

cts | **Ferroperm**
Piezoceramics

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Material data for Ferroperm™ Piezoceramics (based on typical values)

Navy Type / Industry "equivalent"	Symbol	Unit	Traditional Soft PZT				Traditional Hard PZT				
			Pz23	Pz27	P188**	Pz29	Pz24	Pz26	Pz28	P762**	P189**
			N/A	Navy 2 "PZT5A"	Navy 2 "PZT5A"	Navy 6 "PZT5H"	"PZT7A"	Navy 1 "PZT4D"	Navy 3 "PZT8"	Navy 1 "PZT4D"	Navy 3 "PZT8"
Electrical Properties											
Relative Free Dielectric Constant (1 kHz)	K_{33}^{-1}		1500	1800	1850	2900	400	1300	1030	1300	1150
Dielectric dissipation factor (1 kHz)	$\tan \delta (\text{s}^{-1})$	10^{-3}	15	17	20	19	3	3	4	5	3
Curie Temperature	$T_c >$	°C	350	350	340	235	330	330	330	300	320
Recommended maximum working range	$T <$	°C	250	250	240	150	230	230	250	200	220
Electromechanical Properties											
Coupling factors	k_p		0,52	0,59	0,65	0,64	0,50	0,56	0,58	0,58	0,51
	k_t		0,45	0,47	0,49	0,52	0,52	0,47	0,47	0,47	0,46
	k_{31}		-0,29	-0,33	-0,37	-0,37	-0,29	-0,33	-0,34	-0,35	-0,32
	k_{33}		0,65	0,70	0,74	0,75	0,57	0,68	0,69	0,68	0,65
Piezoelectric charge coefficients	$-d_{31}$	10^{-12} C/N	130	170	185	240	55	130	120	130	108
	d_{33}	10^{-12} C/N	330	425	425	575	90	300	275	300	240
	d_{15}	10^{-12} C/N	420	500	400	700	150	330	400		280
Piezoelectric voltage coefficients	g_{31}	-10^{-3} V m/N	10	11	11	10	16	11	13	-11	-11
	g_{33}	10^{-3} V m/N	25	27	26	23	54	28	31	26	23
Frequency constants	N_p	m/s	2160	2010	1970	1970	2400	2230	2180	2250	2350
	N_t	m/s	2030	1950	2020	1960	2100	2040	2010	2050	2150
	N_{31}	m/s	1480	1400	1450	1410	1670	1500	1600	1650	1750
	N_{33}	m/s	1600	1500	1890	1500	1600	1800	1500	1920	2060
Mechanical Properties											
Density	ρ	kg/m ³	7700	7700	7700	7460	7700	7700	7700	7600	7650
Mechanical quality factor	Q_{m1}^E		100	80	80	90	>1000	>1000	>1000	>600	>1000

Notes

* All Pz31, Pz36, Pz37, Pz39 are a new family of materials containing a porous structure. Tolerances might therefore vary more than standard, and be more dependent on size and geometry.

**P188,P189, P762 and P194 are a part of a full technology transfer of the Quartz & Selice programme from Saint-Gobain Quartz in 2010.

Please be aware that extreme dimensions and geometries can lead to exaggeration in tolerances in all materials.

Material data for Ferroperm™ Piezoceramics (based on typical values) cont'd

	Symbol	Unit	Low-Acoustic Impedance Family				HIFU Family			Very Soft Relaxor-Based Comp			High Temp
			Pz31*	Pz36*	Pz37*	Pz39*	Pz34	Pz52	Pz54	Pz21	P194**	Pz59	Pz46
Navy Type / Industry "equivalent"			"K81"	N/A	N/A	N/A	"PZT2"	N/A	N/A	"3203HD"	"3203HD"	N/A	"K15"
Electrical Properties													
Relative Free Dielectric Constant (1 kHz)	K_{33}^T		295	610	1150	1750	210	1900	2700	3800	4300	5100	120
Dielectric dissipation factor (1 kHz)	$\tan \delta (\text{s}^\circ)$	10^{-3}	4	3	17	19	14	3	3	18	25	18	4
Curie Temperature	$T_C >$	°C	330	330	350	220	400	235	220	220	185	150	650
Recommended maximum working range	$T <$	°C	230	230	250	130	150	150	130	130	85	80	550
Electromechanical Properties													
Coupling factors	k_p		0,30	0,26	0,35	0,18	0,07	0,60	0,57	0,59	0,61	0,55	0,03
	k_t		0,52	0,52	0,52	0,53	0,40	0,53	0,48	0,47	0,50	0,46	0,20
	k_{31}				-0,15		-0,05	-0,35	-0,35	-0,34	-0,38		-0,02
	k_{33}				0,60		0,40	0,70	0,70	0,70	0,70		0,09
Piezoelectric charge coefficients	$-d_{31}$	10^{-12} C/N					5	170	200	250	305		2
	d_{33}	10^{-12} C/N	160	230	350	480	50	440	440	600	640	645	18
	d_{15}	10^{-12} C/N					40			620			16
Piezoelectric voltage coefficients	g_{31}	-10^{-3} V m/N					3			7	-7		2
	g_{33}	10^{-3} V m/N	54	40	40	28	25	25	20	18	15		17
Frequency constants	N_p	m/s			1550		2770	2090	2100	2030	1930	1955	2470
	N_t	m/s	1520	1270	1400	1190	2200	1960	2000	1970	2000	2050	2000
	N_{31}	m/s					2050			1375	1380		1900
	N_{33}	m/s								1325	1830		
Mechanical Properties													
Density	ρ	kg/m ³	6200	5600	6000	5800	7550	7350	7800	7780	7900	7900	6550
Mechanical quality factor	$Q_{m,t}^E$		900	500	50	70	>1000	550	>1000	65	60	40	>600

Notes

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