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PZT5A & 5H Materials Technical Data (Typical Values)

Property	Symbol	Units	Material Type				
			3195STD	3195HD	3221HD	3203STD	3203HD
Dielectric Constant (1KHz)	K^T_3		1800	1900	3450	3250	3800
Dielectric Loss Factor (1KHz)	$\tan\delta_e$	%	1.8	1.8		2.0	2.0
Density	ρ	g/cm^3	7.7	7.8	7.87	7.7	7.87
Curie Point	T_c	°C	350	350	242	235	225
Mechanical Quality Factor	Q_m		80	80		30	30
Coercive Field (Measured < 1 Hz)	E_c	kV/cm	14.9	12.0	8.8	10.6	8.0
Remanent Polarization	P_r	$\mu Coul/cm^2$	39.2	39.0		37.2	39.0
Coupling Coefficients	k_p		0.63	0.65		0.69	0.75
	k_{33}		0.70	0.72	0.78	0.73	0.75
	k_{31}		0.35	0.36	0.44	0.41	0.43
	k_t		0.49	0.48	0.55	0.53	0.55
	k_{15}			0.59	0.78		0.78
Piezoelectric Charge (Displacement Coefficient)	d_{31}	Coul/N x 10^{-12} (or) m/V x 10^{-12}	-175	-190	-300	-275	-320
	d_{33}		350	390	595	550	650
Piezoelectric Voltage Coefficient (Voltage Coefficient)	g_{33}	V•m/N x 10^{-3}	24.2	24.0	19.9	19.0	19.0
	g_{31}		-11.0	-11.3	-10.2	-9.6	-9.5
Elastic Modulus	Y^E_{11}	N/m^2 x 10^{10}	6.9	6.7	6.2	6.3	6.2
	Y^E_{33}		5.5	5.3	5.1	5.0	4.9
Frequency Constants Radial	N_r	KHz•cm	202			192	
Resonant Thickness	N_{tr}	KHz•cm	204	211	202	191	202
Anti-Resonant Thickness	N_{ta}	KHz•cm	229	236	235	222	236
Thermal Expansion (Perpendicular to poling)	α	ppm/°C		3.0			3.5
Specific Heat	C_p	J/kg•°C		440			420
		J/mol•°C		145			138
Thermal Conductivity	K_d	W/cm•°C		1.9-2.3			1.9-2.3
		W/m•°K		1.2			1.2
with Au Electrodes		W/m•°K		1.45			1.45
Poisson's Ratio	υ			0.31			0.31
Elastic Constants Short Circuit	S^E_{11}	x 10^{-12} m^2/N		16.2	16.0		16.6
	S^E_{33}			18.6	19.8		21.0
Elastic Constants Open Circuit	S^D_{11}	x 10^{-12} m^2/N		14.6	13.0		13.9
	S^D_{33}			9.6	7.7		8.8
Elastic Constants Short Circuit	Y^E_{11}	x 10^{10} N/m^2		6.7	6.2		6.2
	Y^E_{33}			5.3	5.1		4.9
Elastic Constants Open Circuit	Y^D_{11}	x 10^{10} N/m^2		6.8	7.8		7.0
	Y^D_{33}			10.6	13.0		11.0

Formulas

Disc Capacitance	$(d^2 \cdot K^T_3)/(5.67 \cdot t)$
Plate Capacitance	$(l \cdot w \cdot K^T_3)/(4.45 \cdot t)$
Disc K^T_3	$(5.662 \cdot Cap \cdot t)/d^2$
Plate K^T_3	$(4.447 \cdot Cap \cdot t)/(l \cdot w)$
f_r (radial)	$N_r/(2.54 \cdot d)$
f_r (length)	$N_{31r}/(2.54 \cdot l)$
f_r (width)	$N_{31r}/(2.54 \cdot w)$
f_t (thickness)	$N_t/(2.54 \cdot t)$

Formula length, width, and diameter are for electroded area only.

Definitions

$\tan\delta_e$	Dielectric Loss Factor	C	Capacitance (nF)	N_r	Radial Frequency Constant
ρ	Mass Density of Ceramic	l	Length (in.)	N_t	Thickness Mode Frequency Constant
T_c	Curie Point	w	Width (in.)	P_r	Remanent Polarization
d_{33}	Direct Charge Coefficient	d	Diameter (in.)	Q_m	Mechanical Q (Quality Factor)
d_{31}	Transverse Charge Coefficient	t	Thickness (10^{-3} in.)	Y^E_{33}	Direct Young's Modulus
E_c	Coercive Field	k_{33}	Direct Electromechanical Coupling Coefficient	Y^E_{11}	Elastic Modulus
g_{33}	Direct Voltage Coefficient	k_{31}	Transverse Electromechanical Coupling Coefficient	f_r	Resonant Frequency
g_{31}	Transverse Voltage Coefficient	K^T_3	Free Dielectric Constant Measured Along Poling Axis	f_a	Anti-Resonant Frequency
k_p	Planar Electromechanical Coupling Coefficient				