Application Note APNE-0008
Fieldmeter Measurement Technique for Hostile Environments Using a "Dipstick"

One of the limitations of any fieldmeter is that its probe cannot be placed in an environment that is physically abusive to the probe – for instance, in a process where the temperature or pressure is too high or there is abundant dust or vapor which cannot be accommodated by a low pressure gas purge. Fluidized beds and transport pipelines are examples.

A viable solution is to penetrate the vessel wall with a "dipstick" – generally in the form of (but not limited to) a rod which passes through an insulating bushing into the material or space to be monitored allowing the actual measurement to be made on the outside as shown in Figure 1.

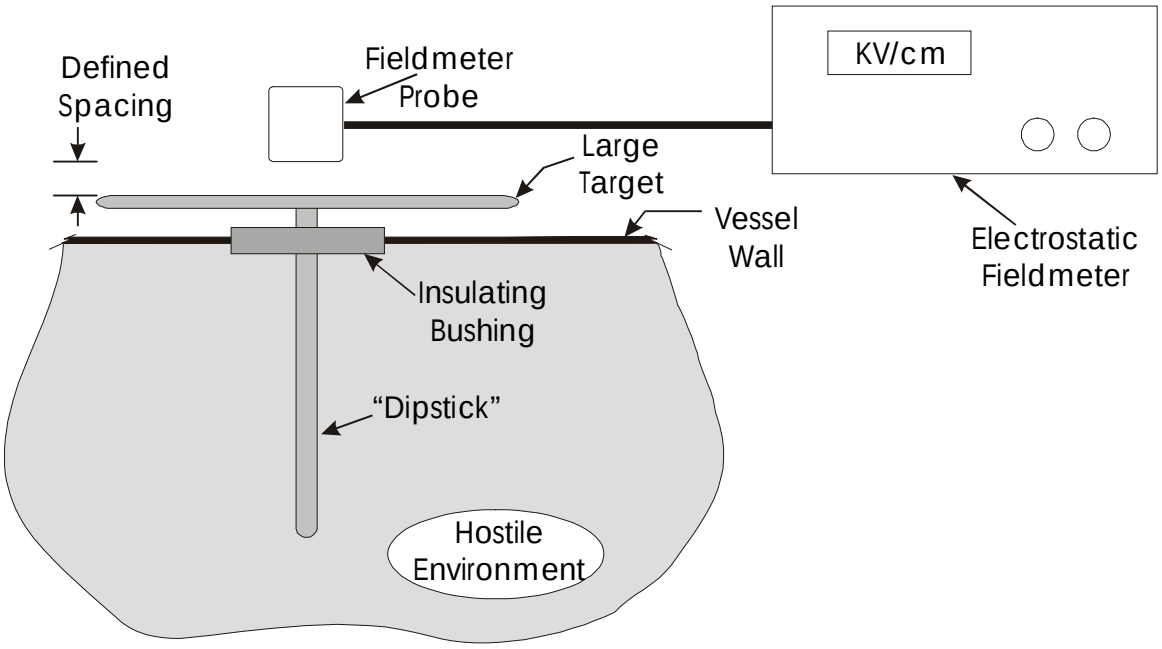

Figure 1

A first impulse would be to use a metal rod and to provide a metallic measuring surface (target). In view of the fact that the process being monitored may produce ionization and arc breakdown either across the insulating bushing or across the air gap to the grounded fieldmeter probe and that this can be destructive to the process or the instrumentation, an alternative is presented here.

Figure 2 depicts a laboratory experiment which was conducted to show that material whose volume resistivity (ρ_V) is low relative to that of a very good insulator will perform just as well as a conductor and will serve to limit current and thus prevent corona from occurring. The materials used in the setup are Teflon® (the good insulator) and paper phenolic (the "leaky" insulator). These are separated by several orders of magnitude ρ_V.

In the experiment, a known voltage was applied to one end of the phenolic rod and that same voltage measured at the opposite end of the rod using a non-contacting electrostatic voltmeter (Monroe Electronics Model 244). The electrostatic voltmeter was used here to simplify the setup. An

electrostatic fieldmeter (any of several manufactured by Monroe) would perform the same function but would require the use of a larger target and careful control over the probe to surface separation to achieve the accuracy necessary to illustrate the point of the experiment – that in electrostatic measurements, even an "insulator" can serve as a "conductor".

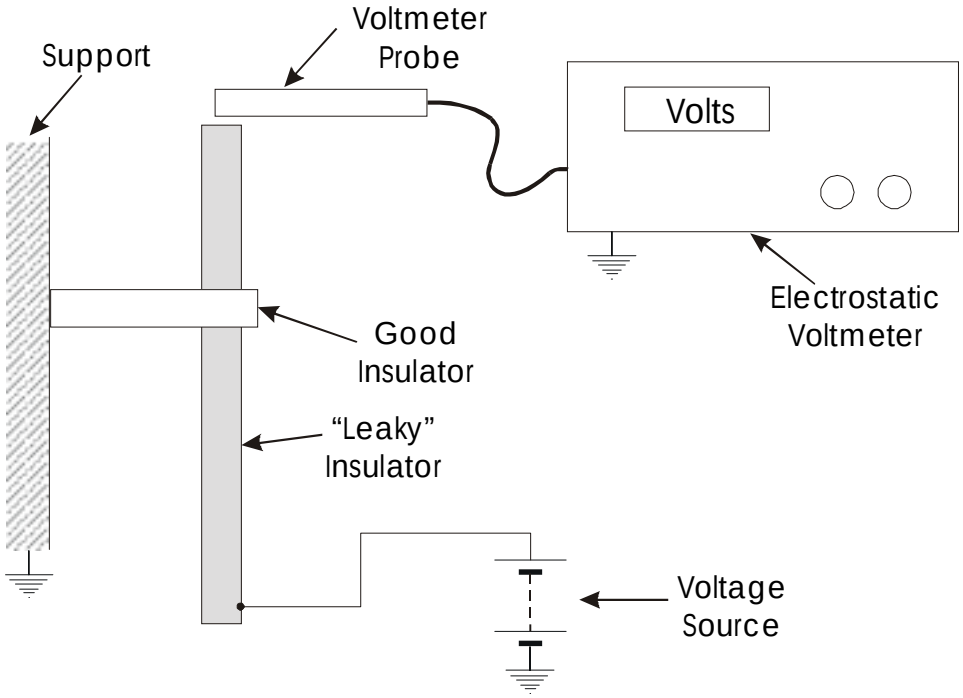

Figure 2

A very good choice of material for the insulating bushing would be polyphenylene sulfide which has the requisite high volume resistivity and is resistant to high heat and most chemicals as well as being dimensionally stable.

Choice of material for the "leaky" insulator would depend on a number of variables including chemical compatibility, temperature requirements and other physical properties. Some materials with volume resistivities in the 10^8 to 10^{10} $\Omega \cdot$cm range are paper phenolic, diallyl phthalate and polyvinyl chloride (PVC). The target may be of the same material.