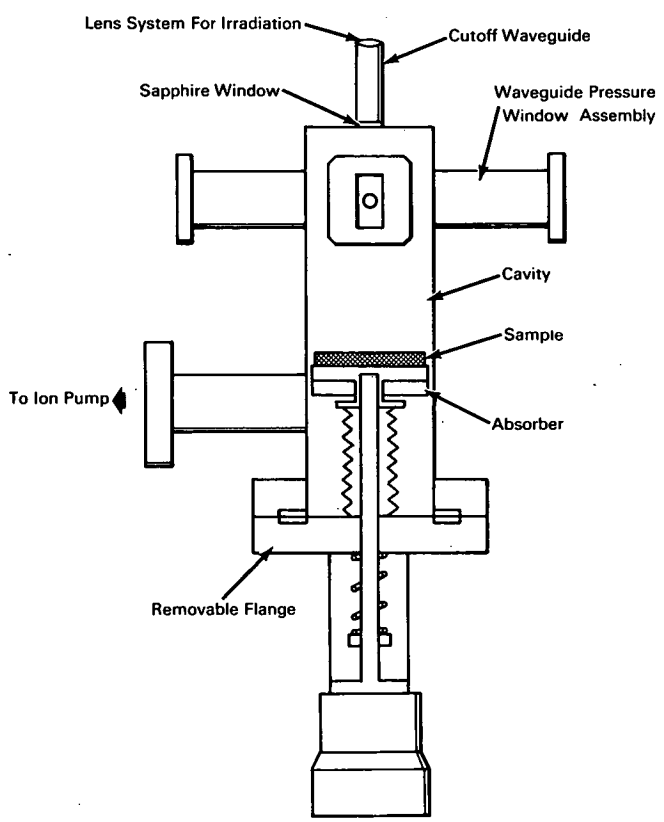
September 1966

Brief 66-10401

NASA TECH BRIEF

Dielectrometer Design Permits Measurement in Vacuum Under Irradiation



The problem:

In a vacuum environment exposed to radiation, critical components may suffer subtle changes in the dielectric constant and loss tangent of materials. For example, insulation may deteriorate as a result of flashover by outgassing or from radiation induced conductivity. Study is needed on the effects of such hostile environments on dielectric materials.

The solution:

A dielectrometer design that permits measurement of dielectric constant and dielectric losses without removing the test sample from the chamber.

How it's done:

This dielectrometer makes use of a resonant cavity to yield precise measurements of dielectric constant and loss tangent data at microwave frequencies. The

(continued overleaf)

cavity is a right circular cylinder operating in a H_{01n} mode. Cavity length is varied by a noncontacting plunger separated from the wall by a few thousandths of an inch, the plunger shaft being located by a bearing and positioned axially by a micrometer screw. Measurements are made at a fixed frequency by means of a frequency-stabilized oscillator. The Q of the cavity is inferred from the width of the resonance peak as the length of the cavity is varied. Desired dielectric information is calculated from change in cavity Q caused by the sample. Change in cavity length is a function of dielectric constant while increase in the resonant half-power is a function of the loss tangent of the sample. The dielectric samples are flat cylindrical disks that need not fit the cavity tightly since the electric field is circumferential in the H_{01n} mode and is zero at the cavity wall.

Irradiation by ultraviolet, X-, or gamma rays is accomplished through a lens system entering the top of the cavity.

Notes:

1. Although designed to simulate the effects of space conditions, this dielectrometer could also be used to simulate the effects of certain earth conditions such as exposure to sunlight or to peculiar environments.
2. A day-to-day standard deviation of 0.003 for a dielectric constant of 6.310 has been demonstrated, with an attendant accuracy on the order of ±1 percent.
3. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B66-10401

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: Hughes Aircraft Company
under contract to
Marshall Space Flight Center
(M-FS-359)