Test results and how

In the second in his series on form filling, *Graham Wretham* looks at the issues that could be tricky to deal with

Readers may recall in the last issue of *The Competent Person* I focused on the completion of the Electrical Installation Certificate or Periodic Inspection Report. Particular areas that were most commonly misunderstood on the inspection schedule were explained.

In this article I will look at the schedule of test results and again concentrate on the issues that appear to give electrical contractors most difficulty.

Firstly I will consider the requirements of testing.

The sequence and details of the relevant tests are as follows:

- continuity of protective conductors including main and supplementary equipotential bonding
- continuity of ring final circuit conductors, where applicable
- insulation resistance
- site applied insulation, not normally undertaken in general installations
- protection by separation of circuits, not normally undertaken in general installations
- protection against direct contact by a barrier or an enclosure provided during erection
- insulation of non-conducting floors and walls, not normally undertaken in general installations
- polarity
- earth electrode resistance
- earth fault loop impedance
- prospective fault current
- and functional testing.

It is most unusual for electrical contractors, other than specialist contractors, to get involved in site applied insulation, protection by separation of circuits and insulation of non-conducting floors and walls in their general contracting work. Accordingly, most schedule of test results' sheets, provided by scheme providers and test instrument manufacturers, do not make any provision for the recording of the results of such tests.

I will consider the tests that are usually undertaken and what common errors are made:

Continuity of protective conductors, including main and supplementary equipotential bonding

There are two options for undertaking this continuity test. The R1+R2 method or the wander lead (R2 only) method.

When testing for continuity of main and supplementary equipotential bonding, it is usual to apply the R2 only test. Before carrying out this test to confirm continuity of the appropriate bonding conductor, it is necessary to avoid the measurement of parallel paths.

Accordingly, it is advisable to disconnect one end of the bonding conductor to be tested and any intermediate connections with services.

The wander lead method is undertaken by connecting one lead of the test instrument to the main earthing terminal with a long lead. With this long lead and the other lead of the instrument, make connection at the remote end of the bonding conductor.

Electrical contractors should remember to null the test leads of their instrument for this test, otherwise the measured value will include the resistance of the wander lead. It is also important to remember to re-null the test leads of the instrument only when the R2 test is completed, otherwise, again, the measured value would give an incorrect measurement.

The R1+R2 method applies to circuit protective conductors and their associated phase conductor.

The procedure is as follows:

- Isolate the supply
- connect the phase and cpc conductors together at the distribution board
- measure the resistance between phase and cpc at each outlet or point
- measure and record the resistance between phase and cpc at the furthest point
- remove the temporary phase/cpc connection.

The R1+R2 method can also be used to check the polarity of each circuit. When testing R1+R2 at each point it is also necessary to operate the switch in order to confirm an open circuit condition when the switch is in the off position, thereby confirming polarity.

Continuity of ring final circuit conductors

The confirmation of continuity of ring final circuits requires five distinct steps to be undertaken. (Unfortunately some contractors appear to omit steps 2, 3 and 4.) The procedures are as follows:

Step 1

Conductor continuity

Isolate the supply

Measure the resistance of the end-to-end phase, neutral and circuit protective conductors separately and record the values.

The values of the phase and neutral conductors will indicate whether or not the conductors are

to fill the boxes

continuous. Moreover, the phase and neutral conductors should have the same value of resistance. The results taken should be recorded as r1, rn and r2. Alternatively, if the schedule does not include the provision for recording such measurements, then a (tick) should be entered in the column marked Ring.

Step 2a
Phase to neutral

Connect the incoming neutral to the outgoing phase of the circuit and vice versa. Measure the resistance between the pairs and note the result. The reading obtained should be half that obtained for either the phase or neutral conductor in step 1.

Step 2b

Measure between phase and neutral at each point on the ring circuit. The readings should be much the same as in step 2a. Sockets wired as spurs will give a slightly higher reading. There is no provision for recording these measurements on the schedule.

Step 3
Phase to earth

Repeat steps 2a and 2b but using the phase and cpc conductors. This test also confirms polarity. The highest value obtained should be recorded in the R1+R2 column.

Step 4
Reconnect the conductors

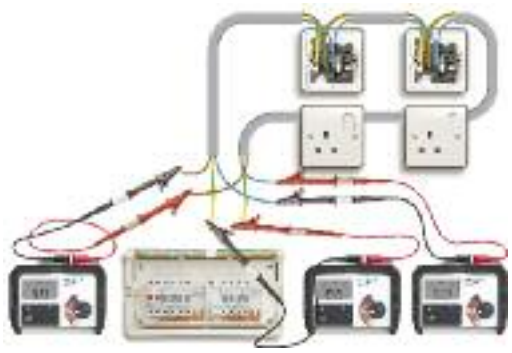
Insulation resistance
Before proceeding with this test it must be ensured that all equipment vulnerable to an insulation resistance test has been disconnected. The insulation is normally measured between live conductors and live conductors to earth. The procedure for insulation resistance testing between live conductors is as follows:

- isolate the supply
- disconnect all current using equipment and close all switches
- disconnect equipment vulnerable to a test
- check instrument and leads
- select test voltage range
- connect the instrument and record values of phase to neutral between phases, and phases to neutral for 3 phase supply and between live conductors (phase and neutral) and earth.

The value recorded should be what is measured by the test instrument, which is likely to be 299M, 500M or 1000 M depending upon the actual instrument manufacturer. The recorded value(s) should be >299, >500 or >1000, as applicable.

Continued on Page 14

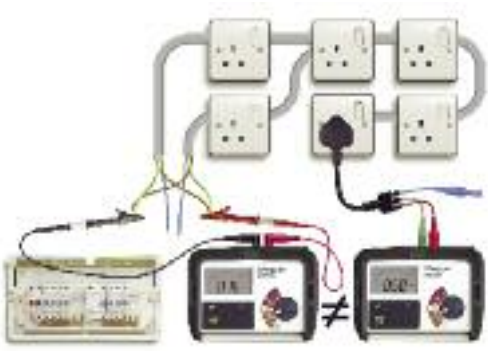
Step 1 **Checking continuity of live and protective conductors of a ring final circuit**



Step 2 **Ring final circuit with no spur**

Step 3 **Ring final circuits with no spur**

Step 4 **Ring final circuit with unintentional spurs**



Diagrams courtesy of Megger

Polarity tests and more

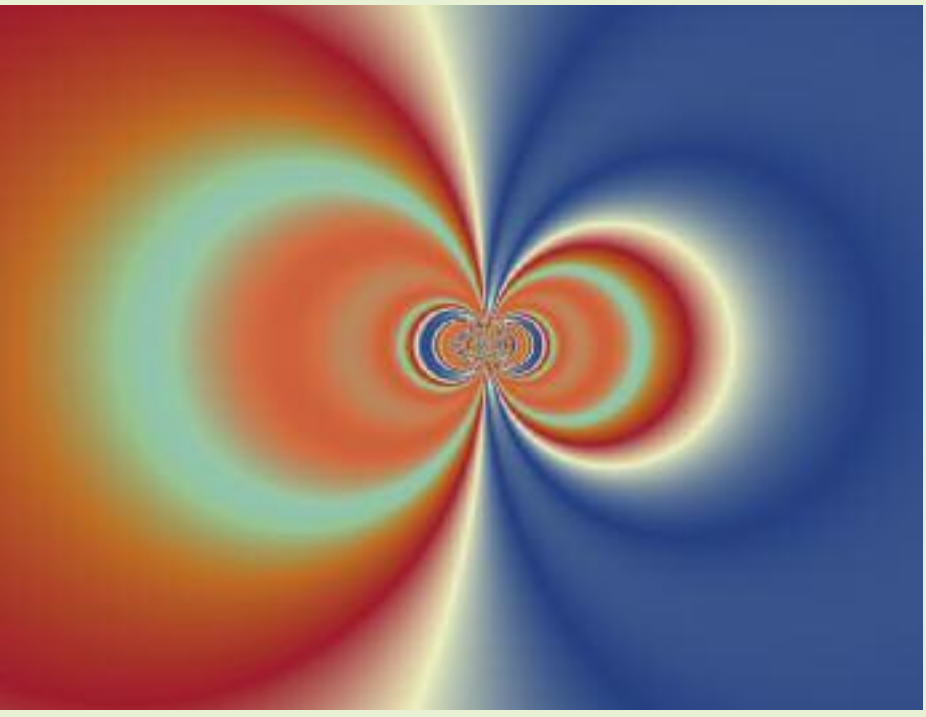
Continued from Pages 12 and 13

Polarity

Polarity tests are made to verify that every fuse or single pole device is connected in the phase conductor only. Edison screw lampholders should be connected so that the phase conductor is connected to the centre contact. A polarity check should also be made on the incoming supply.

The tests should be carried out before the installation is energised using a low reading ohmmeter or continuity test instrument.

Much of the polarity testing can be carried out during the process of testing cpc continuity by using the R1+R2 method. However, polarity should also be confirmed after connection of supply.



Earth fault loop impedance (external to the installation)
The external earth fault loop impedance Z_e is one of the supply characteristics to be recorded. Z_e can only be measured by testing at the origin of the installation. Before testing, the earthing conductor must be disconnected from the main earthing terminal and the entire installation must be isolated from the supply.

The purpose of disconnecting the earthing conductor is to ensure that measurement is not affected by parallel paths of, for example, the main bonding conductors. The instrument to be used is an earth fault loop impedance test instrument.

The procedure is as follows:

- open the main switch
- disconnect the earthing conductor
- check test instrument and leads
- apply test probes to the live side of the main switch and the disconnected earthing conductor
- check polarity indication for correct connection
- press the test button and record result
- reconnect the earthing conductor before restoring the supply.

Circuit impedance measurement
The type of instrument to be used is the same as that used for external impedance testing. The earth loop impedance (Z_s) of every circuit should be measured at the point furthest from the incoming supply. The test must be undertaken with all protective conductors connected.

Prospective fault current
This is the largest current that would flow in the event of a fault between live conductors or between a live conductor and the earthing conductor. The value should only be measured at the origin of the installation. Only the largest value is recorded

The earthing conductor, main bonding conductor and cpc should all be connected. The instrument used is an earth fault loop impedance test instrument with a prospective fault current range.

Next issue: circuit charts and diagrams