Metal waveguides with shape changed cross sections

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This paper first addresses the behavior of a rectangular waveguide centrally loaded with a dielectric product. The results show that the product is not exposed to uniformly distributed microwave energy. One well-known solution to this problem is the dielectric slab loaded rectangular waveguide (TEM waveguide). A TEM waveguide could guarantee the product to be exposed in a uniformly distributed electric field, however, there are some shortcomings limit the application of the TEM waveguide. First, the lossless dielectric slabs with high permittivity are not cheap. Second, the waveguide with high permittivity dielectric slabs is heavy, and the dielectric slabs may peel off because the glue loses its function due to the microwave heat, thus the whole expensive TEM waveguide will not work.

Next new methods are explored by shaping the metal comprising the waveguide to make the central region containing the product much more uniform. Also metal sleeves are added inside the waveguides which will generate distributed capacities in between the sleeves and waveguides. With the distributed capacities, the electric length of each sleeve is longer than its physical length, thus the metal sleeves could be adjusted to electrically one quarter wavelength, so that the E field can vary from zero at the shorted end to maximum at the opening to the waveguide interior, thus allowing a hybrid TE10 variation of fields and make the electric field more uniform around the center. HFSS simulation results show that the new methods can greatly widen the uniform electric field area and even lower the cutoff frequency.