Loop Testing

Loop testers are used to measure earth fault loop impedance and determine prospective fault currents. Initially loop testers used a high current load to measure the voltage drop on the supply and measure the source impedance. With the introduction of RCDs on many circuits alternative methods of loop testing have been developed to prevent tripping during a loop test.

The table below shows how different loop testing methods have different benefits; none of the test techniques are perfect. All tests are performed on live circuits with a variety of protective devices installed. Different test types are affected by these parameters in different ways and users should be aware of how this may affect the results. Loads should be disconnected during a loop test in case they interfere with the measurement.

Test currents

High loop test currents develop large signals that are easier and more accurate to measure. They also can cause large touch voltages on the installation under test that should be monitored to prevent danger.
Lower test currents are less likely to operate protection and touch voltages are reduced.

Loop testing limits

The IET Guidance Note 3 says that circuits rated up to 50 A can be tested with a loop tester with a resolution of 0.01 down to values of 0.2 Ohms. Values below this can be inaccurate and alternative methods should be used to calculate prospective fault current.

The Electrical Safety Council Best Practice Guide "Test instruments for Electrical Installations Accuracy and Consistency" offers further guidance. It suggests that low current tests below about 1Ω could be prone to significant errors.

Sources of error

Any loop test is measuring the small difference in voltage between a loaded and un-loaded condition. The loop test can be susceptible to errors from;

1, Changes in the load or switching on the supply
This can influence supply voltage during the test sequence.

2, Supply harmonics
These can affect general performance. They are less obvious than voltage changes.

3, Transformer proximity
Measurement close to the transformer will exhibit high reactance, but low resistance. This can produce a lower displayed loop impedance than expected.

4, RCD inductance
Low test currents may not always saturate the RCD measurement coil of some RCDs and RCBOs, presenting additional resistance in the measured circuit.

5, Test leads
The contact resistance of test leads, particularly on contaminated surfaces, and fused leads also add additional resistance to the measurement.

In all cases it is recommended to make more than one measurement to check that any changes in load or switching on the supply have not interfered with the results.

Safety and measurement standards

Testers must comply with EN61010 for safety and EN61557 for performance.

- BS EN61557-3 requires manufacturers to declare a measurement range within which the loop tester will achieve better than 30% accuracy under worst case conditions
- Guidance Note 3 "Inspection & Testing" talks about basic measurement accuracy of 5%. GN3 also states "The 'Operating Accuracy' is always worse than the basic accuracy"

Calibration checks

Intermediate checks should be performed on test equipment to ensure they do not deviate from their specification between calibration intervals. To check loop testers a dedicated socket is recommended. Check boxes are usually only able to add resistance to the supply source impedance.

Type of test	Technique	Advantages	Disadvantages	Notes
High current	2 x 23 A half cycles	Quick, accurate measurements within 3 – 4 s Same test for P-E and L-N tests	Trips RCDs when used P-E & some 6 A MCBs	Industry is tending towards lower test currents
DC biasing current	High dc current to block RCD plus high current test typically 23 A	Quick, consistent measurements Same test for P-E and L-N tests	Trips electronic RCDs Susceptible to supply offset voltages	Neutral connection required for power, but can be connected to earth
2-wire low current 15 mA	Low current tests for up to 30 s	Will not trip any RCD >30 mA; same as ½ x I no-trip RCD test	Slow, susceptible to noise and existing earth leakage currents	
3-wire high/low current	High current L-N, 15 mA L-E up to 30 s	Less susceptible to noise	Requires 3 wire connection RCD inductance can influence results Supply must have N-E connection so cannot be used on 110 V centre-tapped supplies	Neutral not always accessible
3-wire high/dc or low frequency AC current	High current L-N, dc L-E for up to 30 s	Faster than 2-wire test	Can be inaccurate on TT systems Supply must have N-E connection so cannot be used on 110 V centre-tapped supplies	Neutral not always accessible
2 wire low energy	Low energy test up to 30 s	Repeatable results, 2 wire connection Less susceptible to leakage currents	May trips some RCDs or RCBOs, Measurement accuracy depends on system characteristics	

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