



Piezoceramics:

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Typical Values of Piezoelectric Ceramic Material

Material Types		P-4	P-4D	P-8	P-54	P-5B	PZT-5H	PZT-5X
Coupling Coefficients	K_p	0.65	0.66	0.57	0.62	0.67	0.69	0.72
	K₃₃	0.69	0.71	0.68	0.71	0.72	0.77	0.78
	K₃₁	0.33	0.35	0.34	0.34	0.35	0.40	0.40
Piezoelectric Charge Constants (PC/N)	d₃₃	290	320	280	400	455	600	750
	d₃₁	-125	-145	-105	-170	-210	-280	-320
Piezoelectric Voltage Constants (x10 ⁻³ Vm/N)	g₃₃	25.5	26.7	31.0	27.0	24.5	21.5	19.0
	g₃₁	-11.40	-11.80	-11.90	-10.60	-10.00	-9.50	-8.20
Dielectric Constants	E₃₃^T/E₀	1250	1500	1180	1900	2250	3400	4500
Dissipation factor (%)	tang	0.40	0.40	0.20	1.60	1.60	1.70	2.00
Frequency Contents (Hz · M)	N_t	2050	2040	2100	1900	2005	2000	2200
	N_p	2230	2230	2330	2010	2077	1980	1960
	N₃₁	1600	1560	1670	1560	1420	1450	1430
Elastic Constants (x10 ¹⁰ N/m ²)	Y₁₁^E	7.9	7.5	8.6	7.4	7.4	6.1	6.1
	Y₃₃^E	6.6	6.2	7.1	5.0	5.0	5.0	4.3
Mechanical Q	Q_m	750	1000	1200	80	78	65	65
Poison's Ratio	q^E	0.33	0.35	0.33	0.35	0.39	0.34	0.35
Curie Temperature (°C)	T_c	320	310	320	310	260	190	180
Density (g/cm ³)	P	7.6	7.7	7.7	7.6	7.6	7.6	7.4

These typical values are provided for design information only. Standard tolerances are approximately +/- 20% of these values. Material properties are measured according to standard IEEE and DOD definitions and measuring techniques. All data shown represent nominal characteristics (20°C) 24 hours after polarization.

Piezoceramic Shapes:

Typical Dimensional Specifications

	Disc Products	Sheet Products
Diameter	1mm ± 0.02 - 180mm ± 0.01	1x1mm ² ± 0.02 - 200x300mm ² ± 0.01
Thickness	0.05mm ± 0.01 - 20mm ± 0.05	0.1mm ± 0.01 - 20mm ± 0.05
Flatness	0.003 - 0.01	0.01 - 0.01
Parallelism	0.02TIR - 0.02TIR	0.02TIR - 0.02TIR

Screen Printing/Sintered: Silver

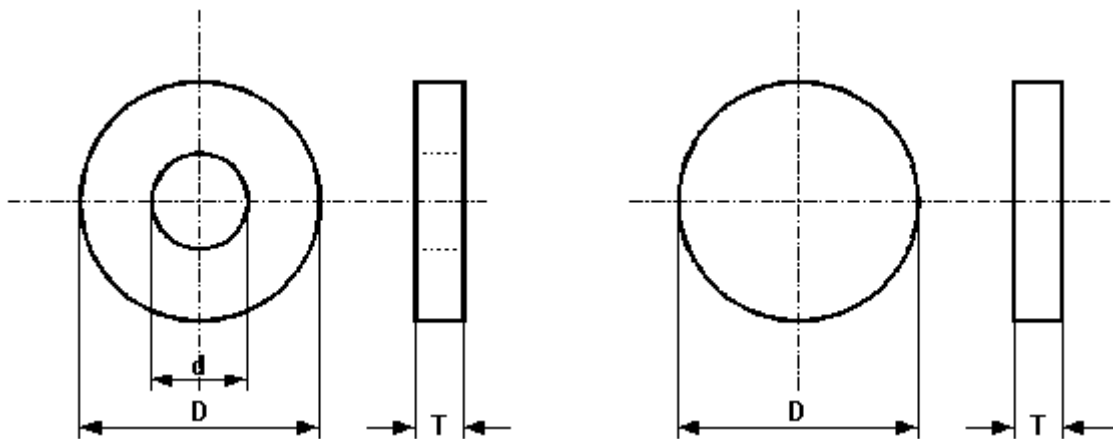
Vacuum sputtered: Nickel, Gold/Nickel, Silver/Nickel, Gold/Silver/Nickel.

Igniter Elements

	STE2-4	STE3-5	STE5-10	STE6-15S	STE6-16	STE7-15
Type	Impact	Impact	Impact	Squeeze	Impact	Impact
Diameter (mm)	2.15 ± 0.05	3.00 ± 0.05	5.00 ± 0.05	6.35 ± 0.05	6.27 ± 0.05	7.00 ± 0.05
Length (mm)	4.50 ± 0.08	5.00 ± 0.08	10.00 ± 0.1	15.00 ± 0.1	16.00 ± 0.1	15.00 ± 0.1
Density (ρ)	7.6	7.6	7.6	7.6	7.7	7.7
Dielectric Constant (E)	950 ± 50	980 ± 100	980 ± 50	1100 ± 100	2000	2000
Electric Capacity (c)	8 ± 2(pf)	10 ± 2(pf)	14 ± 4(pf)	20 ± 2(pf)	38 ± 2(pf)	50 ± 5(pf)
Electro-Mechanical coupling factor (K33)	≥ 0.68	≥ 0.65	≥ 0.68	0.65	0.75	0.75
Output Voltage Constant (G33)	28 ± 2 (10 ⁻³ V·m/N)	28 ± 2 (10 ⁻³ V·m/N)	31 ± 2 (10 ⁻³ V·m/N)	30 ± 2 (10 ⁻³ V·m/N)	28 ± 2 (10 ⁻³ V·m/N)	28 ± 2 (10 ⁻³ V·m/N)
Piezoelectric Charge Constants (D33)	≥ 290 (PC/N)	≥ 300 (PC/N)	≥ 260 (PC/N)	≥ 300 (PC/N)	≥ 450 (PC/N)	≥ 500 (PC/N)
Curie Point (Tc)	≥ 310°C	≥ 310°C	≥ 310°C	≥ 310°C	≥ 300°C	≥ 300°C
Temperature for Operation	Under 100°C	Under 100°C	Under 120°C	Under 120°C	Under 120°C	Under 120°C
Insulation Resistance	Over 50,000 MΩ	Over 50,000 MΩ	Over 50,000 MΩ	Over 50,000 MΩ	Over 50,000 MΩ	Over 50,000 MΩ
Static Compressive Strength	More than 3,000 Kg/cm ²	More than 3,000 Kg/cm ²	More than 4,000 Kg/cm ²	More than 6,000 Kg/cm ²	More than 5,000 Kg/cm ²	More than 5,000 Kg/cm ²

Piezoceramics Elements for Ultrasonic Cleaner

Rings

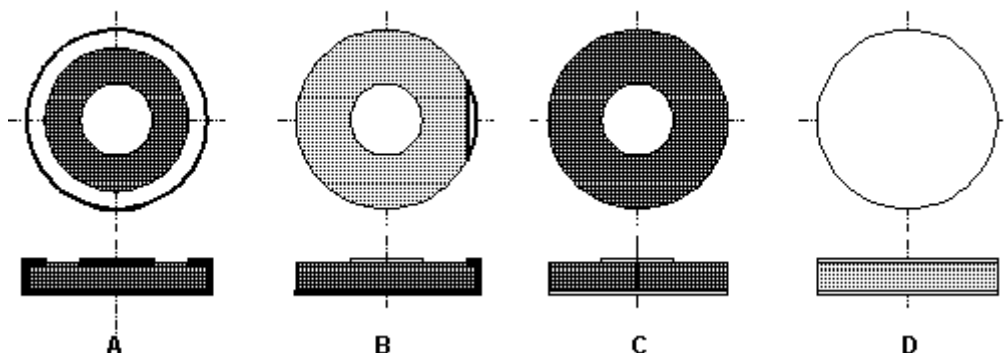


Ceramic Material: 4D13

Parts Number	Piezoelectric Charge Constants d_{33} (PC/N)	Capacitance C (pf)	Dielectric Loss tan d (%)	Resonant Frequency F_s (kHz)	Dimensions (mm)		
					D (± 0.25)	d (± 0.15)	T (± 0.05)
R-34.8/15/5.5	> 320	1750 \pm 10%	0.5%	42 \pm 5%	34.80	15.00	5.50
R-38.1/12.7/6.35	>320	1600 \pm 10%	0.5%	43 \pm 5%	38.10	12.70	6.35
R-50/15/6	>320	4000 \pm 10%	0.5%	41 \pm 5%	50.00	15.00	6.00
R-50/27.8/6	>280	2900 \pm 10%	0.5%	26 \pm 5%	50.00	27.80	6.00
R-50/19.1/6.35	>290	3700 \pm 10%	0.5%	31 \pm 5%	50.00	19.10	6.35

Discs

Electrode Pattern



Part Number	Piezoelectric Charge Constants d_{33} (PC/N)	Capacitance C (pf)	Dielectric Loss $\tan d$ (%)	Resonant Frequency F_s (kHz)	Dimensions (mm)	
					D	T
D-20/2-A	> 300	2000 ± 10%	0.5%	1.0 ± 5%	20 ± 0.25	2.0 ± 0.02
D-20/0.84-B	> 310	3000 ± 10%	0.5%	2.4 ± 5%	20 ± 0.25	0.84 ± 0.02
D-20/0.9-C	> 300	4800 ± 10%	0.5%	2.3 ± 5%	20 ± 0.25	0.90 ± 0.02
D-22/2-A	> 300	2000 ± 10%	0.5%	1.0 ± 5%	22 ± 0.25	2.0 ± 0.02
D-22/2-C	> 290	1900 ± 10%	0.5%	1.0 ± 5%	22 ± 0.25	2.0 ± 0.02
D-25/1.22-A	> 310	1900 ± 10%	0.5%	1.65 ± 5%	25 ± 0.25	1.22 ± 0.02
D-25/1.22-C	> 280	1900 ± 10%	0.5%	1.70 ± 5%	25 ± 0.25	1.22 ± 0.02
D-30/2-D	> 280	3900 ± 10%	0.5%	1.0 ± 5%	30 ± 0.25	2.0 ± 0.02
D-50/5-D	> 320	4900 ± 10%	0.5%	42 ± 5%	50 ± 0.25	5.0 ± 0.05
D-50/3-D	> 310	8000 ± 10%	0.5%	42 ± 5%	50 ± 0.25	3.0 ± 0.05
D-50/2.5-D	> 300	8200 ± 10%	0.5%	43 ± 5%	50 ± 0.25	2.5 ± 0.05
D-50.8/2.54-D	> 320	10800 ± 10%	0.5%	42 ± 5%	50.8 ± 0.25	2.54 ± 0.05
D-50.8/3.18-D	> 320	8000 ± 10%	0.5%	41 ± 5%	50.8 ± 0.25	3.18 ± 0.05