

FAQ's TO FERROPERM PIEZOCERAMICS

QUESTION

What are the standard tolerances for products made by Ferroperm?

What are the minimum tolerances your production can produce?

ANSWER:

Our customer specifies more than 95% of all production in Ferroperm Piezoceramics. This means, that most orders will come with a list of individual parameters and tolerances that will have to be fulfilled before the final inspection unit can approve the production, and parts can be shipped.

In most cases it is not necessary to specify all parameters, since over-specification often leads to an unnecessarily difficult part to produce, and therefore also becomes very expensive. We have therefore a set of standard tolerances that we use if nothing else is specified. This list is separated into several different categories. For most of these categories the customer however have the opportunity to specify other tolerances for the specific parameters which are most critical for that certain application.

If this is the case it should however always be discussed with Ferroperm and incorporated into the quotation and ordering as soon as possible in the dialog.

First of all there is of course the material itself, where a list of tolerances must be fulfilled in order to qualify as a "Pz21", "Pz27" or any of the 9 other materials in our programme. A set of tolerances has therefore been defined for this. These tolerances are also used to verify any new material batches before it is released for regular production.

Dielectrical Properties	± 10 %
Relative dielectric constant	
Dielectric loss factor	
Electromechanical Properties	± 5 %
Coupling factors	
Charge coefficients	
Voltage coefficients	
Frequency constants	
Mechanical Properties	± 2,5 %
Density	
Elastic compliances	

Note:

Catalogue values are based on measurements on standard geometries fulfilling recommended geometrical conditions. When parts differ from optimum geometrical conditions, one or more parameters may be affected, and larger variation than allowed for by the standard tolerances must therefore be expected.

A very thin disc will for example have a lower dielectric constant than a standard geometry, whereas very thick parts for example have thickness frequency constants in-between N_t and N_{33} .

For the specific production there will then be a list of parameters regarding the size, geometrical parameters and electric behaviour, which have to be fulfilled. The standard tolerances on these parameters can be summarised as follows:

	Standard tolerance	Minimum tolerance
Diameter of Rings or Discs OD \leq 10 mm OD $>$ 10 mm	\pm 0,3 mm \pm 3 %	0,01 mm 0,01 mm
Length and width of Plates L, W \leq 10 mm L, W $>$ 10 mm	\pm 0,3 mm \pm 3 %	0,01 mm 0,01 mm
Thickness of Rings, Discs or Plates T \leq 1 mm T $>$ 1 mm	\pm 0,3 mm \pm 3 %	0,01 mm 0,01 mm
Focussing Bowls Radius of curvature (R1 and R2) Diameter Thickness uniformity	\pm 3 % or \pm 3 mm whichever is largest \pm 3 % or \pm 3 mm whichever is largest Max variation 2,5% or 0,025 mm whichever is largest	1 mm, (dependent on total size) 0,01 mm 0,05 mm (dependent on total size)
Resonance frequency Resonance \leq 4 MHz Resonance $>$ 4 MHz	\pm 5% \pm 10%	\pm 0,5% \pm 1%
Capacitance	Fulfil dielectric constant for material	1 pF

Finally other more subjective parameters will be measured and documented when relevant. Among these parameters are for example, internal cracks, solderability, electrode adherence, surface roughness, and edge resistance in wrap-around electrodes.

Based on these measurements the final Inspection unit will document all productions on a final inspection sheet as shown below. With this sheet a print-out of an impedance curve will be made, and saved as a "finger-print" of that specific production showing resonances, spurious modes etc.

Journ. No	Customer	Batch Fz	Type	Part (Dimensions in mm)	Drawing no.		
Date of inspection	Lot size	Sample plan II AQL 0.65	Sample size	Acc. Number	Rejection number		
Temperature °C	Sublot no. Humidity %RFP	Remarks about origin or treatment of lot Control :					
Property	Unit	Tolerance	Measured Minimum	Measured Maximum	Mean within Sample	Remarks	Number of defects
1. Outer dia. or length (M / Sc)	mm						
2. Inner dia. or width (M / Sc / Int. gauges)	mm						
3. Thickness or length (M / Sc)	mm						
4. Radius of curvature (watch dial/UEM)	mm						
5.							
6.							
7. Capacitance (HP 4278A)	pF nF					σ =	
8. Dielectric loss tan δ (HP 4194A)	%						
9. Impedance spectrum (HP 4194A)							
10. f_r / f_t (HP 4194A)	kHz MHz						
11. $K_p / K_1 / K_{eff}$ (HP 4194A)	%						
12. d_{33}	pC/N						
13. *Dielectric Constant							
14. * N_y / N_z	Hz m						
15. Electrodes			Tape test or soldering test				
16. Poling	Date	Direction of poling	Marking				
17. Visual inspection							
Remarks						Numbers of defects in sample	
						Number of approved parts after sample test	
						Total number of rejects	
						Total number of approved parts after sorting	
*Calculated on parts with max. / min. Cap. / F_r / F_t M: Micrometer screw, Sc.: Slide caliper						Date of approval:	Sign: