₂	2.02 ₇	0.58 ₀	0.11 _i	44.7 _i	2.09 ₀	42.6 ₂	0.00 ₄	0.02 ₈	
Laboratories	L ₁	9.96 _{0 p}	38.3 _{1 e}	0.36 _{7 i}	0.20 _{4 i}	1.56 _{7 i}	1.99 _{3 i}	2.04 _{5 a}	0.58 _{1 a}	0.12 _{0 i}	44.7 _{2 m}	2.06 _{1 x}	—	0.00 _{4 i}	0.02 _{7 c}
	L ₂	9.96 _{7 p}	38.0 _{4 e}	0.37 _{5 c}	0.21 _{0 i}	1.53 _{6 i}	1.94 _{9 i}	2.03 _{5 f}	0.58 _{7 f}	0.11 _{4 i}	44.7 _{5 m}	2.07 _{0 i}	—	0.00 _{4 i}	0.03 _{0 c}
	L ₃	10.1 _{6 h}	38.2 ₅	0.37 _{7 c}	0.19 _{6 c}	1.58 _{2 a}	2.00 _{2 a}	1.99 _{9 a}	0.56 _{4 a}	0.10 _{8 a}	44.8 _{2 m}	2.06 _{9 x}	—	—	—
	L ₄	9.92 _{9 p}	38.1 _{4 v}	0.37 _{1 i}	0.20 _{5 i}	1.56 _{2 i}	1.99 _{7 i}	2.04 _{3 a}	0.60 _{1 a}	0.11 _{1 i}	44.7 _{5 m}	2.12 _{1 i}	—	0.00 _{4 i}	—
	L ₅	9.99 _{5 h}	38.2 _{9 e}	0.37 _{5 c}	0.19 _{8 c}	1.54 _{5 a}	1.98 _{9 a}	2.03 _{9 a}	0.54 _{9 a}	0.10 _{6 a}	44.6 _{2 m}	2.03 _{5 x}	—	0.00 _{2 a}	0.02 _{7 c}
	L ₆	9.99 _{2 h}	38.1 _{6 e}	0.36 _{9 c}	0.22 _{1 c}	1.55 _{9 i}	1.98 _{7 i}	2.01 _{3 a}	0.57 _{9 a}	0.10 _{4 n}	44.5 _{4 m}	2.11 _{8 i}	—	0.00 _{4 i}	0.02 _{9 c}
	L ₇	10.1 _{5 p}	38.3 _{8 e}	0.38 _{3 c}	0.23 _{1 c}	1.54 _{4 a}	1.98 _{3 i}	2.01 _{7 a}	0.59 _{1 a}	0.11 _{2 a}	44.7 _{9 g}	2.10 _{7 i}	—	—	—
	L ₈	9.94 _{6 p}	38.1 _{4 v}	0.37 ₉	0.22 _{0 c}	1.54 _{2 a}	1.95 _{9 a}	2.02 _{7 a}	0.58 _{5 a}	0.11 _{2 a}	44.7 _{0 m}	2.13 _{8 x}	—	0.00 _{5 a}	0.02 _{6 c}
Average (\bar{X})	10.01 ₂	38.21 ₄	0.374 ₅	0.210 ₆	1.554 ₆	1.982 ₄	2.027 ₃	0.579 ₆	0.110 ₉	44.71 ₁	2.089 ₉	42.62 ₁	0.003 ₈	0.027 ₈	
Standard deviation	(Reproducibility) $s_{\bar{x}}$	0.09 ₀	0.10 ₁	0.005 ₆	0.012 ₂	0.016 ₁	0.018 ₃	0.016 ₃	0.016 ₁	0.005 ₀	0.09 ₄	0.036 ₀	—	0.001 ₀	0.001 ₄
	(Reproducibility without laboratories) $s_{I(T)}$ *1	0.05 ₇	0.07 ₉	0.007 ₆	0.003 ₄	0.011 ₆	0.011 ₉	0.017 ₅	0.012 ₂	0.002 ₄	0.10 ₉	0.009 ₃	—	0.000 ₈	0.001 ₃
Uncertainty C (95%) *2	0.0 ₈	0.0 ₈	0.00 ₅	0.01 ₀	0.01 ₃	0.01 ₅	0.01 ₄	0.01 ₃	0.00 ₄	0.0 ₈	0.03 ₀	0.0 ₈ *4	0.00 ₁	0.00 ₂	

(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)* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$ * 4 $s_{\bar{x}_{ZrO_2}} = \sqrt{(s_{\bar{x}_{ZrO_2}(HfO_2)})^2 + (s_{\bar{x}_{HfO_2}})^2}$

- (1) List of laboratories : Krosaki Corporation, Kawasaki Refractories Co.,Ltd., Yotai Refractories Co.,Ltd., Asahi Glass Co.,Ltd., Harima Ceramic Co.,Ltd., Shinagawa Refractories Co.,Ltd., Toshiba Ceramics Co.,Ltd., Toshiba Monofrax Co.,Ltd.
- (2) Analytical techniques : JIS R 2013(Method for chemical analysis of refractory containing alumina, zirconia and silica) a:AAS, c:colorimetry, e:Ionexchange-chelatometry, f:flametry, g:Cupfron Gravimetry, h:dehydration+colorimetry, i:ICP-AES, m:Mandelic acid Gravimetry, p:coagulation+colorimetry, v:Cupfron Separation-chelatometry, x:XRF
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J R R M 7 0 3 (Alumina-Zirconia-Silica Refractory)
Results of Analyses

Unit : mass%

Constituent	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	Na ₂ O	K ₂ O	Cr ₂ O ₃	ZrO ₂ (+HfO ₂)	HfO ₂	ZrO ₂ * ₃	Uncertified value		
													MnO	P ₂ O ₅	
Certified value	14.6 ₆	46.3 ₉	0.05 ₉	0.07 ₂	0.03 ₇	0.01 ₁	0.53 ₅	0.00 ₂	0.00 ₆	38.1 ₂	0.72 ₈	37.3 ₉	0.00 ₀	0.03 ₅	
Laboratories	L ₁	14.5 _{1 p}	46.6 _{3 e}	0.05 _{8 i}	0.07 _{0 i}	0.03 _{6 i}	0.01 _{2 i}	0.52 _{2 a}	0.00 _{4 a}	0.01 _{0 i}	38.2 _{2 m}	0.71 _{9 x}	—	0.00 _{0 i}	0.03 _{7 c}
	L ₂	14.6 _{6 p}	46.2 _{8 e}	0.06 _{0 c}	0.07 _{3 c}	0.03 _{6 i}	0.00 _{8 i}	0.53 _{2 f}	0.00 _{0 f}	0.00 _{4 i}	37.9 _{1 m}	0.70 _{3 i}	—	0.00 _{0 i}	0.03 _{4 c}
	L ₃	14.7 _{7 h}	46.3 ₄	0.06 _{4 c}	0.08 _{1 c}	0.03 _{8 a}	0.01 _{4 a}	0.53 _{8 a}	0.00 _{2 a}	0.02 _{2 a}	38.3 _{0 m}	0.70 _{9 x}	—	—	—
	L ₄	14.5 _{5 p}	46.2 _{2 v}	0.05 _{6 i}	0.06 _{4 i}	0.04 _{1 i}	0.01 _{1 i}	0.55 _{9 a}	0.00 _{0 a}	0.00 _{0 i}	38.2 _{0 m}	0.74 _{3 i}	—	0.00 _{1 i}	—
	L ₅	14.5 _{5 h}	46.4 _{4 e}	0.06 _{0 c}	0.06 _{6 c}	0.03 _{5 a}	0.01 _{0 a}	0.54 _{6 a}	0.00 _{1 a}	0.00 _{2 a}	38.1 _{6 m}	0.71 _{3 x}	—	0.00 _{0 a}	0.03 _{2 c}
	L ₆	14.6 _{9 h}	46.2 _{5 e}	0.05 _{4 c}	0.07 _{2 c}	0.04 _{0 i}	0.01 _{1 i}	0.52 _{0 a}	0.00 _{6 a}	0.00 _{0 n}	38.0 _{3 m}	0.74 _{0 i}	—	0.00 _{0 i}	0.04 _{0 c}
	L ₇	14.8 _{8 p}	46.5 _{1 e}	0.05 _{5 c}	0.08 _{3 c}	0.03 _{4 a}	0.01 _{0 i}	0.53 _{0 a}	0.00 _{4 a}	0.00 _{4 a}	38.0 _{0 g}	0.74 _{2 i}	—	—	—
	L ₈	14.6 _{1 p}	46.4 _{4 v}	0.06 _{2 c}	0.06 _{7 c}	0.03 _{8 a}	0.01 _{4 a}	0.53 _{5 a}	0.00 _{2 a}	0.00 _{4 a}	38.1 _{0 m}	0.75 _{3 x}	—	0.00 _{0 a}	0.03 _{0 c}
Average (\bar{X})	14.66 ₀	46.38 ₉	0.058 ₆	0.072 ₀	0.037 ₃	0.011 ₃	0.535 ₃	0.002 ₄	0.005 ₈	38.11 ₅	0.727 ₈	37.38 ₇	0.000 ₂	0.034 ₆	
Standard deviation	(Reproducibility) s_x	0.12 ₁	0.14 ₃	0.003 ₄	0.006 ₇	0.002 ₅	0.002 ₀	0.012 ₂	0.002 ₁	0.008 ₁	0.13 ₁	0.018 ₈	—	0.000 ₉	0.004 ₁
	(Reproducibility without laboratories) $s_{I(T)}$ * ₁	0.08 ₇	0.07 ₆	0.001 ₉	0.003 ₀	0.005 ₂	0.001 ₃	0.005 ₀	0.001 ₉	0.004 ₀	0.08 ₆	0.006 ₂	—	0.000 ₃	0.001 ₁
Uncertainty C (95%) * ₂	0.1 ₀	0.1 ₂	0.00 ₃	0.00 ₆	0.00 ₂	0.00 ₂	0.01 ₀	0.00 ₂	0.00 ₇	0.1 ₁	0.01 ₆	0.1 ₁ * ₄	0.00 ₁	0.00 ₅	

(Note) *₁ $s_{I(T)}$ is intermediate precision without a time condition.*₂ The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_x / \sqrt{\ell}$ (ℓ = number of laboratories)*₃ $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$ *₄ $s_{ZrO_2} = \sqrt{(s_{ZrO_2(+HfO_2)})^2 + (s_{HfO_2})^2}$

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J R R M 7 0 4 (Alumina-Zirconia-Silica Refractory)
Results of Analyses

Unit : mass%

Constituent	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	Na ₂ O	K ₂ O	Cr ₂ O ₃	ZrO ₂ (+HfO ₂)	HfO ₂	ZrO ₂ *3	Uncertified value		
													MnO	P ₂ O ₅	
Certified value	42.6 ₄	19.5 ₉	0.55 ₄	1.02 ₆	0.15 ₅	0.51 ₅	0.22 ₈	0.40 ₂	0.51 ₈	34.1 ₆	0.68 ₅	33.4 ₈	0.08 ₉	0.13 ₀	
Laboratories	L ₁	42.4 _{2 p}	19.7 _{1 e}	0.55 _{0 i}	1.03 _{2 i}	0.14 _{8 i}	0.49 _{4 i}	0.22 _{2 a}	0.40 _{0 a}	0.50 _{3 i}	34.2 _{9 m}	0.67 _{0 x}	—	0.09 _{2 i}	0.13 _{8 c}
	L ₂	42.7 _{4 p}	19.5 _{0 e}	0.55 _{2 c}	1.01 _{1 i}	0.14 _{9 i}	0.51 _{3 i}	0.23 _{4 f}	0.40 _{2 f}	0.51 _{1 i}	34.0 _{9 m}	0.68 _{9 i}	—	0.09 _{4 i}	0.11 _{4 c}
	L ₃	42.7 _{2 h}	19.5 ₇	0.55 _{3 c}	1.03 _{0 c}	0.16 _{4 a}	0.51 _{6 a}	0.22 _{9 a}	0.39 _{2 a}	0.51 _{1 a}	34.3 _{2 m}	0.65 _{9 x}	—	—	—
	L ₄	42.4 _{8 p}	19.5 _{7 e}	0.54 _{1 i}	1.03 _{3 i}	0.16 _{2 i}	0.53 _{5 i}	0.24 _{4 a}	0.40 _{4 a}	0.50 _{8 i}	34.1 _{7 m}	0.69 _{3 i}	—	0.09 _{9 i}	—
	L ₅	42.7 _{3 h}	19.5 _{0 e}	0.55 _{9 c}	1.03 _{1 c}	0.15 _{2 a}	0.51 _{2 a}	0.21 _{0 a}	0.40 _{2 a}	0.54 _{1 a}	34.1 _{6 m}	0.69 _{7 x}	—	0.05 _{8 a}	0.11 _{2 c}
	L ₆	42.6 _{9 h}	19.5 _{3 e}	0.56 _{0 c}	1.03 _{4 i}	0.15 _{8 i}	0.51 _{0 i}	0.22 _{6 a}	0.40 _{2 a}	0.51 _{8 i}	34.1 _{2 m}	0.68 _{8 i}	—	0.09 _{4 i}	0.17 _{2 c}
	L ₇	42.7 _{0 p}	19.7 _{2 e}	0.56 _{5 c}	1.01 _{7 x}	0.15 _{2 a}	0.51 _{2 i}	0.23 _{6 a}	0.41 _{0 a}	0.53 _{2 a}	34.1 _{0 g}	0.69 _{3 i}	—	—	—
	L ₈	42.6 _{3 p}	19.6 _{5 v}	0.55 _{0 c}	1.02 _{0 c}	0.15 _{4 a}	0.52 _{8 a}	0.22 _{4 a}	0.40 _{0 a}	0.51 _{8 a}	34.0 _{6 m}	0.69 _{0 x}	—	0.09 _{6 a}	0.11 _{6 c}
Average (\bar{X})	42.64 ₁	19.59 ₄	0.553 ₈	1.026 ₀	0.154 ₉	0.515 ₀	0.228 ₁	0.402 ₀	0.517 ₈	34.16 ₄	0.684 ₉	33.47 ₉	0.088 ₈	0.130 ₄	
Standard deviation	(Reproducibility) $s_{\bar{x}}$	0.11 ₈	0.09 ₁	0.007 ₆	0.008 ₆	0.006 ₁	0.011 ₈	0.010 ₂	0.004 ₉	0.012 ₆	0.09 ₈	0.014 ₀	—	0.015 ₂	0.025 ₉
	(Reproducibility without laboratories) $s_{I(T)}$ *1	0.08 ₆	0.10 ₂	0.006 ₄	0.007 ₁	0.004 ₀	0.004 ₃	0.005 ₄	0.005 ₈	0.008 ₃	0.10 ₇	0.006 ₇	—	0.001 ₈	0.003 ₂
Uncertainty C (95%) **2	0.1 ₀	0.0 ₇	0.00 ₆	0.00 ₇	0.00 ₅	0.01 ₀	0.00 ₈	0.004 ₀	0.01 ₀	0.0 ₈	0.01 ₁	0.0 ₈ *4	0.01 ₂	0.02 ₁	

(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)* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$ * 4 $s_{\bar{x}_{ZrO_2}} = \sqrt{(s_{\bar{x}_{ZrO_2}(HfO_2)})^2 + (s_{\bar{x}_{HfO_2}})^2}$

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- (5) Date of preparation : June, 1996

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The Technical Association of Refractories, Japan

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

J R R M 7 0 5 (Alumina-Zirconia-Silica Refractory)
Results of Analyses

Unit : mass%

Constituent	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	Na ₂ O	K ₂ O	Cr ₂ O ₃	ZrO ₂ (+HfO ₂)	HfO ₂	ZrO ₂ * ³	Uncertified value	
													MnO	P ₂ O ₅
Certified value	2.00 ₂	64.2 ₄	0.14 ₁	2.02 ₄	0.19 ₁	0.46 ₁	0.30 ₁	0.01 ₈	2.02 ₂	28.5 ₀	0.48 ₅	28.0 ₁	0.00 ₄	0.01 ₇
Laboratories														
L ₁	2.00 _{4 c}	64.2 _{5 e}	0.13 _{1 i}	2.04 _{9i}	0.19 _{4 i}	0.45 _{5 i}	0.28 _{0 a}	0.01 _{9 a}	2.02 _{6 i}	28.3 _{5 m}	0.47 _{9 x}	—	0.00 _{4 i}	0.04 _{0 e}
L ₂	1.97 _{4 c}	64.1 _{3 e}	0.14 _{0 c}	2.02 _{9 i}	0.18 _{0 i}	0.46 _{9 i}	0.30 _{0 f}	0.01 _{8 f}	2.01 _{9 i}	28.5 _{4 m}	0.48 _{7 i}	—	0.00 _{5 i}	0.01 _{1 c}
L ₃	2.01 _{1 h}	64.0 ₅	0.14 _{4 c}	2.03 _{5 c}	0.20 _{8 a}	0.46 _{1 a}	0.32 _{6 a}	0.02 _{3 a}	1.99 _{6 a}	28.6 _{6 m}	0.47 _{2 x}	—	—	—
L ₄	1.93 _{7 p}	64.1 _{5 e}	0.14 _{3 i}	2.04 _{8 i}	0.19 _{8 i}	0.48 _{3 i}	0.30 _{3 a}	0.01 _{9 a}	2.03 _{4 i}	28.7 _{3 m}	0.50 _{4 i}	—	0.00 _{6 i}	—
L ₅	2.08 _{5 c}	64.3 _{2 e}	0.13 _{9 c}	1.97 _{0 c}	0.18 _{2 a}	0.45 _{7 a}	0.28 _{9 a}	0.01 _{8 a}	2.02 _{9 a}	28.4 _{0 m}	0.47 _{1 x}	—	0.00 _{0 a}	0.01 _{1 c}
L ₆	2.06 _{6 c}	64.4 _{2 e}	0.13 _{1 c}	2.04 _{8 i}	0.19 _{8 i}	0.46 _{7 i}	0.29 _{9 a}	0.01 _{4 a}	2.01 _{6 i}	28.4 _{1 m}	0.48 _{3 i}	—	0.00 _{4 i}	0.01 _{2 c}
L ₇	2.01 _{0 c}	64.4 _{9 e}	0.15 _{0 c}	1.99 _{4 x}	0.18 _{4 a}	0.45 _{4 a}	0.31 _{3 a}	0.01 _{8 a}	2.03 _{7 a}	28.5 _{1 m}	0.48 _{7 i}	—	—	—
L ₈	1.93 _{1 c}	64.1 _{2 v}	0.15 _{2 c}	2.02 _{0 c}	0.18 _{6 a}	0.44 _{1 a}	0.29 _{6 a}	0.01 _{8 a}	2.02 _{1 a}	28.3 _{7 m}	0.49 _{5 x}	—	0.00 _{6 a}	0.01 _{2 c}
Average (\bar{X})	2.002 ₃	64.24 ₁	0.141 ₃	2.024 ₁	0.191 ₃	0.460 ₉	0.300 ₈	0.018 ₄	2.022 ₃	28.49 ₆	0.484 ₈	28.01 ₁	0.004 ₂	0.017 ₂
Standard deviation (Reproducibility) s_x	0.054 ₆	0.13 ₇	0.007 ₈	0.028 ₈	0.009 ₇	0.012 ₃	0.014 ₀	0.002 ₄	0.012 ₆	0.14 ₄	0.011 ₂	—	0.002 ₀	0.012 ₅
Standard deviation (Reproducibility without laboratories) $s_{I(T)}$ * ¹	0.061 ₆	0.11 ₄	0.003 ₀	0.008 ₀	0.002 ₄	0.006 ₆	0.005 ₃	0.001 ₇	0.010 ₈	0.08 ₃	0.004 ₂	—	0.000 ₈	0.001 ₂
Uncertainty C (95%) * ²	0.04 ₆	0.1 ₁	0.00 ₇	0.02 ₄	0.00 ₈	0.01 ₀	0.01 ₂	0.00 ₂	0.01 ₁	0.1 ₂	0.00 ₉	0.12 * ⁴	0.00 ₂	0.01 ₆

(Note) * 1 $s_{I(T)}$ is intermediate precision without a time condition.* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_x / \sqrt{\ell}$ (ℓ = number of laboratories)* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$ * 4 $s_{ZrO_2} = \sqrt{(s_{ZrO_2(+HfO_2)})^2 + (s_{HfO_2})^2}$

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

J R R M 7 0 6 (Alumina-Zirconia-Silica Refractory)
Results of Analyses

Unit : mass%

Constituent	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	Na ₂ O	K ₂ O	Cr ₂ O ₃	ZrO ₂ (+HfO ₂)	HfO ₂	ZrO ₂ *3	Uncertified value		
													MnO	P ₂ O ₅	
Certified value	39.6 ₂	26.1 ₄	0.13 ₁	3.80 ₆	1.59 ₉	0.15 ₉	3.52 ₁	0.95 ₉	0.01 ₀	24.0 ₉	1.19 ₉	22.8 ₉	0.00 ₄	0.01 ₆	
Laboratories	L ₁	39.6 _{3 p}	26.1 _{5 e}	0.13 _{1 i}	3.77 _{6 i}	1.61 _{6 i}	0.16 _{5 i}	3.51 _{6 a}	0.97 _{1 a}	0.01 _{0 i}	24.1 _{2 m}	1.19 _{7 x}	—	0.00 _{6 i}	0.01 _{7 c}
	L ₂	39.6 _{3 p}	26.0 _{9 e}	0.13 _{5 c}	3.81 _{9 x}	1.59 _{2 i}	0.15 _{8 i}	3.56 _{8 f}	0.96 _{9 f}	0.01 _{1 i}	24.0 _{4 m}	1.13 _{4 i}	—	0.00 _{4 i}	0.01 _{6 c}
	L ₃	39.6 _{5 p}	26.1 _{6 e}	0.12 _{9 c}	3.78 _{9 i}	1.61 _{7 i}	0.16 _{1 i}	3.49 _{8 a}	0.97 _{2 a}	0.00 _{8 i}	24.0 _{7 m}	1.19 _{1 i}	—	0.00 _{6 i}	0.01 _{4 c}
	L ₄	39.5 _{9 h}	26.2 ₅	0.13 _{0 c}	3.82 _{2 x}	1.58 _{8 a}	0.14 _{6 a}	3.51 _{4 a}	0.96 _{3 a}	0.00 _{8 a}	24.0 _{0 m}	1.18 _{3 x}	—	—	—
	L ₅	39.5 _{7 p}	26.1 _{0 e}	0.13 _{1 i}	3.81 _{9 i}	1.59 _{0 i}	0.15 _{9 i}	3.54 _{5 a}	0.95 _{7 a}	0.01 _{2 i}	24.0 _{2 m}	1.20 _{8 i}	—	0.00 _{5 i}	—
	L ₆	39.6 _{1 h}	26.0 _{6 e}	0.13 _{0 c}	3.78 _{9 x}	1.59 _{5 a}	0.16 _{1 a}	3.49 _{9 a}	0.95 _{1 a}	0.01 _{0 a}	24.0 _{8 m}	1.23 _{3 x}	—	0.00 _{2 a}	0.01 _{7 c}
	L ₇	39.6 _{3 h}	26.2 _{0 e}	0.12 _{9 c}	3.82 _{6 c}	1.61 _{1 i}	0.16 _{6 i}	3.50 _{5 a}	0.94 _{3 a}	0.00 _{8 n}	24.1 _{2 m}	1.21 _{2 i}	—	0.00 _{1 i}	0.01 _{8 c}
	L ₈	39.6 _{1 p}	26.1 _{3 e}	0.13 _{3 c}	3.80 _{9 x}	1.58 _{2 a}	0.15 _{8 a}	3.52 _{6 a}	0.94 _{3 a}	0.00 _{9 a}	24.2 _{4 m}	1.23 _{5 x}	—	0.00 _{3 a}	0.01 _{1 c}
Average (\bar{X})	39.61 ₅	26.14 ₃	0.131 ₀	3.806 ₁	1.598 ₉	0.159 ₃	3.521 ₄	0.958 ₈	0.009 ₅	24.08 ₆	1.199 ₁	22.88 ₇	0.003 ₉	0.015 ₅	
Standard deviation	(Reproducibility) s_x	0.03 ₀	0.06 ₄	0.002 ₀	0.019 ₂	0.013 ₀	0.006 ₂	0.024 ₃	0.011 ₇	0.001 ₅	0.07 ₉	0.032 ₁	—	0.002 ₀	0.002 ₅
	(Reproducibility without laboratories) $s_{I(T)}$ *1	0.08 ₄	0.07 ₃	0.001 ₇	0.010 ₉	0.008 ₂	0.004 ₀	0.016 ₈	0.004 ₄	0.001 ₅	0.06 ₅	0.012 ₈	—	0.000 ₅	0.001 ₆
Uncertainty C (95%) *2	0.0 ₃	0.0 ₅	0.00 ₂	0.01 ₆	0.01 ₁	0.00 ₅	0.02 ₀	0.01 ₀	0.00 ₁	0.0 ₇	0.02 ₇	0.0 ₇ *4	0.00 ₂	0.00 ₃	

(Note) * 1 $s_{I(T)}$ is intermediate precision without a time condition.* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_x / \sqrt{\ell}$ (ℓ = number of laboratories)* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$ * 4 $s_{z_{ZrO_2}} = \sqrt{(s_{z_{ZrO_2}(HfO_2)})^2 + (s_{z_{HfO_2}})^2}$

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J R R M 7 0 7 (Alumina-Zirconia-Silica Refractory)
Results of Analyses

Unit : mass%

Constituent	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	Na ₂ O	K ₂ O	Cr ₂ O ₃	ZrO ₂ (+HfO ₂)	HfO ₂	ZrO ₂ * ³	Uncertified value		
													MnO	P ₂ O ₅	
Certified value	21.1 ₇	55.7 ₈	1.81 ₅	0.28 ₉	1.08 ₈	0.84 ₄	0.19 ₉	0.15 ₅	0.18 ₀	18.5 ₃	0.36 ₇	18.1 ₆	0.00 ₃	0.05 ₅	
Laboratories	L ₁	21.1 _{6 p}	55.6 _{9 e}	1.83 _{2 i}	0.28 _{5 i}	1.09 _{4 i}	0.84 _{8 i}	0.20 _{2 a}	0.15 _{4 a}	0.18 _{3 i}	18.5 _{2 m}	0.36 _{3 x}	—	0.00 _{5 i}	0.05 _{2 c}
	L ₂	21.2 _{0 p}	55.7 _{0 e}	1.81 _{2 c}	0.28 _{5 i}	1.08 _{3 i}	0.84 _{5 i}	0.19 _{3 f}	0.15 _{9 f}	0.17 _{6 i}	18.4 _{4 m}	0.37 _{8 i}	—	0.00 _{4 i}	0.05 _{5 c}
	L ₃	21.0 _{4 p}	55.8 _{3 e}	1.80 _{8 c}	0.29 _{2 i}	1.09 _{2 i}	0.84 _{1 i}	0.20 _{4 a}	0.15 _{0 a}	0.17 _{9 i}	18.4 _{5 m}	0.37 _{2 i}	—	0.00 _{4 i}	0.05 _{5 c}
	L ₄	21.2 _{5 h}	55.7 ₉	1.80 _{7 c}	0.29 _{0 c}	1.08 _{2 a}	0.84 _{8 a}	0.20 _{8 a}	0.15 _{4 a}	0.17 _{8 a}	18.7 _{3 m}	0.34 _{9 x}	—	—	—
	L ₅	21.1 _{9 p}	55.7 _{5 e}	1.82 _{0 i}	0.29 _{0 i}	1.07 _{8 i}	0.84 _{6 i}	0.20 _{6 a}	0.15 _{6 a}	0.17 _{4 i}	18.4 _{7 m}	0.37 _{3 i}	—	0.00 _{4 i}	—
	L ₆	21.2 _{7 h}	55.8 _{5 e}	1.82 _{0 c}	0.29 _{1 c}	1.08 _{4 a}	0.84 _{4 a}	0.20 _{3 a}	0.15 _{2 a}	0.18 _{2 a}	18.4 _{6 m}	0.35 _{4 x}	—	0.00 _{2 a}	0.05 _{6 c}
	L ₇	21.0 _{2 h}	55.8 _{9 e}	1.82 _{6 c}	0.29 _{4 c}	1.09 _{2 i}	0.84 _{1 i}	0.17 _{7 a}	0.15 _{3 a}	0.18 _{2 i}	18.4 _{8 m}	0.37 _{6 i}	—	0.00 _{1 i}	0.05 _{6 c}
	L ₈	21.2 _{2 p}	55.7 _{7 e}	1.79 _{4 c}	0.28 ₂	1.08 _{0 a}	0.84 _{2 a}	0.20 _{0 a}	0.16 _{0 a}	0.18 _{4 a}	18.6 _{6 m}	0.37 _{4 x}	—	0.00 _{2 a}	0.05 _{3 c}
Average (\bar{X})	21.16 ₉	55.78 ₄	1.814 ₉	0.288 ₆	1.085 ₆	0.844 ₄	0.199 ₁	0.154 ₈	0.179 ₈	18.52 ₆	0.367 ₄	18.15 ₉	0.003 ₁	0.055 ₀	
Standard deviation	(Reproducibility) $s_{\bar{x}}$	0.09 ₃	0.07 ₄	0.012 ₂	0.004 ₂	0.006 ₄	0.002 ₉	0.009 ₉	0.003 ₃	0.003 ₅	0.10 ₈	0.011 ₀	—	0.001 ₆	0.002 ₃
	(Reproducibility without laboratories) $s_{I(T)}$ * ¹	0.04 ₃	0.12 ₄	0.007 ₈	0.002 ₃	0.006 ₄	0.007 ₁	0.002 ₅	0.004 ₄	0.002 ₇	0.07 ₄	0.005 ₁	—	0.001 ₂	0.001 ₂
Uncertainty C (95%) * ²	0.0 ₈	0.0 ₆	0.01 ₀	0.00 ₄	0.00 ₅	0.00 ₂	0.00 ₈	0.00 ₃	0.00 ₃	0.0 ₉	0.00 ₉	0.0 ₉ * ⁴	0.00 ₂	0.00 ₂	

(Note) * 1 $s_{I(T)}$ is intermediate precision without a time condition.* 2 The half-width confidence interval C (95%) = $t_{\nu-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$ (ℓ = number of laboratories)* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$ * 4 $s_{ZrO_2} = \sqrt{(s_{ZrO_2(+HfO_2)})^2 + (s_{HfO_2})^2}$

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J R R M 7 0 8 (Alumina-Zirconia-Silica Refractory)
Results of Analyses

Unit : mass%

Constituent	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	Na ₂ O	K ₂ O	Cr ₂ O ₃	ZrO ₂ (+HfO ₂)	HfO ₂	ZrO ₂ *3	Uncertified value		
													MnO	P ₂ O ₅	
Certified value	0.54 ₇	79.6 ₃	0.80 ₁	1.02 ₁	1.17 ₄	1.64 ₉	0.08 ₉	0.74 ₆	0.29 ₈	13.8 ₉	1.03 ₄	12.8 ₆	0.00 ₁	0.00 ₂	
Laboratories	L ₁	0.54 _{7 c}	79.5 _{0 e}	0.80 _{5 i}	1.00 _{1 i}	1.18 _{2 i}	1.66 _{4 i}	0.07 _{4 a}	0.72 _{3 a}	0.29 _{8 i}	13.9 _{1 m}	1.01 _{9 x}	—	0.00 _{2 i}	0.00 _{2 c}
	L ₂	0.56 _{3 c}	79.7 _{2 e}	0.80 _{6 c}	1.03 _{5 x}	1.18 _{3 i}	1.66 _{4 i}	0.09 _{4 f}	0.75 _{1 f}	0.29 _{4 i}	13.9 _{6 m}	1.06 _{5 i}	—	0.00 _{1 i}	0.00 _{2 c}
	L ₃	0.54 _{3 c}	79.6 _{7 e}	0.80 _{1 c}	1.01 _{4 i}	1.18 _{5 i}	1.65 _{4 i}	0.08 _{7 a}	0.75 _{5 a}	0.29 _{9 i}	13.9 _{1 m}	1.03 _{2 i}	—	0.00 _{1 i}	0.00 _{3 c}
	L ₄	0.55 ₇	79.7 ₄	0.80 _{1 c}	1.03 _{8 x}	1.16 _{2 a}	1.64 _{4 a}	0.09 _{2 a}	0.75 _{1 a}	0.29 _{8 a}	13.8 _{0 m}	1.01 _{6 x}	—	—	—
	L ₅	0.55 _{9 c}	79.4 _{8 e}	0.79 _{1 i}	1.00 _{9 i}	1.15 _{4 i}	1.64 _{7 i}	0.09 _{6 a}	0.77 _{9 a}	0.29 _{7 i}	13.8 _{2 m}	1.03 _{9 i}	—	0.00 _{1 i}	—
	L ₆	0.54 _{7 c}	79.6 _{7 e}	0.79 _{7 c}	1.02 _{5 x}	1.18 _{3 a}	1.64 _{2 a}	0.09 _{1 a}	0.74 _{3 a}	0.29 _{9 a}	13.8 _{7 m}	1.01 _{9 x}	—	0.00 _{0 a}	0.00 _{2 c}
	L ₇	0.52 _{3 c}	79.6 _{1 e}	0.80 _{7 c}	1.03 _{1 i}	1.18 _{6 i}	1.64 _{0 i}	0.08 _{5 a}	0.74 _{3 a}	0.29 _{5 i}	13.9 _{6 m}	1.01 _{6 i}	—	0.00 _{0 i}	0.00 _{2 c}
	L ₈	0.53 _{6 c}	79.6 _{7 e}	0.80 _{1 c}	1.01 _{5 x}	1.15 _{1 a}	1.63 _{4 a}	0.09 _{0 a}	0.72 _{4 a}	0.30 _{0 a}	13.8 _{9 m}	1.06 _{8 x}	—	0.00 _{0 a}	0.00 _{0 c}
Average (\bar{X})	0.546 ₉	79.63 ₃	0.801 ₁	1.021 ₀	1.173 ₉	1.648 ₆	0.088 ₆	0.746 ₅	0.297 ₅	13.89 ₀	1.034 ₃	12.85 ₆	0.000 ₇	0.001 ₈	
Standard deviation	(Reproducibility) s_x	0.013 ₀	0.10 ₅	0.005 ₃	0.013 ₂	0.015 ₄	0.010 ₉	0.006 ₇	0.018 ₀	0.002 ₁	0.05 ₉	0.021 ₅	—	0.000 ₇	0.000 ₈
	(Reproducibility without laboratories) $s_{I(T)}$ *1	0.007 ₃	0.07 ₈	0.004 ₈	0.005 ₉	0.004 ₇	0.007 ₉	0.001 ₈	0.002 ₄	0.002 ₈	0.07 ₄	0.012 ₃	—	0.000 ₇	0.001 ₀
Uncertainty C (95%) *2	0.01 ₁	0.0 ₉	0.00 ₄	0.01 ₁	0.01 ₃	0.00 ₉	0.00 ₆	0.01 ₅	0.00 ₂	0.0 ₈	0.01 ₈	0.0 ₅ *4	0.00 ₁	0.00 ₁	

(Note) * 1 $s_{I(T)}$ is intermediate precision without a time condition.* 2 The half-width confidence interval C (95%) = $t_{\nu-1,0.05} \times s_x / \sqrt{\ell}$ (ℓ = number of laboratories)* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$ * 4 $s_{x-ZrO_2} = \sqrt{(s_{x-ZrO_2(HfO_2)})^2 + (s_{x-HfO_2})^2}$

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The Technical Association of Refractories, Japan

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

J R R M 7 0 9 (Alumina-Zirconia-Silica Refractory)
Results of Analyses

Unit : mass%

Constituent	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	Na ₂ O	K ₂ O	Cr ₂ O ₃	ZrO ₂ (+HfO ₂)	HfO ₂	ZrO ₂ *3	Uncertified value		
													MnO	P ₂ O ₅	
Certified value	34.4 ₅	50.4 ₅	0.47 ₇	0.09 ₁	0.52 ₅	1.21 ₀	1.04 ₀	0.21 ₆	2.92 ₂	8.52 ₃	0.18 ₄	8.34 ₀	0.00 ₂	0.00 ₉	
Laboratories	L ₁	34.5 _{6 p}	50.2 _{7 e}	0.47 _{2 i}	0.08 _{8 i}	0.52 _{6 i}	1.21 _{1 i}	1.01 _{6 a}	0.21 _{4 a}	2.93 _{3 i}	8.61 _{5 m}	0.17 _{6 x}	—	0.00 _{4 i}	0.01 _{0 c}
	L ₂	34.4 _{2 p}	50.4 _{3 e}	0.48 _{2 c}	0.08 _{8 i}	0.53 _{4 i}	1.20 _{9 i}	1.05 _{8 f}	0.21 _{8 f}	2.88 _{6 i}	8.50 _{8 m}	0.20 _{0 i}	—	0.00 _{2 i}	0.01 _{0 c}
	L ₃	34.4 _{8 p}	50.4 _{8 e}	0.47 _{4 c}	0.09 _{2 i}	0.52 _{4 i}	1.21 _{3 i}	1.04 _{0 a}	0.22 _{1 a}	2.93 _{9 i}	8.57 _{8 m}	0.19 _{0 i}	—	0.00 _{4 i}	0.00 _{8 c}
	L ₄	34.5 _{5 h}	50.5 ₀	0.47 _{3 c}	0.09 _{2 c}	0.51 _{9 a}	1.21 _{0 a}	1.03 _{6 a}	0.22 _{4 a}	2.94 _{3 a}	8.52 _{5 m}	0.15 _{8 x}	—	—	—
	L ₅	34.3 _{6 p}	50.4 _{3 e}	0.47 _{9 i}	0.09 _{7 i}	0.51 _{7 i}	1.20 _{9 i}	1.03 _{4 a}	0.21 _{4 a}	2.93 _{9 i}	8.51 _{2 m}	0.19 _{0 i}	—	0.00 _{4 i}	—
	L ₆	34.4 _{1 h}	50.4 _{8 e}	0.47 _{9 c}	0.09 _{2 c}	0.52 _{6 a}	1.20 _{3 a}	1.04 _{8 a}	0.21 _{8 a}	2.92 _{8 a}	8.52 _{5 m}	0.17 _{9 x}	—	0.00 _{1 a}	0.01 _{0 c}
	L ₇	34.3 _{9 h}	50.5 _{4 e}	0.47 _{7 c}	0.09 _{1 c}	0.51 _{5 i}	1.21 _{1 i}	1.03 _{4 a}	0.21 _{2 a}	2.91 _{4 i}	8.36 _{5 i}	0.19 _{3 i}	—	0.00 _{0 i}	0.01 _{0 c}
	L ₈	34.4 _{5 p}	50.4 _{7 e}	0.47 _{9 c}	0.08 _{8 c}	0.53 _{9 a}	1.21 _{8 a}	1.05 _{4 a}	0.20 _{9 a}	2.89 _{6 a}	8.55 _{8 m}	0.18 _{2 x}	—	0.00 _{2 a}	0.00 _{4 c}
Average (\bar{X})	34.45 ₃	50.45 ₀	0.476 ₉	0.091 ₀	0.525 ₁	1.210 ₅	1.040 ₀	0.216 ₃	2.922 ₃	8.523 ₃	0.183 ₅	8.339 ₈	0.002 ₄	0.008 ₇	
Standard deviation	(Reproducibility) s_x	0.07 ₀	0.08 ₃	0.003 ₆	0.003 ₁	0.008 ₅	0.004 ₀	0.013 ₅	0.004 ₈	0.021 ₀	0.012 ₆	—	0.001 ₁	0.002 ₅	
	(Reproducibility without laboratories) $s_{I(T)}$ *1	0.05 ₀	0.11 ₉	0.003 ₀	0.001 ₈	0.003 ₈	0.010 ₀	0.012 ₄	0.006 ₉	0.019 ₇	0.007 ₆	0.003 ₅	—	0.001 ₆	0.001 ₈
Uncertainty C (95%) *2	0.0 ₆	0.0 ₇	0.00 ₃	0.00 ₃	0.00 ₇	0.00 ₃	0.01 ₁	0.00 ₄	0.01 ₈	0.06 ₀	0.01 ₁	0.06 ₁ *4	0.00 ₁	0.00 ₃	

(Note) * 1 $s_{I(T)}$ is intermediate precision without a time condition.* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_x / \sqrt{\ell}$ (ℓ = number of laboratories)* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$ * 4 $s_{x_{ZrO_2}} = \sqrt{(s_{x_{ZrO_2}(HfO_2)}}^2 + (s_{x_{HfO_2}})^2}$

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J R R M 7 1 0 (Alumina-Zirconia-Silica Refractory)
Results of Analyses

Unit : mass%

Constituent	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	Na ₂ O	K ₂ O	Cr ₂ O ₃	ZrO ₂ (+HfO ₂)	HfO ₂	ZrO ₂ * ³	Uncertified value		
													MnO	P ₂ O ₅	
Certified value	5.62 ₉	82.3 ₆	1.15 ₁	3.00 ₅	0.22 ₅	0.04 ₉	1.42 ₁	0.63 ₇	1.02 ₈	4.47 ₉	1.51 ₂	2.96 ₇	0.00 ₂	0.04 ₂	
Laboratories	L ₁	5.49 _{7 p}	82.1 _{9 e}	1.16 _{1 i}	3.02 _{1 i}	0.22 _{8 i}	0.05 _{0 i}	1.39 _{6 a}	0.64 _{2 a}	1.04 _{1 i}	4.59 _{2 m}	1.51 _{1 x}	—	0.00 _{3 i}	0.04 _{1 c}
	L ₂	5.59 _{8 p}	82.3 _{2 e}	1.19 _{7 c}	2.99 _{1 x}	0.22 _{4 i}	0.05 _{0 i}	1.46 _{9 f}	0.64 _{2 f}	1.05 _{9 i}	4.58 _{5 m}	1.52 _{4 x}	—	0.00 _{2 i}	0.04 _{2 c}
	L ₃	5.65 _{7 c}	82.4 _{9 e}	1.14 _{9 c}	3.01 _{8 i}	0.22 _{6 i}	0.05 _{0 i}	1.42 _{1 a}	0.63 _{9 a}	1.02 _{3 i}	4.50 _{5 m}	1.50 _{0 i}	—	0.00 _{3 i}	0.04 _{4 c}
	L ₄	5.68 _{8 h}	82.4 _{6 e}	1.09 _{1 c}	3.02 _{3 x}	0.22 _{4 a}	0.04 _{6 a}	1.42 _{7 a}	0.63 _{2 a}	1.01 _{5 a}	4.46 _{0 m}	1.49 _{3 x}	—	—	—
	L ₅	5.59 _{6 c}	82.3 _{8 e}	1.11 _{9 i}	2.96 _{0 i}	0.22 _{0 i}	0.04 _{9 i}	1.42 _{0 a}	0.64 _{6 a}	1.00 _{3 i}	4.27 _{9 m}	1.51 _{4 i}	—	0.00 _{3 i}	—
	L ₆	5.79 _{5 c}	82.3 _{4 e}	1.15 _{9 c}	3.00 _{2 x}	0.23 _{0 a}	0.04 _{9 a}	1.41 _{5 a}	0.63 _{7 a}	1.02 _{3 a}	4.40 _{1 m}	1.50 _{9 x}	—	0.00 _{2 a}	0.04 _{0 c}
	L ₇	5.76 _{0 c}	82.3 _{2 e}	1.15 _{9 c}	3.01 _{0 c}	0.22 _{4 i}	0.05 _{0 i}	1.40 _{3 a}	0.62 _{6 a}	1.01 _{7 i}	4.46 _{4 i}	1.47 _{9 i}	—	0.00 _{0 i}	0.04 _{4 c}
	L ₈	5.44 _{1 c}	82.4 _{1 e}	1.17 _{1 c}	3.01 _{1 x}	0.22 _{4 a}	0.05 _{1 a}	1.41 _{3 a}	0.63 _{1 a}	1.04 _{4 a}	4.54 _{8 m}	1.56 _{5 x}	—	0.00 _{1 a}	0.04 _{4 c}
Average (\bar{X})	5.629 ₀	82.36 ₄	1.150 ₈	3.004 ₅	0.225 ₀	0.049 ₄	1.420 ₅	0.636 ₉	1.028 ₁	4.479 ₃	1.511 ₉	2.967 ₄	0.002 ₀	0.042 ₅	
Standard deviation	(Reproducibility) $s_{\bar{x}}$	0.121 ₇	0.08 ₃	0.032 ₇	0.021 ₃	0.003 ₀	0.001 ₄	0.022 ₂	0.006 ₉	0.018 ₀	0.105 ₁	0.025 ₄	—	0.001 ₀	0.001 ₄
	(Reproducibility without laboratories) $s_{I(T)}$ * ¹	0.025 ₇	0.11 ₇	0.007 ₆	0.005 ₃	0.008 ₃	0.002 ₉	0.008 ₁	0.008 ₉	0.018 ₈	0.025 ₇	0.007 ₇	—	0.001 ₄	0.000 ₆
Uncertainty C (95%) * ²	0.10 ₂	0.0 ₇	0.02 ₇	0.01 ₈	0.00 ₃	0.00 ₁	0.01 ₉	0.00 ₆	0.01 ₅	0.08 ₃	0.02 ₁	0.09 ₀ * ⁴	0.00 ₁	0.00 ₂	

(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)* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$ * 4 $s_{ZrO_2} = \sqrt{(s_{ZrO_2(HfO_2)})^2 + (s_{HfO_2})^2}$

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