The Selection of Dielectric Test Equipment...

When selecting test equipment to be used in testing the dielectric strength of production products there are a number of factors to consider...

Is the dielectric test equipment designed with state of the art features?

Features now available on hi-pot testers improve their ability to identify a defect, offer more consistent results and reduce the harmful impact of surge currents.

Electronic voltage ramp

The concept of ramming the voltage up and down prior to and following a dielectric test is not new. Ramming can be a very important feature particularly voltage ramps replacing motor driven auto-transformers have driven the cost down and improved the reliability. The electronic ramps created some wave distortion during the transaction period, but reduce the potential for voltage spikes.

Zero crossing turn on

Applies the test voltage at the zero crossing point. Even when products have smaller amounts of the inherent induction the controlled application of the test voltage is important. This single, simple feature substantially reduces the variability in the test results while reducing the occurrence of rejecting good products. It also eliminates much of the inherent product degradation that occurs with dielectric strength testing. A zero crossing turn-on is preferred by high volume producers that must process products faster than would be possible with a voltage ramp, yet retain the benefits of a controlled application.

Capacity compensation circuits

If the amount of inherent capacity reaction in a product is high, relative to the test voltage and current, it will appear as apparent fault current, which might lead to the rejection of good products. More importantly, the high apparent current can mask a true fault, because the operator desensitizes the tester to compensate for the total current measured and masks the real current variances that should be looked for.

To overcome the problem, manufacturers of products with noise filters and similar capacitor coupled compounds use a circuit that cancels the measured capacity by applying an out of phase capacitor in the circuit. This type of circuit introduces some inherent error in the measurement and requires the operator to tune the circuit for a null in the reading. The electronic version of this circuit measures only the resistive component of the current thereby providing a far more accurate reading and eliminating the need for tuning the circuit. The value measured using the electronic circuit is known in the industry as the resistive or true fault current.

Direct current test potentials

DC is often specified when it is desired to cancel out the fault currents resulting from the capacity coupling that occurs between the current carrying wires and ground. As direct current does not pass through the capacitor, the leakage reading is far lower. This allows the products true internal leakage to be measured without being masked by the capacitor leakage. This is a simple and low cost test method that is suitable in many cases. This is particularly important when testing for very low levels of fault current such as the 10 to 100 microamperes specified in some medical applications. It is also used when testing products containing RFI filters because of their high line to ground capacity. The use of a DC test voltage does present some problem.

The most important of these is the safety problem, particularly when testing RFI protected products. When a DC test potential is applied to the product, the capacitors to ground retain the charge voltage after the connection is broken. A person contacting the product, even hours afterwards, is subjected to a substantial risk of shock. To prevent this, a direct short circuit must be placed across the output following the test. From a quality assurance stand point the DC test has the disadvantage that it does not create the stress reversals present in an AC test. To offset this, a longer test duration or higher test voltage is normally specified. A capacity compensation circuit avoids this problem and should be considered in some applications.

Automatic voltage regulation and filtering

To control the quality of the test voltage. With the application of dielectric test voltage to a product a sudden upward drift in voltage, or a voltage transient, can cause permanent damage to a product and its unwarranted rejection. A downward drift in line voltage under-tests the product and can lead to the acceptance of a defective product. The voltage instability has two sources. They are part due to variances and electrical noise that are introduced in the input power. To a larger degree they are due to the voltage drop that occurred in the transformer as connection to the product is made or broken. The use of a much larger transformer overcomes the regulation problem, but this can impose a very dangerous safety problem unless care is taken to insure that there is a fail-safe current sensing circuit coupled with a fast response shut off circuit.

Sensitivity control

Allows the sensitivity of the dielectric test to be adjusted based on the product being tested. First it should be understood that the dielectric strength test is normally conducted as a proof test of the insulation, not as a measurement of the insulation leakage. As such it is designed to detect a flash over or similar catastrophic breakdown. When monitoring for such breakdowns the precise measurement of the fault is of limited value. Older testers and most low cost testers often contain just a breakdown sensor to detect this condition. Higher quality testers today often use a combination of sensors to detect and measure the actual amount of fault current and a second sensor if detect a rapid change in current or arcing.

Outside the medical field, most domestic and foreign test standards do not specify a maximum allowable leakage value. They often specify only that there shall be no breakdown or flashover. UL does often require that the test must respond to a 120,000 ohm fault, but this is equal to a leakage of anywhere from 10 to 20 milliamperes depending on the test voltage used. Most test equipment manufacturers use a sensitivity of five milliamperes. For small power tools and appliances the level is often set in the one to two milliamperes range. For large motor operated equipment the level is often set to ten milliamperes or more. Some applications call for sensitivities of 20 to 30 milliamperes, but these are often better addressed with the use of capacity compensation circuits.

It is to the appliance manufacturer's advantage to set the sensitivity level as low as practical, consistent with good product yield. The low sensitivity level offers greater protection to the operator and allows any marginal products to be identified. It also is quicker to detect a fault, particularly when a voltage ramp is used; this reduces the chance of permanent damage to the product as a result of the fault current. In a production environment, it is desirable to have the ability to set the appropriate fault current for each product type to be tested. Some small manual testers offer a selector switch or a trim control for this purpose. An automatic test set can allow you to set the sensitivity as part of test parameters established for each product type.