Does Your Electrical Safety Testing Routine Need a Boost?
Exploring the Benefits of the Leakage Current and Functional Run Tests

Introduction

Most electrical product manufacturers perform safety tests on the production line in order to comply with safety agency standards. Common tests such as hipot, ground bond, and insulation resistance tests are an important part of any firm's quality assurance program because they help to determine if a product is safe for customer use. Although UL, TUV, and other global safety agencies often specify some combination of electrical safety tests to be performed on all products before shipment, there are two tests not necessarily required by safety agencies that many manufacturers can benefit from: the Leakage Current test (LCT), and the Functional Run test. Many manufacturers who have yet to incorporate these tests into their electrical safety testing routines should seriously consider doing so. Performing both a LCT and a Functional Run test on all manufactured products will not only improve quality, but also decrease the chance of liability litigation.

Test Descriptions

Leakage Current Test

While many manufacturers use a hipot test to measure the amount of leakage current that flows through a DUT's insulation, this test alone does not guarantee the safety of the product. The LCT is the only test capable of measuring how much leakage current a customer is exposed to when operating the product. The data recorded during a LCT is vitally important to a manufacturer not only to ensure product quality, but also because it may be used to refute product liability lawsuits in case of customer injury.

LCT is actually a general term used to describe 4 different types of tests: earth leakage, enclosure

SCI
28105 North Keith Drive - Lake Forest, IL 60045 USA
T. +1-847-932-3662 **F.** +1-847-932-3665
info@hipot.com www.hipot.com

leakage, applied part leakage, and patient auxiliary leakage. As applied part and patient auxiliary leakage tests are usually specified for medical device manufacturers, we will only discuss earth leakage and enclosure leakage tests. The earth leakage test measures how much leakage current is flowing through the product's insulation from the mains-input line to ground. The enclosure leakage test measures how much leakage current is flowing through the product's insulation from particular points on the chassis to ground.

Measurements are taken with a measuring device (MD) which is located inside the tester and consists of resistive and capacitive networks designed to simulate the impedance of the human body. During testing, operators can select a number of different MD's to help estimate the leakage current that a human being is exposed to when operating the DUT. The placement of the MD determines the type of test (if the MD is placed between the DUT's ground pin and the neutral side of the line, the test is an earth leakage test; if the MD is placed between a point on the DUT's chassis and the neutral side of the line the test is an enclosure leakage test). Figure 1 below provides a basic test setup diagram.

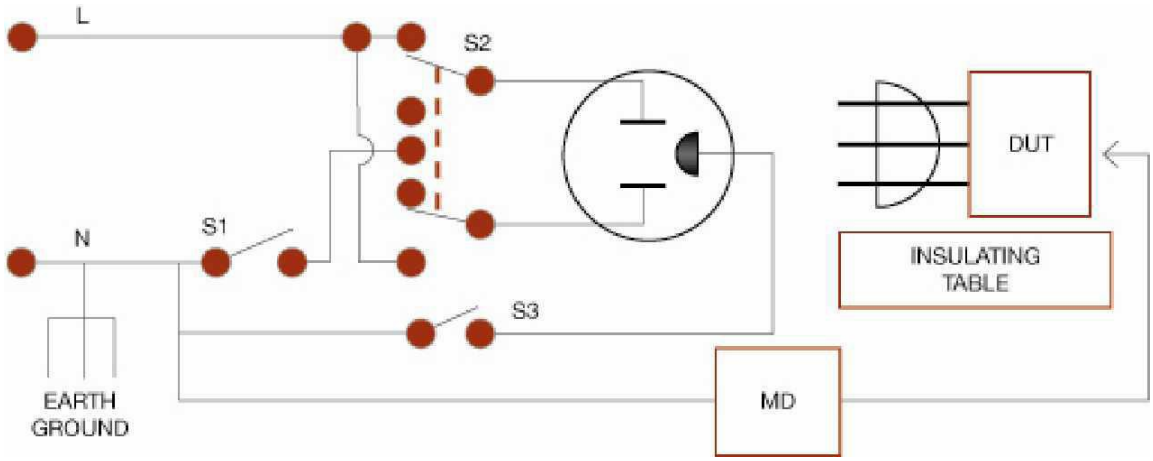

Figure 1: LCT Schematic

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28105 North Keith Drive - Lake Forest, IL 60045 USA
T. +1-847-932-3662 **F.** +1-847-932-3665
info@hipot.com www.hipot.com

The earth leakage test and the enclosure leakage test are performed in a sequence of 8 steps that simulate both the normal operating condition and 7 common fault conditions (see Table 1 below). Tests steps are performed through a network of relays inside the test instrument (see Figure 1). The information gained from these tests allows manufacturers to determine if their product will operate within safe limits even when the operator uses the product incorrectly or a fault occurs while the product is running.

Neutral (S1)	Polarity (S2)	Ground (S3)
Closed	Normal	Closed
Open	Normal	Closed
Closed	Reverse	Closed
Closed	Normal	Open
Open	Reverse	Closed
Closed	Reverse	Open
Open	Normal	Open
Open	Reverse	Open

Table 1: LCT Conditions Fault Conditions

Until recently, LCT testing was primarily reserved for medical device manufacturers because many medical products come into direct contact with the human body. However, as new all-in-one testers have become available, electrical product manufacturers of all types are starting to catch on to the benefits that LCT testing can provide. Whether the DUT is a lighting fixture, an appliance, or a hand held tool, performing a LCT as a 100% production line test is a great way to improve product quality and prevent product liability lawsuits.

Functional Run Test

Perhaps the most overlooked test on the production line, the Functional Run test is performed after traditional safety tests, but before the product is shipped. The purpose of the test is to provide final

verification that the DUT is operating within normal specifications. Performing a Functional Run test as a 100% production line test takes little time, but provides big benefits. The measurements taken during a Functional Run test provide important information about the DUT, including the operating input voltage, current draw, power consumption, and power factor. This information helps the test operator to verify that the DUT is functioning correctly before it arrives in the hands of a customer. Functional Run testing is especially important for manufacturers looking to sell their products internationally because a Functional Run test can help determine how products made in the U.S. behave when operating under foreign utility power.

Functional Run testing wasn't always easy or convenient because it often required the purchase of additional test equipment (power analyzers, digital multi-meters, etc.). Some new electrical safety testers like the SCI model 6330 (shown below) include Functional Run test capability, making it easy to verify that every DUT's operating parameters are within specification.

Figure 2: SCI Model 6330

By including a Functional Run test in every electrical safety routine manufacturers can prevent defective instruments from reaching customers, avoid costly recalls and reduce warranty-related repairs.

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28105 North Keith Drive - Lake Forest, IL 60045 USA
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info@hipot.com www.hipot.com

Incorporating LCT and Run Tests into Production Line Test Routines

With recent advances in safety testing technology, it has never been easier to setup and perform LCT and Functional Run tests quickly and efficiently. SCI's model 6330 allows manufacturers to perform Leakage Current and Functional Run tests along with hipot, ground bond, and insulation resistance tests with a single piece of equipment. Models like the 6330 make all necessary connections from one test to another internally, which not only increases operator safety but also minimizes the potential for operator error. Damaged test equipment is all but eliminated because all-in-one instrument designs drastically reduce test setup complexity. With multiple programmable memory locations, instruments like the model 6330 allow test operators to quickly program a test sequence that includes all necessary electrical safety tests followed by a Functional Run test without having to change test leads or hook-up additional equipment.

Conclusion

The decision to add both a Leakage Current test and a Functional Run test to your electrical safety testing routine is an important one. Although safety agencies do not require these tests for all electrical products, it still makes economic sense to consider performing them. With the technological improvements made to new testing equipment, it has never been easier or more cost-effective to improve both product manufacturing processes and quality assurance.

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