

Importance of Sample Preparation

Proper sample preparation is the first step to accurate measurements.

Both methods, the resonator method and the S-parameter method, require the sample to be machined to fit the fixture. Since the size of the sample is used to calculate the permittivity and permeability, measurement errors in the sample size directly affect the measured values of permittivity and permeability. Therefore, in order to evaluate material properties accurately, it is necessary to know the size accurately. Ideally, the cross-sectional area of a rod-shaped sample should be uniform, and the thickness of a plate-shaped sample should be uniform.

Material preparation for cavity resonators

It is basic to machine the sample into a rod shape. The recommended size is shown below. In the case of anisotropic samples, the difference in permittivity due to anisotropy can be evaluated by changing the direction of sample extraction.

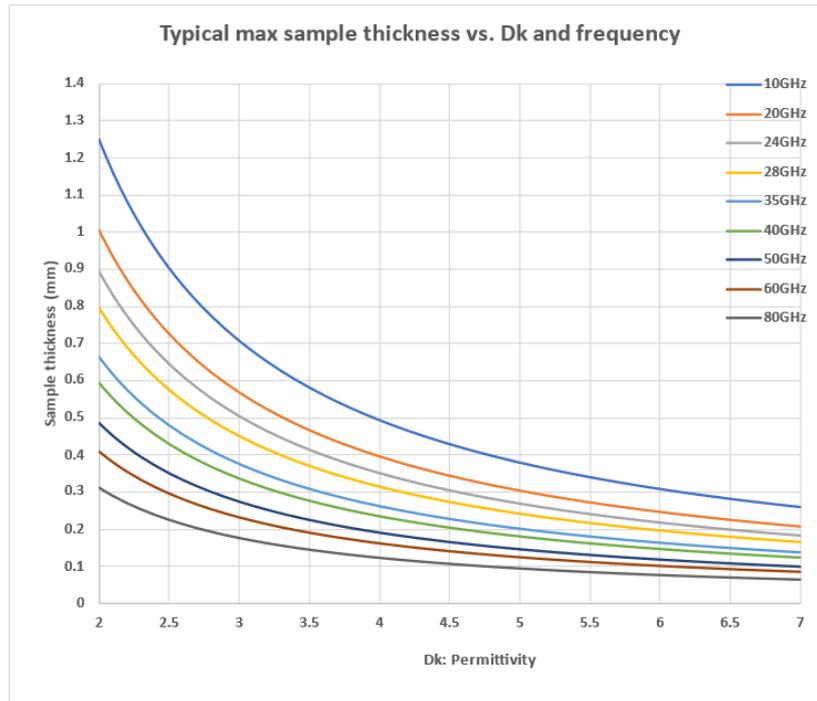
Size recommendation: Cavity

Resonator	WxD (mm)	L (mm)
1- 5.8 GHz	1.5 x 1.5	80
10 GHz		60

Material preparation overview for Split Cylinder/Fabry-Perot

The sample needs to be processed into a plate. The characteristics of the material and the measurement frequency determine the appropriate thickness and size.

Thickness : We recommend about 100 μ m. The graph shows the approximate maximum thickness that can be measured with the split cylinder resonators. The larger the permittivity and the higher the frequency, the thinner the sample needs to be. If the loss is more than about 0.01, a thinner sample may be required. On the other hand, it should be noted that the thinner the sample (e.g. 10 μ m), the more noticeable the error in thickness measurement becomes, and consequently the larger the error in permittivity measurement becomes. For details, please contact us.



Size:

Recommended size for split cylinder

Resonator	Short side (mm)	Long side (mm)
10 GHz	62	75
20-80 GHz	34	45

Recommended size for Fabry-Perot

Resonator	Square (mm)
E/W/D/G/Jband	50

Material preparation overview for free space method

It is necessary to process the sample into a plate shape. The recommended size varies depending on the measurement frequency and the permittivity/permeability of the material.

Thickness One quarter wavelength is optimal. (It is necessary to take into account the wavelength shortening $1/\sqrt{\epsilon_r \mu_r}$ (relative permittivity / relative permeability) in the sample.) If the sample gets thicker, the error due to multiple reflection inside the sample can get significant. This is especially noticeable in magnetic permeability measurement.

Size: A diameter of 6 wavelengths or more is recommended. A diameter of 60 mm or more makes it easier to fix to the fixture.