8.6 Testing

Certain tests shall not be carried out in hazardous locations. Due to the characteristics of the intrinsic safety features of equipment, such equipment can be damaged by certain tests. Certain tests might be impractical in existing installations already under power.

8.6.1 General

NOTE Conduct all tests and complete a copy of Section 4: Tests for each distribution board and supply (normal and alternative supplies).

Additional tests may be required for large installations and where alternative supplies are installed.

For the testing of installations that are fully or partially in hazardous or specialized locations, see the relevant standards, and complete the additional report(s) (see 8.7 for medical locations and for hazardous locations).

For cases where multiple tests are required, such as earth resistances, protection device ratings, insulation resistances etc, record all those applicable to the installation under test and attach them to the test report.

In the case of failure in any test, the test shall be repeated after the fault has been rectified. Other tests that might have been influenced by the fault shall also be repeated.

8.6.2 Continuity of bonding

Confirm the continuity of the bonding conductors between all exposed conductive parts within arms reach (or see annex A) of each other. When a test device is used, it shall have a supply that has a no-load d.c. or a.c. voltage of 4 V to 24 V, and a current of at least 0,2 A. In each case, the resistance shall not exceed 0,2 Ω.

8.6.3 Resistance of earth continuity conductor

Determine the resistance of the earth continuity conductors between the earth terminal of the distribution board under test and the earthing terminals of all points of consumption and switches supplied from the disctribution board. The values shall not exceed those given in table 8.1. In instances where it is not practical to measure the resistance, suitability of the ECC can be confirmed by doing an earth loop impedance test from the point of consumption as prescribed in 8.6.5.1.

For final circuits with rated current greater than 63 A, table 6.28 shall apply.

Table 8.1 — Maximum resistance of earth continuity conductor and neutral

1	2
Rated current of protective device	**Maximum resistance of earth continuity path**
A	Ω
6	1,533
10	0,920
16	0,575
20	0,460
25	0,368
32	0,288
40	0,230
45	0,204
50	0,184
63	0,146

All socket-outlets shall be tested by inserting a plug and including the resistance of the earth pin in the measurements.

8.6.4 Continuity of ring circuits (where applicable)

Remove both ends of each live conductor, separate them and test the circuit for continuity. Ensure that the two ends of the live conductor are connected to the same terminal after the test (see 6.6.1.13).

8.6.5 Earth and neutral fault loop impedance at the main switch

8.6.5.1 At the main switch, the earth loop impedance shall be such that an earth fault current double the rated current (or higher) of the main protective device automatically disconnects the supply to the installation. Table 8.2 indicates the earth fault loop circuits for different distribution systems.

Table 8.2 — Earth fault loop circuits for different distribution systems

1	2	3	4	5	6
Electricity supply system earthing	**Earth fault loop circuit**				
	Source	**Phase**	**PEN**	**PE**	**Return through earth (soil)**
TN-C-S (Figure J.2.1)	X	X	X		
TN-S (Figure J.2.2)	X	X		X	
TT (Figure J.2.3)	X	X			X

NOTE 1 The items marked X form the loop for the particular supply system earthing.

NOTE 2 The TT system relies on a low-impedance earth both at the source transformer and at every consumer's installation. This system is impractical in most parts of Southern Africa due to high soil resistivity and conductor losses. It has the added disadvantage that the loss of earth connection is not inherently self-monitoring. The system is not recommended for use in South Africa.

8.6.5.2 Where a Neutral conductor is provided, test the Neutral loop impedance for all low voltage distribution systems.

NOTE 1 For this test using the same instrument as per 8.6.5.1, both the neutral and earth clamps of the instrument will be connected onto the neutral conductor.

NOTE 2 To carry out this test, where possible switch off the main switch and disconnect the main neutral so as to minimise parallel neutral or earth paths. Connect the test leads to the line side of the supply. The resistance reading should normally be lower than that calculated for the earth loop impedance or be at least substantially the

same. At no stage may the Neutral impedance ever be higher than that calculated for the earth conductor

NOTE 3 The introduction of the neutral fault loop impedance test will be implemented six months after the publication of this document.

8.6.5.3 At the main switch, the neutral loop impedance shall be such that the fault current double the rated current (or higher) of the main protective device automatically disconnects the supply to the installation.

8.6.5.4 If, for practical reasons, the requirement in 8.6.5.1 and 8.6.5.2 cannot be complied with, as an alternative, an earth fault detection and disconnecting device may be installed at the supply to the installation. The earth fault detection and disconnecting device should be so installed that it operates at a current related to the earth fault loop impedance which will limit touch voltages to 25 V under short-circuit fault conditions for a period not exceeding 5 s.

8.6.6 Elevated voltage on supply neutral

With the main switch off, measure the voltage between the supply neutral and any earth external to the installation. Notify the supplier if the reading exceeds 25 V.

Disconnect the installation and notify the supplier (see annex H) if the reading exceeds 50 V.

8.6.7 Earth resistance

8.6.7.1 Earth resistance can be determined in accordance with SANS 10199. Where the supplier does not provide an earthing terminal or where an alternative supply is installed, the efficiency of the earthing system can be confirmed by this test in SANS 10199.

8.6.7.2 Where the supplier provides an earthing terminal, this test is optional.

8.6.8 Insulation resistance

NOTE 1 Before power is connected to any new or altered circuit, the test for insulation resistance should be carried out to ensure there is no short-circuit or high impedance faults in the installation, and that it is safe to energize.

NOTE 2 In the case of existing installations where the power may not be switched off from certain circuits in order to carry out this test, the fact that the circuits are subject to the supply voltage can be regarded as evident that the insulation resistance is compliant.

WARNING: Special precautions are required for medical locations and in hazardous locations (see 7.7 and 7.14).

8.6.8.1 When carrying out insulation-resistance tests,

a) use an a.c. or d.c. voltage of at least twice the nominal voltage, with a minimum of 500 V,

NOTE The working voltage is taken as the maximum of the voltages measured.

a) in the case of a.c., between each phase conductor and either the neutral or the earthing conductor, and

b) in the case of d.c., between positive and negative conductors.

b) ensure that all fuses are in place and switches and circuit-breakers are in the closed positions. Loads may be disconnected.

NOTE To prevent damage, ensure that voltage-sensitive electronic equipment such as dimmer switches, touch switches, time delay devices, power controllers, electronic starters for fluorescent lamps, earth leakage units, surge protection devices and certain appliances are disconnected so that they are not subjected to the test voltage.

8.6.8.2 The insulation resistance, measured as follows, shall be at least 1,0 MΩ:

a) to measure the insulation resistance to earth, apply the test voltage between the earth continuity conductor and the whole system of live conductors, or any section of it; and

b) to measure the insulation resistance between the conductors, apply the test voltage

1) between the phase conductors, and, when relevant,

2) between the phase conductors and the neutral conductor.

8.6.8.3 When there are sub-distribution boards and the total insulation resistance is less than 1,0 MΩ, the insulation-resistance test may be carried out by

a) isolating and testing the wiring between the main supply and the sub-distribution boards, and

b) testing, as a separate section, each sub-distribution board connected to all the circuits that it feeds, but the insulation resistance in each section shall be at least 1,0 MΩ.

8.6.9 Voltage, at distribution board — no load

With all load switched off, measure the voltage at the point of control. Notify the supplier (see annex H) if the voltage is outside the standard voltage limits (see 5.4.2).

8.6.10 Voltage, at distribution board — on load

Switch on the maximum available load and measure the voltage at the point of control. Calculate for full load conditions and notify the supplier (see annex H) if that voltage will be outside the regulatory limits (see 5.4.2).

8.6.11 Operation of earth leakage units

Ensure that earth leakage protection is installed in each circuit that is required to be so protected. At various points of outlet and for each phase conductor of the outlet, measure the earth leakage tripping current and record the value on the test report. There may be more than one unit in a DB, in such case each needs to be tested accordingly.

The unit must sustain a leakage current at 50 % and trip at 100 % of the rated earth leakage tripping current (rated residual current) $I_{\Delta n}$.

NOTE This test can be carried out only after power is available at the point of supply.

8.6.12 Earth leakage test button

Press the test button to see that the unit trips.

There may be more than one unit in a DB, in such case each needs to be tested accordingly.

NOTE The test is intended to check whether the earth leakage unit is operating correctly, not to check its sensitivity.

8.6.13 Polarity at points of consumption

Ensure that

a) all single-pole switching devices, fuses and circuit-breakers have been connected in the phase conductor,

b) the phase terminals in fixed appliances and in all single-phase socket-outlets have been connected to the phase conductor,

c) the centre contact of each Edison-screw lamp holder is connected to the phase conductor, and

d) phase rotation and identification is maintained for three-phase systems on the supply sides of all distribution boards.

8.6.14 Switching devices

Ensure that when switching devices are operated, the circuit is interrupted as intended.

8.7 Test reports

The following test reports are applicable:

a) Test report for all electrical installations, excluding secondary reticulation,

b) test report for secondary reticulation per 7.16,

NOTE this report may be supplemented with the additional report for a medical location.

c) Additional test report for electrical installations in medical location, and

d) Inspection and test report for electrical installations in hazardous locations.