

# Error Analysis of the Open-Structure Resonant Technique for Measuring Dielectric Properties

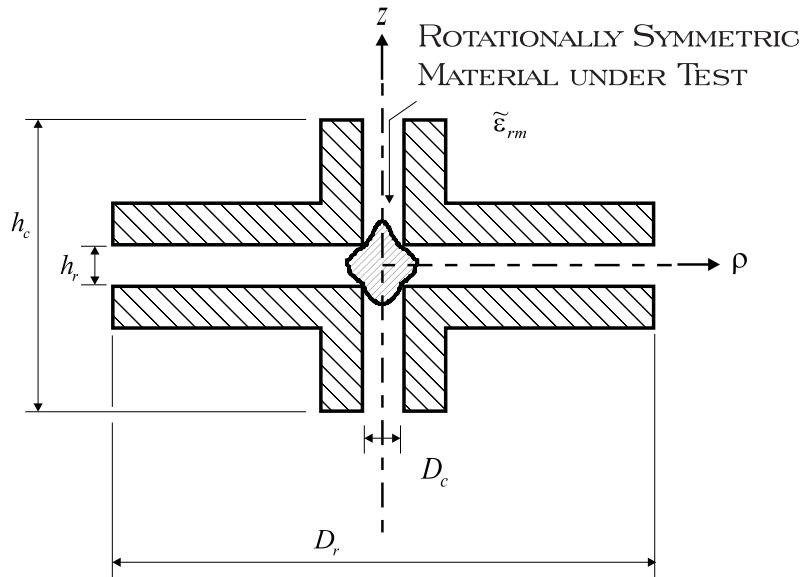
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Various errors that may occur in dielectric measurements using the open-structure resonant technique are presented. The measurement fixture used in this technique is rotationally symmetric and is shown in the figure below (cross section in  $\rho - z$  plane). The fixture consists of two metallic plates placed opposite each other, where each plate has a center opening leading to a tubular section. In this configuration, the fixture has both circular and radial waveguide regions. At the junction of these waveguide regions is the core of the resonator. The material or a portion of the material to be measured is positioned within the core of the resonator. The resonant frequency and quality factor are measured. Using these measurements along with a finite-element model of the fixture containing the material under test, the relative permittivity and loss tangent of rotationally symmetric materials can be determined. The technique has been successfully used to measure a wide range of materials in both dielectric properties and material geometry. Measured results show the technique to be very accurate.



A sensitivity analysis will be presented which quantifies the errors associated with inaccurate measurements of the critical dimensions,  $h_r$  and  $D_c$ . Also, an investigation of the effect of air gaps on measured results will be presented. Finally, results will be presented which support the treatment of the right-angle metallic corner and the open-ended waveguide regions in the finite-element model.