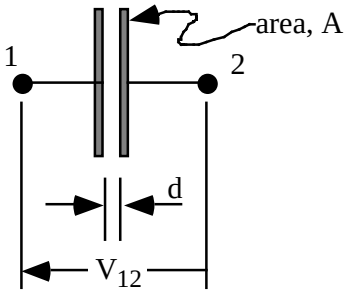
Parallel-Plate Capacitor:

We have to design a very large, parallel plate capacitor that will have very tight tolerances on its final dimensions. The area, A, of each of the two plates is 4.0 m^2, and the distance between the plates is 0.50 mm. Two mediums will be considered for the space between the plates, one is air, permittivity, $\varepsilon_o = 8.85 \times 10^{-12}$, dielectric strength = 3 kV/mm, and a 0.50 mm thick dielectric paper, dielectric constant, $\kappa = 3.5$, dielectric strength = 16 kV/mm.



a. Determine the **capacitance C** of the two plates with air.

b. Determine the **capacitance C'** of the two plates with the 0.50 mm thick dielectric paper.

c. What is the **maximum voltage**, $\mathbf{V_{12}}$, can be applied to the capacitor before there is a breakdown of the paper dielectric?

d. If $\mathbf{V_{12} = 1500\ V}$, how much **charge** can be stored in the paper dielectric capacitor, assuming the above dimensions?

e. In part (d), what is the **surface charge density** of charges on the plates of the capacitor?

f. In constructing the paper dielectric capacitor with 0.5 mm thick paper, insufficient plate support stiffness is used, so that when the applied voltage V_{12} = 1500 V, the two plates are forced apart, to a total, very uniform separation of **d = 0.75 mm**, and air fills the extra space. What is the new **capacitance C"** after this separation, assuming no further changes occur?

g. Determine the **force** between the two plates when the separation is held at 0.50 mm, the 0.50 mm thick paper dielectric is in that space, and the applied voltage $\mathbf{V_{12}}$ = **1500 V**.