Letter to the Editor of ESD Association Newsletter 'Threshold' December 1996 p9

Rebuttal Letter #2 by John Chubb

Ben Baumgartner mounts a vitriolic attack on charge decay test methods in general and on the 'corona charge decay' method in particular. As originator of the 'corona charge decay' method I ask for the right to reply to put the record straight.

I think we can all agree that the aim of 'resistivity' and 'charge decay' tests on materials is to determine how quickly static charge created on a material by rubbing can dissipate. If the rate of dissipation from the area of charge separation and away to earth adequately exceeds the rate of charge separation then there will be no problem from static electricity. We are thus interested in the time for charge to move.

Traditionally, resistivity measurement has seemed a good way to measure how quickly charge could move on materials. We are used to using resistance to determine how current flows for given voltages - and where capacitance is involved we can calculate a decay time. It seemed a natural progression.

There are however obvious problems with fabrics having embedded conductive fibres. It is obvious that any 'resistivity' assessment of such materials will be dominated by the conductivity of the embedded fibres- and no useful information will be obtained about the charge retention capability of fabric surface between the conductive fibres.

If we start from the other end and ask what happens to the charge separated when we have rubbed a material - how quickly does this charge move away. This is a very direct question about the real practical situation. This involves no assumptions and no modelling. As the local charge density can be observed without contact to the surface (for example using a nearby electrostatic fieidmeter or voltage follower) there is no interference with the process of charge migration after the charge has been created by the rubbing action. This must be the ultimate test against which any method of assessing materials for their ability to dissipate static charge must be judged - do measurements relate to the time for decay of triboelectric charge?

At the Electrostatics '95 Conference in York (April 1995) I reported studies on a number of aspects of our 'corona charge decay' method for assessing the static charge dissipation performance of materials. Further studies have been reported recently in the Journal of Electrostatics (37 1996 p53). Ben Baumgartner received copies of both papers from me. The most important points from these studies are:

— that 'decay time' values (time from initial peak voltage to l/e of this) and the form of the decay curve measured for the decay of corona charge corresponds well to these features observed on the same samples under the same test conditions for triboelectrically generated charge on a number of materials.

— that decay times have no relation to measured values of resistivity

— that decay times are not much influenced by the geometry of the test arrangement or the corona charging conditions

— that measurements are reproducible and do not change the surface tested

—- that appreciable voltages (e.g. up to 200 V) can be generated by rubbing fabrics which include conductive fibres and which are mounted with an earth connection

Are there any comparable studies to show that resistivity measurements or FTS IOIC actually show how quickly static charge dissipates?

Comments on a number of specific points:

>Why is a circuit analysis of any value? I am at the moment doing some computer modelling studies to try to understand the form of charge decay curves observed - but such analysis does not affect the validity of the observations made or the matching to practical experience of the decay oftriboelectric charge. As Ben says, De Forest invented the triode without a theory, ...and it works!

>'0pen backing' and 'earthed backing' are the two extremes of capacitance loading and earth linkage in the practical use of materials. Understanding of the form of decay curves observed will come with further work and will be interesting, but lack of 'understanding' does not invalidate measurements.

Corona charging will indeed put charge down non-uniformly. So does rubbing a surface. Experimental studies with a single point and 7 points on a 10 mm dia. ring, and early results of modelling, show that similar decay behaviour is observed - probably because the form of the initial charge pattern rapidly changes to some common pattern.

>With FTS 101C Method 4046 one does not know how or where the charge is placed (particularly if the surface includes components with slow charge migration rates) and rubbing may well only put charge on to one side of the material.

>Experience shows that positive and negative decay times are similar. As the charge species involved may vary with charge polarity (and may not be electrons) and have different mobilities it is useful to measure both polarities of charging.

There is certainly need for more extensive study of the design and operation of charge decay instrumentation. Instead of carping from the sidelines why not make a positive contribution and check the effectiveness and practical utility of the corona charge decay method

- and help to develop enhancements and modifications as prove needed?

John Chubb

(This article represents the personal views and experience of the author)