GKCL09 - Equipping the LVD Test Laboratory

Introduction

We are now nearing the end of this series of articles covering the LVD. In this ,the ninth article, we will consider the electrical and mechanical equipment that we will need for LVD Compliance proving.

Please note that the information contained in this series is intended to provide a basic awareness of some aspects of product safety testing and is not intended as an alternative to reading and understanding the relevant safety standard or seeking expert help.

Readers with specific requests for future subjects should address them to "The Editor" quoting GKCL09.

Compliance Proving or Production Test

It is often thought that if we have a HiPot tester and an Earth Bond Tester we have all the test equipment we need. This is a, potentially dangerous, underestimation of what is required. HiPot and Earth bond are the minimum equipment required to support production of mains powered equipment. To support Type-Testing and Compliance Proving a great deal more equipment is required.

To aid this potential for confusion, when we look at the specifications for the various equipment we see that there are a wide range of options. It is therefore vital that we understand the essential characteristics and properties of each: otherwise, it is quite likely that we will not purchase the 'best' options for money. Therefore we will carefully consider what will influence our choice of equipment.

We shall therefore consider what is essential, and what characteristics it would be '*nice - to - have*'.

Classifications of Requirements

One of the first considerations is if the equipment is intended for 100% Production Testing or for 'one-off' Type-Testing.

As we know - all mains powered equipment should have an Earth Bond - except, obviously Class II - and HiPot test. (Yet it is quiet alarming to realise how many manufacturers fail to implement these basic, rudimentary, safety tests.)

Earth Bond

For small or low volume production the requirements are not demanding and most simple Portable Appliance Testers will suffice - all that is required is 25Amps for about 5 seconds and a measurement of the resistance.

It is useful to have some form of "Zero-Calibration" so that when the probes are short-circuited the unit reads zero but we can always record the numbers and do the sums!

We must remember that these small, lightweight Earth Bond testers have limitations - usually they will require a 30 second "rest" between measurements - so that the transformer can cool - but otherwise I have found them (generally) satisfactory.

Do, however be aware that some of the 'clever' testers take charge of the test. Some will indicate "Failure - High Earth Resistance" - without giving a reading! Others just tell us "Pass" or "Fail" - I have a preference for numbers.

A good manual or semi-automatic Earth Bond tester will be quite satisfactory for Production Testing or Type-Testing.

As production quantities increase we need more specialist products. Bigger transformers capable of high duty cycle and a computer interface for control or data logging.

One client had a problem with lead resistance but was operating full statistical controls - this enabled them to remove products and test them on their type-test equipment so that they could re-calibrate their production (statistical) 'control-line'.

HiPot

Some people refer to this as Insulation Testing but this can lead to the mistake of making a resistance measurement using 500Vdc. Whilst this is good practice and useful (to identify potential failures in filters it does not test insulation.

For Production voltages between 1500 and 2,500 Volts are necessary to verify that insulation is in place. Anything less may "Pass" faulty insulation.

For Type-Test it is important to read the standard - test voltages of up to 4,500V may be required.

Some standards allow AC or DC HiPot testers. DC testing should always be the preference because measurements are not affected by filter capacitance - but do make sure there is a indication that the external load is discharged after testing. A 0.1µF capacitor charged to 2,000V stores 0.2 Joules and can pack an nasty punch to the unsuspecting user.

Other standards require 250VA (or higher) output to produce a "burn out" test. If specified then the correct power must be used.

High power is useful for tracing insulation faults but is not the only method. Some of the better 'Intelligent' HiPot testers have built-in sensing and will ramp continuously to provide a series of low-power flash-overs. This achieves the same result but will much less power. My personal preference is to use the lowest power possible (5-10mA) for reasons of 'self preservation' and limiting potential damage to circuits.

Mechanical Test Equipment

It is difficult to find something to say about a 500 gram 2" diameter steel ball, Jointed Test Finger, and Test Pins: but I shall try.

There are not easy to procure - in fact - I know only of one company from where they - plus everything else you will need - can be sourced. (Details at end of this article.)

Force Probes to produce the 30N and up to 250N force tend to fall into two classification:

- ?? Dial-gauge - designed for high use
- ?? Probe-type - designed for low use

The cost of these can vary by more than 2:1 so the best advice is to think carefully and check out the options before you buy.

Test Boxes

When we carry out our Type - Tests we will need some means of breaking into the mains circuit to inject high voltages or to measure voltage, current and resistance. It is therefore extremely wise to build (or purchase) a selection of suitable 'break-out' boxes. Without these the job of testing is not only more difficult but takes longer and is significantly more hazardous.

The following describe some of the 'break-out' boxes that can be used - some are identified as 'nice-to-have' others as 'essential'.

In brief these are summarised as follows:-

- The Constant Voltage Transformer (CVT) - optional - to stabilise the units connected downstream
- The Inverter - essential if equipment is to be used with a different mains frequency
- The Variable Transformer - essential
- Earth Leakage - essential
- Rise of Resistance - optional for measuring the temperature of wound components
- Outlet box - optional it makes life simple by having a range of UK, European, US and other outlet connectors

The Constant Voltage Transformer

The Constant Voltage Transformer (CVT) can be included as the first unit in the sequence - this will stabilise the voltage downstream - it is particularly valuable during long running thermal tests where fluctuations of mains voltage would invalidate the tests. This also avoids the need for constant monitoring of the mains voltage.

The Inverter

The Inverter is essential if the equipment being tested is to be supplied to a region with a different mains frequency. (e.g. 60 Hz equipment may overheat when used on 50 Hz: conversely 50 Hz equipment may have excessive Earth Leakage Current when used on a 60 Hz supply.)

It must be protected from instantaneous and permanent short circuits and open circuits. This device can be subject to high fault currents and inadvertent misuse, and needs to be 'bomb-proof'.

It will be used for a variety of tests, including thermal, and must be permanently rated for the maximum load.

The Variable Transformer

Our tests will require a wide range of supply voltage and therefore a Variable Transformer is essential for Type-Testing.

***Special note to North American engineers**:- You will not make true measurements if you derive 230 volts between two 115V phases. The differential voltage will be correct but the voltage with respect to ground will be only half that of the EU and you will measure about half the 'true' Earth Leakage Current.*

The Variable Transformer break-out Box (Essential) takes an input of 230V 50Hz or 110V 60Hz and allows the user to control the output voltage up to 10% above nominal mains voltage.

The mains feed is broken to allow voltage, current or power to be measured reliably and safely.

Earth Leakage Box

Whilst this is an essential measurement during type testing it may not, unless we consider there is a risk of non - compliance during manufacture, be necessary as a production test.

There are three basic methods of measuring Earth Leakage Current (ELC) but the standards only accept measurements made by two of them.

The first method involves using an isolating transformer, to isolate the Safety Earth Ground (SEG) from the equipment. The second method disconnect the SEG using a switch leaving the EUT floating. Both methods measure the current flowing through a precision shaping (filter) network connected to the 'floating' circuit. The third method uses a current transformer in the SEG line.

Whilst there are distinct advantages to this third technique the use of current transformers is not recognised by most of the safety standards and therefore we do not use them for Type-Testing.

Of the two acceptable methods the second method is quiet common because it produces a light and portable method of test. (Note An isolation transformer capable of 3kVA is ***seriously*** heavy!) The ELC test (along with most of the other Type - Tests) is commonly performed in a small cordoned-off area.

The filter network in these test sets is extremely venerable to catastrophic damage (I have destroyed several networks when measuring faulty equipment.). Also, some standards may require a different shaping filter. Therefore it is wise to select test equipment that can be fitted with a range of filters.

Rise of Resistance Box

Used with transformers, AC solenoids, motors etc. This is used for measuring the rise in resistance of windings - the measurement must be performed quickly to avoid measurement errors.

Outlet box

Not essential but could be high on the options list. This contains sockets for all the usual mains supplies world wide.

Documentation

Remember that our test evidence will form but one small part of the CE Marking Data (or Technical) File for the product. Whilst not difficult to produce it is essential that it is compiled correctly because, as any auditor will tell you, "if you find one problem then you know where to keep looking".

We will also need to produce instructions that detail what documentation will required from our engineering teams.

Test Methods

A few suppliers will provide detailed test methods with the test equipment that they supply; however not all of these test processes will enable us to test our product in accordance with the relevant safety standard.

If this level of documentation is not supplied then we must produce detailed instructions to enable these - potentially lethal - items to be used safely by our Compliance Engineers.

(Please note that Compliance Engineers are not Test Engineers nor are the Design Engineers but a very rare blend of the two.)

Test Reports

There are many Harmonised Safety Standards, compliance with which are essential before affixing the CE Marking. Most of these standards will contain about 200 pages of detailed requirements.

All of the major test houses and laboratories use a specialist format for test reports - these are commonly referred to as the "Competent Body" style.

These reports will reference each and every clause of the relevant standard. It will contain a brief synopsis of the condition, leaving space for the test engineer to enter their conclusion. (An abstract of one of these reports can be downloaded from http://www.gkcl.com.)

It is essential to understand why there are so many individual standards.

There are so many standards because:-

- ?? the types of hazards are so varied
- ?? the criteria of acceptability are so varied

and

- ?? the levels of acceptable risk vary between application

Therefore it is not possible to have a single test report that supports the LVD in a truly generic sense and we must use only those based upon the relevant standard for our products.