

Property	Symbol	Units	Hard Material Type							
			K1000	NCE81*	K1100	NCE80*	K1300	NCE40*	NCE41*	K1450
Dielectric Constant (1 kHz)	K^T_3		1000	1030	1100	1050	1300	1250	1350	1450
Dielectric Loss Factor (1 kHz)	$\tan\delta_e$		0.004	0.004	0.004	0.004	0.005	0.004	0.004	0.012
Dielectric Constant (1 kHz)	K^T_1						1250			
Clamped Dielectric Constant	K^S_3		445		550		600			
Density	ρ	kg/m ³	7550	7750	7550	7800	7550	7750	7900	7550
Curie Point	T_c	°C	325	300	325	307	325	318	284	320
Mechanical Quality Factor	Q_m		1000	1300	550	1000	500	700	1400	350
Coupling Coefficients	k_p		0.56	0.56	0.57	0.55	0.58	0.580	0.57	0.57
	k_{33}		0.64	0.69	0.66	0.68	0.7	0.7	0.68	
	k_{31}		0.33	0.31	0.33	0.3	0.32	0.34	0.33	0.32
	k_t		0.52	0.47	0.52	0.48	0.51	0.5	0.5	
	k_{15}		0.58				0.65			
Piezoelectric Charge	d_{31}	Coul/N x 10 ⁻¹² (or)	-110	-98	-120	-100	-125	-140	-130	-130
(Displacement Coefficient)	d_{33}	m/V x 10 ⁻¹²	230	255	250	240	300	320	310	350
	d_{15}					500				
Piezoelectric Voltage Coefficient	g_{31}		-14	-10.8	-12.3	-11.0	-10.9	-11	-10.9	-10.1
(Voltage Coefficient)	g_{33}	V·m/N x 10 ⁻³	26	28	25.7	27.0	26.1	27	25.0	30.4
	g_{15}					45.2				
Frequency Constants	N_p		2270	2300	2180	2270	2200	2160	2280	2080
	N_{tr}		2067		2024	2050	2100	1980	2000	
	N_{ta}		2361		2310		2375			
	N_{33}		1550		1520	1500	1500	1340	1500	
	N_{31}		1630	1410	1620	1610	1570	1470	1600	
	N_H		1065		1050		1040			1000
Poisson's Ratio	γ		0.32		0.32		0.34			

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			K1000	NCE81*	K1100	NCE80*	K1300	NCE40*	NCE41*	K1450
Elastic Constants Short Circuit	S_{11}^E	$\times 10^{-12}m^2/N$	12		12.1	11.0	11.1	13.0	13.0	12.5
	S_{33}^E		14.6		14.7	14	16	17	16	
	S_{12}^E		-3.9		-3		-3.8			
	S_{13}^E		-5.2		-5.3		-4.5			
	S_{55}^E						50.4			
	S_{66}^E		31.8		30.2		29.8			
Elastic Constants Open Circuit	S_{11}^D	$\times 10^{-12}m^2/N$	10.5		10.7	10.0	10	11.5	11.6	11.2
	S_{33}^D		9.5		8.2	7.5	8.2	8.7	8.6	
	S_{55}^D						29.1			
Elastic Constants Short Circuit	Y_{11}^E	$\times 10^{10}N/m^2$	8.3		8.3	9.1	9	7.7	7.7	8
	Y_{33}^E		6.8		6.8	7.1	6.3	5.9	6.3	
Elastic Constants Open Circuit	Y_{11}^D	$\times 10^{10}N/m^2$	9.5		9.3	10.0	10	8.7	8.6	8.9
	Y_{33}^D		10.5		12.3	13.3	12.2	11.5	11.6	

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Property	Symbol	Units	Soft Material Type											
			3195STD	3195HD	NCE51*	3222HD	NCE56*	3203STD	3221HD	3203HD	3241HD	NCE55*	3257HD	3265HD
Dielectric Constant (kHz)	K^T_3		1800	1900	1900	2650	2900	3250	3450	3800	4100	5000	5700	6500
Dielectric Loss Fact (1 kHz)	$\tan\delta_e$		0.02	0.02	0.02	0.02	0.014	0.02	0.02	0.02	0.02	0.022	0.03	0.03
Dielectric Constant (kHz)	K^S_1		1500	1600		2948		2800	3550	3200	3420		5900	5400
Clamped Dielectric Constant	K^S_3		875	900		800		775	1000	1200	1300		2050	2100
Density	ρ	kg/m ³	7700	7950	7850	7900	7650	7700	7870	7870	7880	8000	8220	8220
Curie Point	T_c	°C	350	350	360	270	242	225	242	225	223	159	155	>135
Mechanical Quality Factor	Q_m		80	80	80	80	80	50	50	50	50	70	75	75
Coercive Field (Measured < 1 Hz)	E_c	kV/cm	14.9	12				10.6	8.8	8	9			
Remanent Polarization	P_r	μCoul/cm ²	39.2	39				37.2	38.5	39	38.5			
Coupling Coefficient	k_p		0.63	0.68	0.65	0.72	0.64	0.69	0.74	0.75		0.62	0.7	0.66
	k_{33}		0.7	0.72	0.74	0.74	0.74	0.7	0.78	0.78	0.77	0.72	0.76	0.73
	k_{31}		0.35	0.4	0.38	0.45	0.37	0.41	0.46	0.43	0.44	0.39	0.41	0.4
	k_t		0.49	0.49	0.5	0.53	0.5	0.56	0.54	0.55	0.55	0.5	0.5	0.49
	k_{15}		0.56	0.61		0.77		0.72	0.78	0.78	0.75		0.65	0.68
Piezoelectric Charge (Displacement Coefficient)	d_{31}	Coul/N x 10 ⁻¹² (or) m/V x 10 ⁻¹²	-175	-190	-195	-270	-250	-270	-300	-320	-325	-260	-360	-370
	d_{33}		350	390	450	485	580	530	600	650	640	670	730	750
	d_{15}		360	460		850		790	1000	1000	880		850	900
Piezoelectric Voltage Coefficient (Voltage Coefficient)	g_{31}	V·m/N x 10 ⁻³	-11	-11.3	-13.0	-11.5	-9.0	-9.4	-9.8	-9.5	-8.9	-9.0	-7.1	-6.4
	g_{33}		24.2	23.2	26.0	21.3	20.0	18.4	19.7	19	17.6	19.0	14.5	13
	g_{15}		27.1	32.4		32.6		31.9	31.8	35.3	29.1		16.3	18.8
Frequency Constant	N_p		2020		1925	1910	2000	1920	1830			1970	1940	2020
	N_{tr}		2025	2110	2000	2050	2030	1870	2020	2000	2000	1990	2090	2095
	N_{1a}	Hz·m	2250	2360		2350		2220	2340	2350	2340		2350	2340
	N_{33}					1320		1400					1590	1550
	N_{31}		1420	1440	1370	1420	1530	1400					1430	1440
Poisson's Ratio	ν		0.32	0.34		0.31				0.31	0.31		0.32	0.32
Elastic Constants Short Circuit	S^E_{11}	x 10 ¹² m ² /N	15.6	15.1	16.0	15.8	18.0	16.7	16	16.6	15.6	17.0	14.7	14.5
	S^E_{33}		18.6	18.6	19	18.8	20	19.7	19.8	21	19.2	21	18.1	18
	S^E_{12}		-5.3	-4.8		-5		-5.6	-4.2	-4.2	-4.7		-4.7	-4.7
	S^E_{13}		-6.8	-7.6		-7.7		-7.6	-7.2	-8.2	-7.7		-7.3	-7.2
	S^E_{55}		37	40		47		48.5	54	52.4	45.9		38.1	41.4
	S^E_{66}		41.6	39.8										
Elastic Constants Open Circuit	S^0_{11}	x 10 ¹² m ² /N	13.7	12.7	13.7	12.6	15.5	13.9	12.6	13.5	12.5	14.4	12.2	12.2
	S^0_{33}		9.4	9	8.6	8.5	9.0	10	7.8	8.2	7.8	10.1	7.6	8.4
	S^0_{55}		25.4	25.1		19.1		23.4	21.1	20.5	20.1		22	22.3



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			3195STD	3195HD	NCE51*	3222HD	NCE56*	3203STD	3221HD	3203HD	3241HD	NCE55*	3257HD	3265HD
Elastic Constants Short Circuit	$\frac{Y_{11}^E}{Y_{33}^E}$	$\times 10^{10} \text{N/m}^2$	6.4	6.6	6.3	6.4	5.6	5.9	6.2	6	6.4	5.9	6.8	6.9
			5.4	5.4	5.3	5.3	5.0	5.1	5.1	4.8	5.2	4.8	5.5	5.6
Elastic Constants Open Circuit	$\frac{Y_{11}^0}{Y_{33}^0}$	$\times 10^{10} \text{N/m}^2$	7.3	7.9	7.3	7.9	6.4	7.2	7.6	7.5	8	6.9	8.1	8.2
			10.6	11.1	11.6	11.7	11.1	10	12.8	13.2	12.8	9.9	13.2	11.9
Thermal Expansion (Perpendicular to poling)	α	ppm/°C		3						3.5				
Specific Heat	C_p	J/kg·°C		440						420				
		J/mol·°C		145						138				
Thermal Conductiv		W/cm·°C		1.9-2.3						1.9-2.3				
		W/m·°K		1.2						1.2				
Thermal Conductiv with Au Electrodes	K_d	W/m·°K		1.45						1.45				

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