



Physical and Piezoelectric Properties of APC Materials

APC Material:	840	841	850	854	855	860	880
Navy Equivalent	Navy I	Hybrid	Navy II	Navy V	Navy VI	Porous	Navy III
Relative Dielectric Constant							
K^T	1275	1375	1900	2750	3300	1200	1050
Dielectric Dissipation Factor (Dielectric Loss(%))*							
$\tan \delta$	0.60	0.40	≤ 2.00	≤ 2.00	≤ 2.50	≤ 2.00	0.40
Curie Point ($^{\circ}\text{C}$)**							
T_c	325	320	360	250	200	360	310
Electromechanical Coupling Factor							
k_p	0.59	0.60	0.63	0.66	0.68	0.50	0.50
k_{33}	0.72	0.68	0.72	0.68	0.76	0.45	0.62
k_{31}	0.35	0.33	0.36	-	0.40	-	0.30
k_{15}	0.70	0.67	0.68	-	0.66	-	0.55
Piezoelectric Voltage Constant (10^{-3} Vm/N or $10^{-3} \text{ m}^2/\text{C}$)							
g_{33}	26.5	25.5	24.8	25.5	21.0	38.0	25.0
$-g_{31}$	11.0	10.5	12.4	-	9.0	-	10.0
g_{15}	38.0	35.0	36.0	-	27.0	-	28.0
Young's Modulus (10^{10} N/m^2)							
Y_{11}^E	8.0	7.6	6.3	6.0	5.9	-	9.0
Y_{33}^E	6.8	6.3	5.4	5.2	5.1	-	7.2
Frequency Constants ($\text{Hz}\cdot\text{m}$ or m/s)							
N_L (longitudinal)	1524	1700	1500	-	1390	-	1725
N_T (thickness)	2005	2005	2040	2000	2079	1390	2110
N_p (planar)	2130	2055	1980	1972	1920	1900	2120
Density (g/cm^3)							
ρ	7.6	7.6	7.6	7.6	7.6	6.6	7.6
Mechanical Quality Factor							
Q_m	500	1400	80	70	65	50	1000
Acoustic Impedance (Mrayl)							
Z_a	-	-	31.5	-	-	16.5	-

The values listed above pertain to test specimens. They are for reference purposes only and cannot be applied unconditionally to other shapes and dimensions. In practice, piezoelectric materials show varying values depending on their thickness, actual shape, surface finish, shaping processes and post-processing.

Note: measurements made 24 hours after polarization.
 Maximum voltage: 5-7 VAC /mil for 850, 851, 855, Type VI VDC ~2X.
 9-11 VAC /mil for 840, 841, 842, 844, 880, 881 VDC ~2X.

*At 1 kHz, low field.

**Maximum operating temperature = Curie point/2.

Standard Tolerances
 (Tighter tolerances available on request)

- Capacitance: $\pm 20\%$

- d_{33} Value: $\pm 20\%$

- Frequency: $\pm 5\%$ (to $\pm 0.5\%$ on request)



Physical and Piezoelectric Properties of APC Materials

Material:	842	844	851	881	Type I	Type II	Type III
Equivalent Material	Type I		Type II	Type III	Type I	Type II	Type III
Relative Dielectric Constant							
K^T	1375	1500	1950	1030	1300	1800	1000
Dielectric Dissipation Factor (Dielectric Loss (%))*							
$\tan \delta$	0.45	0.4	1.5	0.4	1.0	2.0	1.0
Curie Point ($^{\circ}\text{C}$)**							
T_c	325	320	360	310	320	300	300
Electromechanical Coupling Factor (%)							
k_p	0.65	0.68	0.71	0.58	0.60	.65	.55
k_t	0.48	0.48	0.51	0.46	0.40	.40	.40
Piezoelectric Charge Constant (10^{-12} C/N or 10^{-12} m/V)							
d_{33}	300	300	400	260	275	375	200
Piezoelectric Voltage Constant (10^{-3} Vm/N or 10^{-3} m²/C)							
g_{33}	26.3	24.5	24.8	26.7	26	25	26
Young's Modulus (10^{10} N/m²)							
Y_{11}^E	8	7.6	6.3	9	8	6	9
Y_{33}^E	6.8	6.3	5.4	7.2	7	5	7
Frequency Constants (Hz*m or m/s)							
N_T (thickness)	2050	2050	2040	2050	2050	2000	2100
N_P (planar)	2230	2250	2080	2300	2200	2000	2200
Density (g/cm³)							
ρ	7.6	7.7	7.6	7.6	7.6	7.6	7.6
Mechanical Quality Factor							
Q_m	600	1500	80	1000	600	80	1000

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 *At 1 kHz, low field.
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Physical and Piezoelectric Properties of APC Materials

APC Material:			8447		8550		8843
Equivalent Materials							
			Type I		Type II		Navy III
Relative Dielectric Constant							
K^T			1500		1800		1050
Dielectric Dissipation Factor (Dielectric Loss (%))*							
$\tan \delta$			0.005		0.015		0.004
Curie Point (°C)**							
T_c			285		360		320
Electromechanical Coupling Factor							
k_p			0.56		0.62		0.56
k_{33}			0.69		0.70		0.67
k_{31}			0.33		0.36		0.33
k_{15}			0.66		0.68		0.63
Piezoelectric Voltage Constant (10^{-3} Vm/N or 10^{-3} m²/C)							
g_{33}			22		25		26
$-g_{31}$			-9		11		11
g_{15}			30		40		34
Young's Modulus (10^{10} N/m²)							
Y_{11}^E			8.7		6.2		8.7
Y_{33}^E			6.8		4.9		7.0
Frequency Constants (Hz*m or m/s)							
N_L (longitudinal)			1650		1350		1550
N_T (thickness)			2130		2010		2090
N_P (planar)			2300		1970		2320
Density (g/cm³)							
ρ			7.8		7.7		7.6
Mechanical Quality Factor							
Q_m			1500		85		1000

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