

Piezoelectric Ceramic Material Properties

No.	Property Parameter	Symbol	Index						Allowable Tolerance
			P-33	P-43	P-44	P-51	P-52	P-81	
1	Electromechanical Coupling Coefficient	K_p	0.60	0.58	0.60	0.65	0.64	0.53	±6.0%
		K_{31}	0.36	0.34	0.36	0.38	0.37	0.31	
		K_{33}	0.70	0.67	0.70	0.74	0.76	0.63	
		K_{15}	0.70	0.67	0.70	0.72	0.75	0.66	
		K_t	0.47	0.48	0.48	0.50	0.49	0.47	
2	Free Relative Permittivity	$\varepsilon_{r^3}^T$	1725	1275	1350	2100	3250	1025	±12.5%
		$\varepsilon_{r^1}^T$	1725	1700	1900	2400	3500	1400	
3	Dielectric Loss	$\text{tg}\delta$	0.020	0.006	0.005	0.020	0.020	0.004	≤
4	Elastic Compliance Constants ($\times 10^{-12}\text{m}^2/\text{N}$)	S_{11}^E	15	11.5	13	15	15.5	11.0	±10%
		S_{33}^D	9.0	8.0	8.5	9.0	9.0	8.5	
		S_{55}^D	25	21.0	21.5	22.0	23.0	21.0	
5	Piezoelectric Strain Constants ($\times 10^{-12}\text{m}/\text{v}$ or C/N)	d_{31}	-160	-130	-150	-210	-260	-100	±12.5%
		d_{33}	390	290	320	450	575	225	
		d_{15}	480	500	530	710	950	450	
6	Mechanical Quality Factor	Q_m	75	500	400	70	65	800	≥
7	Frequency Constants ($\text{Hz}\cdot\text{m}$)	N_d	1950	2200	2200	2000	1940	2300	±5%
		N_1	1470	1700	1600	1450	1450	1700	

		N ₃	1880	2050	2000	1900	1900	1960	
		N ₅	1130	1230	1230	1200	1200	1230	
		N _t	2250	2300	2300	2250	2300	2280	
8	Sound Velocity (m/s)	V _d	3000	3500	3300	3000	3010	3500	±5%
		V ₁	2940	3400	3200	2900	2900	3400	
		V ₃	3760	4100	4000	3800	3800	3920	
		V ₅	2260	2460	2460	2400	2400	2460	
		V _t	4500	4600	4600	4500	4600	4560	
9	Density(x10 ³ kg/m ³)	ρ	7.6	7.45	7.5	7.45	7.4	7.45	≥
10	Curie Temperature(°C)	T _c	335	300	300	260	180	300	≥
11	Ten-fold Time Variation Rate (%)	A _{Nd}	0.20	1.3	1.2	0.35	0.35	1.3	
		A _{Kp}	-0.25	-2.0	-1.8	-0.4	-0.25	-2.0	
		Aε	-1.5	-4.5	-4.0	-1.5	-2.0	-4.0	
12	Temperature Relative Change Rate (%)-10°C~50°C Reference 25°C	ΔNd/N	1.0	1.5	1.0	1.5	2.0	1.5	
		Δε/ε	15	9.5	9.0	20	40	9.0	
13	Strong Field Dielectric Properties T=25°C E=400V	tgδ		0.04	0.04			0.01	≤
		Δε/ε		0.20	0.17			0.06	≤

Note: The performance parameter indicators in the table, except for volume density and Curie temperature, are measured values ten days after polarization.