Misinterpreted Voltage Readings and the Capacitive Effect in Cables

Any electrical circuit consists of a number of conductors separated from each other by an insulating material. The definition of a capacitor is two conductors separated by insulating material. So any circuit will consist of at least one capacitor. When an alternating voltage is applied to the circuit, a charging current will flow in all the capacitors comprising that circuit. These currents will flow whether a load is connected to the circuit or not.

In low voltage circuits (less than 1 kV) these charging currents are very small; they usually remain undetected and being very small will normally do no harm. The test instruments normally used to measure currents in power circuits will not detect these charging currents. The size of these charging currents depends on many factors, including the applied voltage, the length of the cable, and the presence of other conductors nearby.

The use of neon testers or modern digital voltmeters has been known to often give dubious test results. Some neon testers will light up when measuring the voltage on the CPC, which in turn causes concern about the integrity of cable. The neon tester lights up, due to the capacitance effect of the cable when connected to an A.C. supply, as described above.

A voltage reading will be obtained when a digital voltmeter is connected between the floating C.P.C. and either the live or the neutral conductor (which are connected to the supply). The voltage reading obtained will depend on the length of the cable being tested, and the sensitivity of the voltmeter being used. They will typically be 110V, mid-way between zero and 230V. These readings will however disappear when the CPC is connected to earth.

If measurements are taken using an older piece of test equipment, such as a moving coil meter, the readings are often found to be negligible.

Tests to Verify Integrity of Cable

With the cable disconnected from all devices within the circuit, a simple resistance check between cores will determine if there is a true problem.

An IR test at 500V between insulated conductors and to CPC will also confirm if there is any insulation breakdown - this would be part of standard installation commissioning.
There will be a noticeable difference in resistance between the live core to CPC and the live core to other cores (neutral) due to the relative positions of the conductors within the cable.

If after doing these tests a short circuit or voltage breakdown is confirmed within the cable, then the fault needs to be isolated by splitting up the circuit and replacing the faulty section.

Tests on cables after installation should be carried out in accordance with BS7671:2008 (IET Wiring Regs.) and only using suitable test equipment.

Magnetic Field Effect

The outlined phenomenon should not be confused with voltages that would be induced into adjacent conductors by alternating magnetic fields. This would only occur when a current flows in the phase and neutral producing the magnetic field. For a twin and earth cable this would be very small indeed and in any case in a 'multicore' cable of this type the magnetic field is essentially cancelled out and so there are 'effectively no' induced circulating currents in the CPC.

LED Lighting Circuits

In some instances, lighting circuits which incorporate LED light fittings have been known to ‘glow’ even when the circuit is open. This is due to the phenomenon previously outlined and may occur even where the armour and/or CPC's are earthed. To cure this it is suggested to utilise switches to minimise long cable runs. The flickering of low energy lights is also thought to be caused by the same phenomenon. The electrician should refer to the manufacturer of the lights in the first instance.