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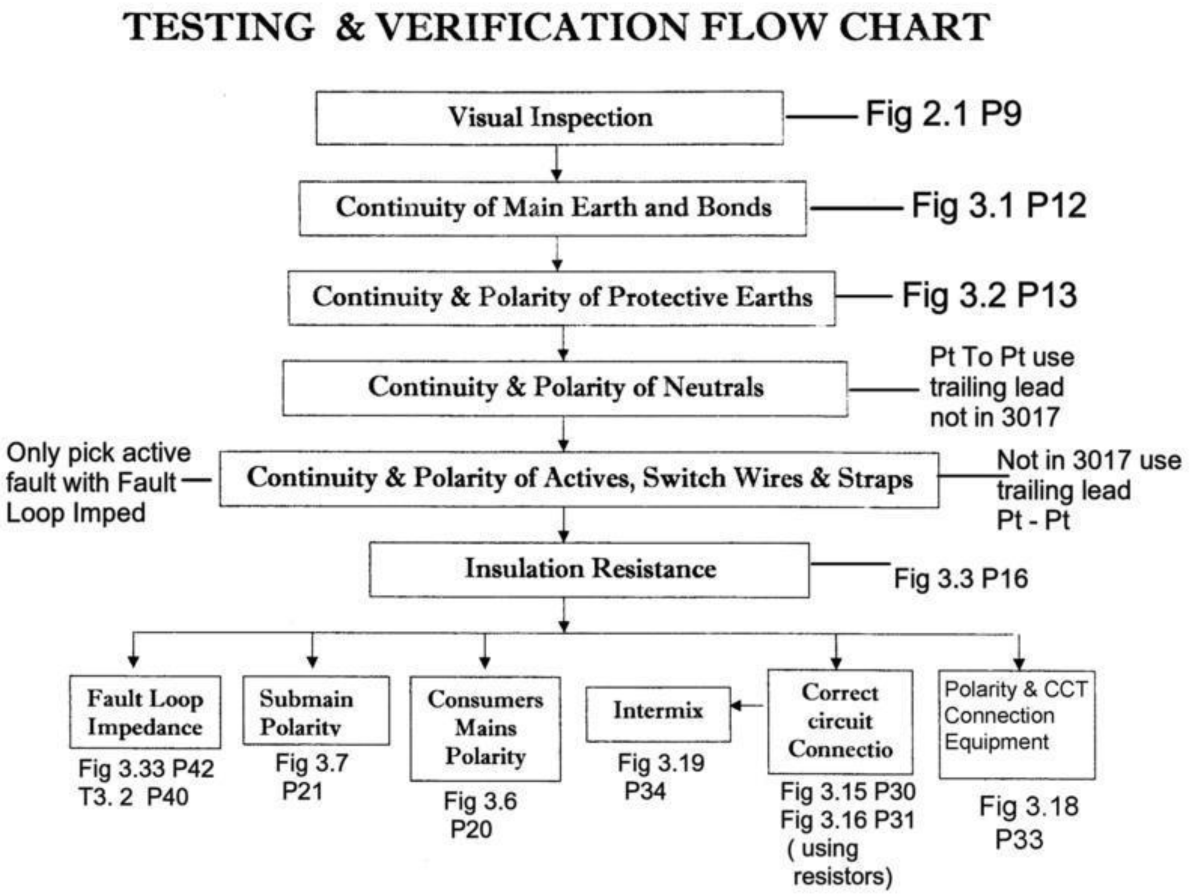
UEENEEG105A

http://www.highlightcomputer.com/electricaltrade2021.htm#G105

UEEEL0039

1.Prepare to design, install, inspect and test an electrical installation



UEEEL0039

5. Visually inspect and conduct safety testing on electrical installation

VISUAL INSPECTION

Portable Electrical Equipment	Yes	No
1. Is there damage (apart from light scuffing) to the cable sheath?		
2. Is the plug damaged (eg. the casing cracked or pins bent)?		
3. Are there inadequate joints, including taped joints, in the cable?		
4. Is the coloured insulation of the internal cable cores showing where they enter the plug?		

5.	Does the appliance appear to have been subjected to conditions for which it is not suitable (eg. is it wet or excessively contaminated)?		
6.	Is there damage to the external casing of the equipment or are there loose screws or parts etc?		
7.	Is there evidence of overheating (eg. burn marks or discoloration)?		
8.	Is the main on/off switch damaged, does it operate incorrectly?		
Notes:			

An answer "Yes" to any of the above indicates that the appliance is potentially dangerous and must be taken out of use.

	General Electrical Inspection: Visual inspection of electrical equipment may include the following:	**Yes**	**No**
1.	Flexible cords in good condition ie look for cuts, abrasion or damage		
2.	External components or casing are not damaged (these may form part of the insulation)		
3.	Power and extension cords anchored and separated from other hazards such as liquids, mechanical action or traffic areas.		
4.	Covers, guards, controls, alarms or mechanical safety features are in good condition		
5.	Power outlets and power boards are not overloaded.		
6.	Cords are kept away from traffic areas.		
7.	Electric cords and wiring are not kept under carpets where they are subject to wear and tear		
8.	Electric cords and wiring are not run through windows or doorways where they are subject to abrasion		
9.	Double adapters are not used (power-boards should be used)		
10.	Bar radiators and para-flood lamps are not used for heating purposes		
11.	Appropriate electrical equipment are used in wet areas such as around sinks and in toilets		
12.	Only designated electrical appliances, equipment, or extension cords are used in areas which contain dangerous or hazardous materials (flammable, explosive, or corrosive)		
Notes:			

Continuity of Main Earth and Bonds

Which Earth Continuity Test

- View Larger
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Which Earth Continuity Test?

The earth continuity test is a designed to test the resistance of the protective earth of an appliance and/or the supply lead. It is measured between any accessible earthed parts and the earth pin of the plug.

The test is based on the principles of Ohm’s Law.

By applying a known voltage and current, the resistance can be calculated using the formula Voltage ÷ Amps = Resistance (Ω).

When performing the earth continuity test you have three options for the test current you apply.

1. 12 V maximum, test current in the range 100 to 200 mA; commonly known as "*screen test*"
2. 12 V maximum, test current of 10 A (rarely used)
3. 12 V maximum, test current of 1.5 times the rated current of the appliance or 25 A, whichever is the greater; commonly known as a "*bond test*"

Most portable appliance testers (PATs), including multimeters, should be able to perform the screen test. The *screen test* is useful for detecting poor connections of the earth conductor to either the chassis or the earth pin of the plug, commonly due to a loose connection or corrosion; the low current being applied makes it fairly sensitive to increases in resistance.

The *bond test* is useful for detecting defects such as breaks in the strands of the earth conductor or connections that can't handle the maximum potential current load that could go through the earth conductor; the higher current being applied would result in high resistance reading.

When there is resistance to the current flow the energy is converted into heat. The heat may be great enough to cause the filaments to melt. Here are two examples to demonstrate how you could have a situation where performing one type of test could produce a pass and the other test would produce a fail.

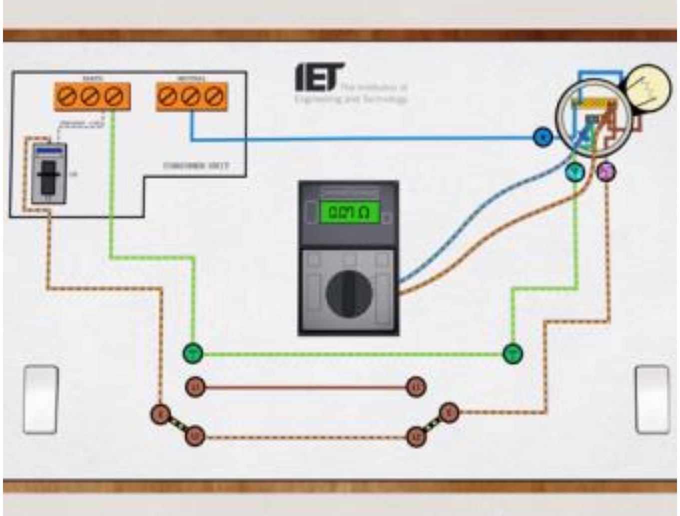
Example 1 The earth connection to the chassis of the appliance is corroded. This could inhibit the flow of the low test current used with the screen test and result in high resistance readings. However the test current used in the bond test is significantly higher and it could "ram through" like a Mac truck with little resistance. In this case, the screen test would be the best choice as it would detect the defect.

Example 2 The connection to the earth pin is held in place by only a few strands. The screen test would produce a pass as there are enough strands to allow the current to flow with little resistance, however there are not enough strands for the higher test current of the bond test to flow unimpeded. This resistance could cause the strands to get so hot they melt and produce a very high resistance reading. In this case, the bond test would be the best choice.

Summary As you can see from these two common examples neither test can detect all possible earthing defects, each test has their own pros and cons.

So which should you use? Unfortunately there is no right or wrong answer. You may in fact want to perform both. Don't be too concerned about performing the bond test on IT equipment. I have done thousands of these without any damage occurring to the appliance(s) and believe it doesn't pose a risk to the appliance provided you do it correctly.

Further reading: Standard AS/NZS 3760 Appendix D



For all protective conductors, including main and supplementary bonding conductors, electricians *must perform a continuity test using a low-reading ohmmeter.* For main equipotential bonding, there is no single fixed value of resistance above which the conductor would be deemed unsuitable. [See European terminology list at end of article]

[Introduction photograph. Continuity of protective conductors (Photo credit: tradeskills4u.co.uk)]

Each measured value, if indeed it is measurable for very short lengths, should be compared with the relevant value for a particular conductor length and size. Such values are shown in Table 1.

CSA (mm)	Length (m)									
	5	10	15	20	25	30	35	40	45	50
1	0.9	0.18	0.27	0.36	0.45	0.54	0.63	0.72	0.82	0.9
1.5	0.06	0.12	0.18	0.24	0.3	0.36	0.43	0.48	0.55	0.6
2.5	0.04	0.07	0.11	0.15	0.19	0.22	0.26	0.03	0.33	0.37
4	0.023	0.05	0.07	0.09	0.12	0.14	0.16	0.18	0.21	0.23
6	0.02	0.03	0.05	0.06	0.08	0.09	0.11	0.13	0.14	0.16
10	0.01	0.02	0.03	0.04	0.05	0.06	0.063	0.07	0.08	0.09
16	0.006	0.01	0.02	0.023	0.03	0.034	0.04	0.05	0.05	0.06
25	0.004	0.007	0.01	0.015	0.02	0.022	0.026	0.03	0.033	0.04
35	0.003	0.005	0.008	0.01	0.013	0.016	0.019	0.02	0.024	0.03

Table 1. Resistance (O) of Copper Conductors at 20°C

Where a supplementary protective bonding conductor has been installed between simultaneously accessible exposed and extraneous conductive parts the resistance of the conductor *R must be equal to or less than 50/ Ia.*

So, R ≤ 50/Ia, where 50 is the voltage, above which exposed metalwork should not rise and Ia is the minimum current, causing operation of the circuit protective device *within 5s*. For example, suppose a *45 A* BS 3036 fuse protects a cooker circuit, the disconnection time for the circuit cannot be met, and so a supplementary bonding conductor has been installed between the cooker case and the adjacent metal sink.

The resistance *R* of that conductor should not be greater than *50/ Ia*, which in this case is 145 A (IEE Regulations). So:

50/145 = 0.34 Ω

How then do we conduct a test to establish continuity of main or supplementary bonding conductors?

Quite simple really, just connect the leads from the continuity tester to the ends of the bonding conductor (figure 1). One end should be disconnected from its bonding clamp; otherwise, any measurement may include the resistance of parallel paths of other earthed metalwork.

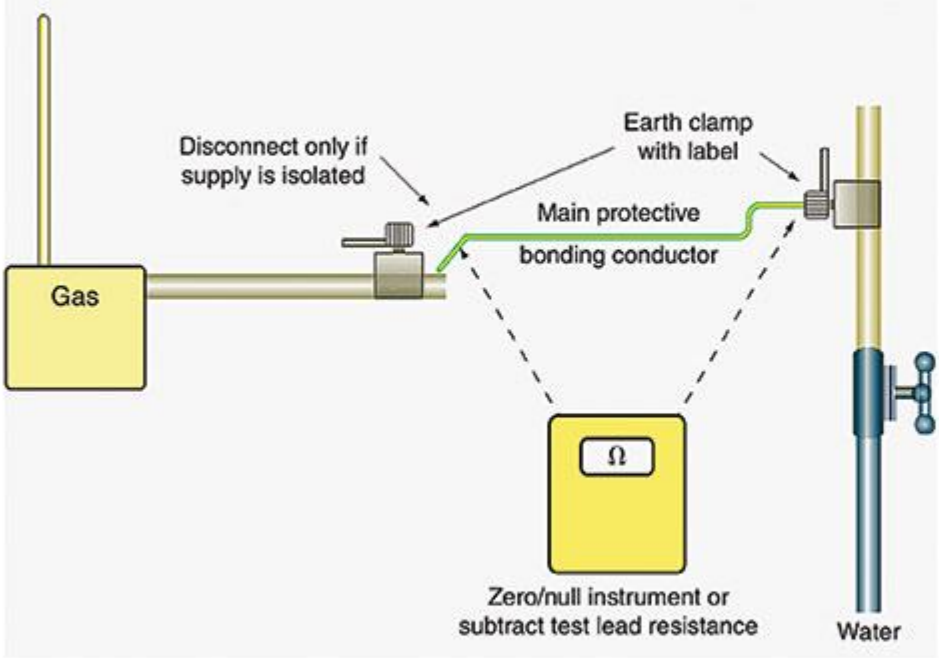


Figure 1.

Continuity of main protective bonding conductors

Remember to zero the instrument first or, if this facility is not available, record the resistance of the test leads so that this value can be subtracted from the test reading.

Important Note:

If the installation is in operation, never disconnect main bonding conductors unless the supply can be isolated. Without isolation, persons and livestock are at risk of electric shock.

The continuity of circuit protective conductors (CPCs) may be established in the same way, but a second method is preferable, as the results of this second test indicate the value of (R1+R2) for the circuit in question.

The test is conducted in the following way (Figure 2):

1. Temporarily link together the line conductor and CPC of the circuit concerned in the distribution board or consumer unit.
2. Test between line and CPC at each outlet in the circuit. A reading indicates continuity.
3. Record the test result obtained at the furthest point in the circuit. This value is (R1+R2) for the circuit.

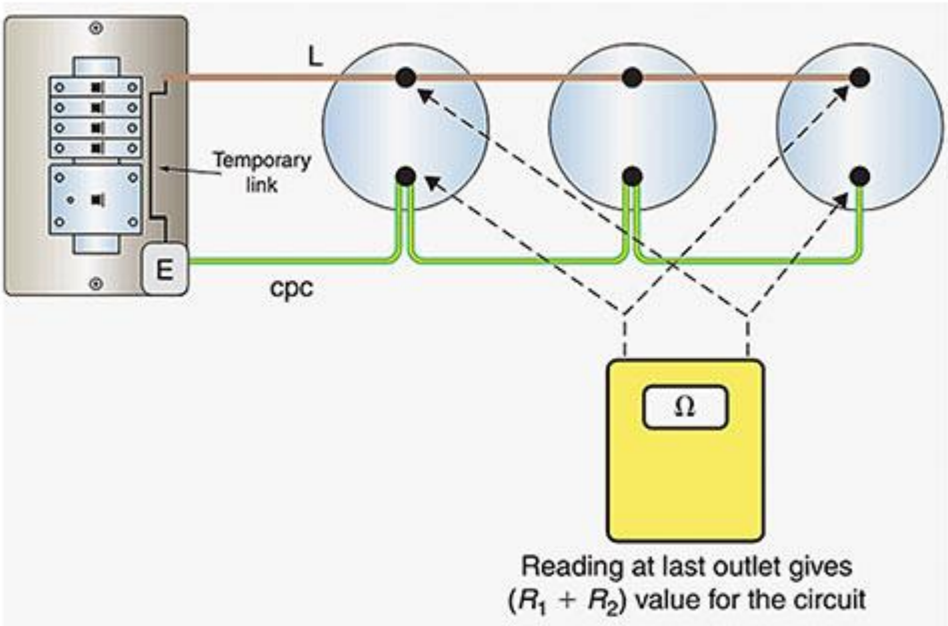


Figure 2. Circuit protective conductors (CPC) continuity

There may be some difficulty in determining the (R1+R2) values of circuits in installations that comprise steel conduit and trunking and/or steel wire armoured (SWA) cables and mineral-insulated metal-sheathed (MIMS) cables because of the parallel earth paths that are likely to exist.

In these cases, continuity tests may have to be carried out at the installation stage before accessories are connected or terminations made off as well as after completion.

Terminology in Europe:

Supplementary bonding. Green and yellow conductors that connect accessible metal parts of electrical equipment (such as a heated towel rail) to accessible metal parts of items of electrical equipment and/or accessible metal parts of items that are not electrical (such as pipes). These connections are made to prevent a dangerous voltage between two accessible metal parts, in case there is a fault. You may need supplementary bonding for rooms containing a bath or shower, except where all circuits in the room are RCD protected and the main bonding is up to the required standard.

Residual current devices (RCDs). A sensitive switching device that trips a circuit when it finds an earth fault.

The circuit protective conductor(increasingly called the 'c.p.c.') is a system of conductors joining together all exposed conductive parts and connecting them to the main earthing terminal. Strictly speaking, the term includes the earthing conductor as well as the equipotential bonding conductors.

Video

https://www.youtube.com/watch?v=ScD3Y1Ty5n8

https://www.youtube.com/watch?v=R2XygQfgJao

https://www.youtube.com/watch?v=rnvNfI__kYU https://www.youtube.com/watch?v=u5SCOb4dBus

https://www.youtube.com/watch?v=Ipo-veJdiTc

https://www.youtube.com/watch?v=2H8ATUWefSk

Continuity and Polarity of Protective Earth

Testing requirements for an installation

When carrying out testing on a new installation or when alterations/additions are made to an installation, a suggested sequence of testing as per AS/NZS 3000:2018 Section 8 would be as follows:

- Visual inspection of works carried out
- Earth resistance test – continuity of the main earthing conductor
- Earth resistance test for other earthed and equipotential bonded parts
- Insulation resistance test of installation
- Polarity and connections test of circuits/wiring installed e.g. consumers mains, submains or sub-circuits.
- Earth fault loop impedence test
- Verification of operation of residual current devices

Further information can be found under AS/NZS 3000:2018 Section 8: Verification.

When carrying out testing ensure all test results are recorded and records are maintained for 5 years. (ELR 1991 Reg 52 (2D)

Recently during inspections being carried out it has been found that the MEN connection has been missed during checking and testing on several installation inspections. This is regarded as a serious defect. Reason given for this has been that it is no longer a requirement to carry out earth fault loop impedence tests as circuits are now covered by RCD and the test is no longer required.

Electrical contractors and electrical workers are reminded that while RCDs can be used to achieve automatic disconnection of supply, RCDs fitted to circuits are intended only to augment other measures of basic protection and that RCD's are additional circuit protection to that of the primary circuit protection. (AS/NZS 3000:2018 clause 2.4.1, 2.6.1)

The operation of the circuit protection is reliant upon the integrity of the MEN connection and the supply neutral (PEN) conductors. If the value of the earth fault loop impedance exceeds that of Table 8.1 AS/NZS 3000:2018 then correct operation of the primary circuit device may not be achieved. Further information on this can be found under Appendix B, B4: Protection by automatic disconnection of supply.

When completing the Electrical Safety Certificate and/or Notice of completion for electrical works carried out, electrical contractors and workers are again reminded to ensure that when completing section 4E as the completing electrical worker and signing off as the nominee that all electrical work has been checked, tested, test results recorded and certified safe to operate when connected to supply. (AS/NZS 3000:2018 clause 2.1.2 and 4.1.2, E(L)R 1991 Reg 49, 49B, 52(2B), 52(2D) and 52B.)

Note: Under certain circumstances a test for fault loop impedance could give a false impression that a MEN is present, therefore a visual confirmation of the MEN is essential.

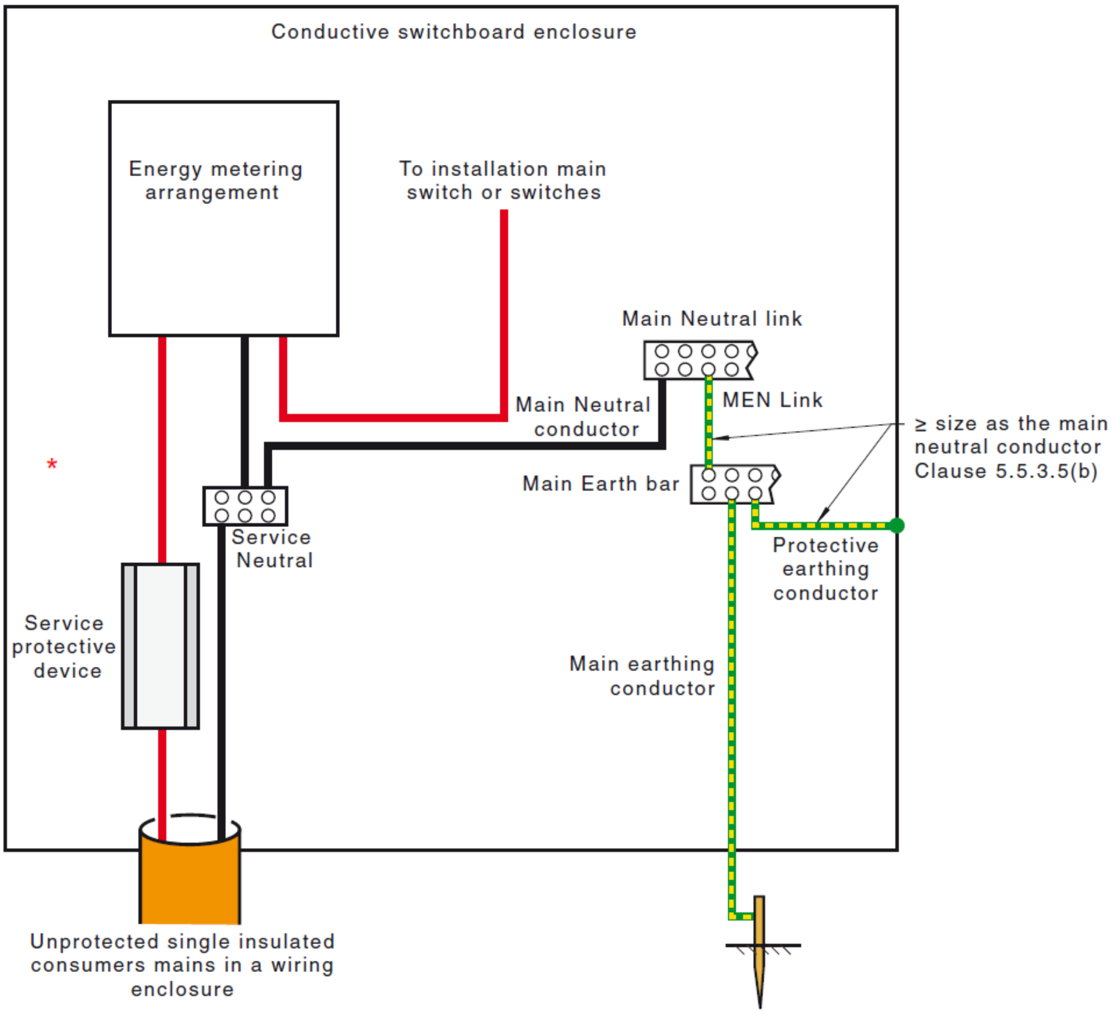
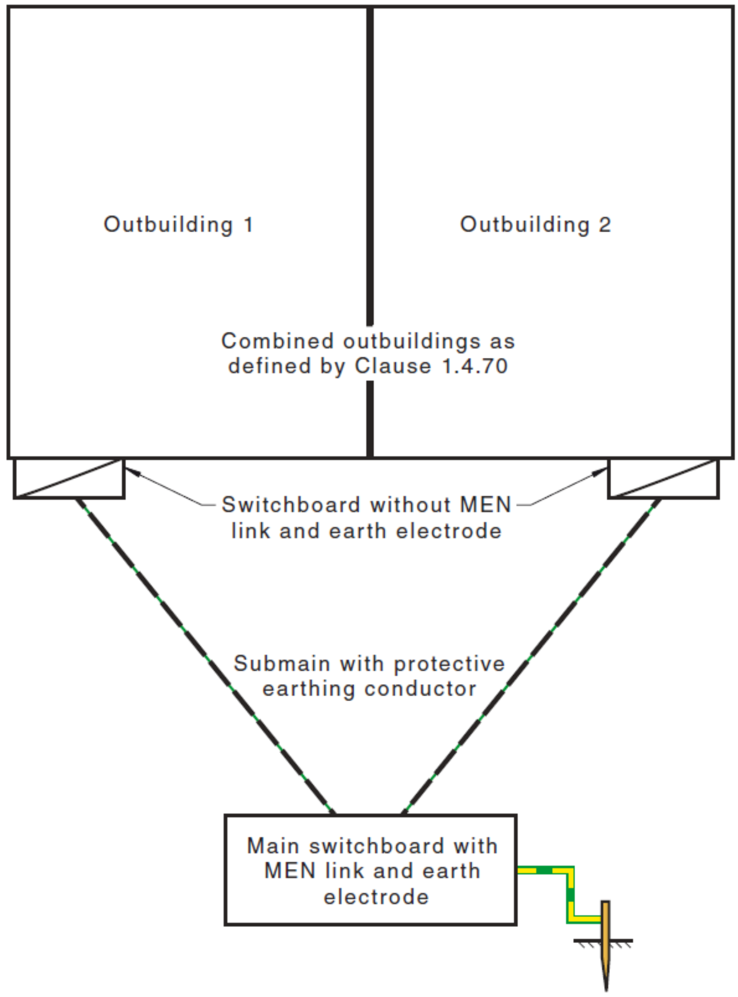
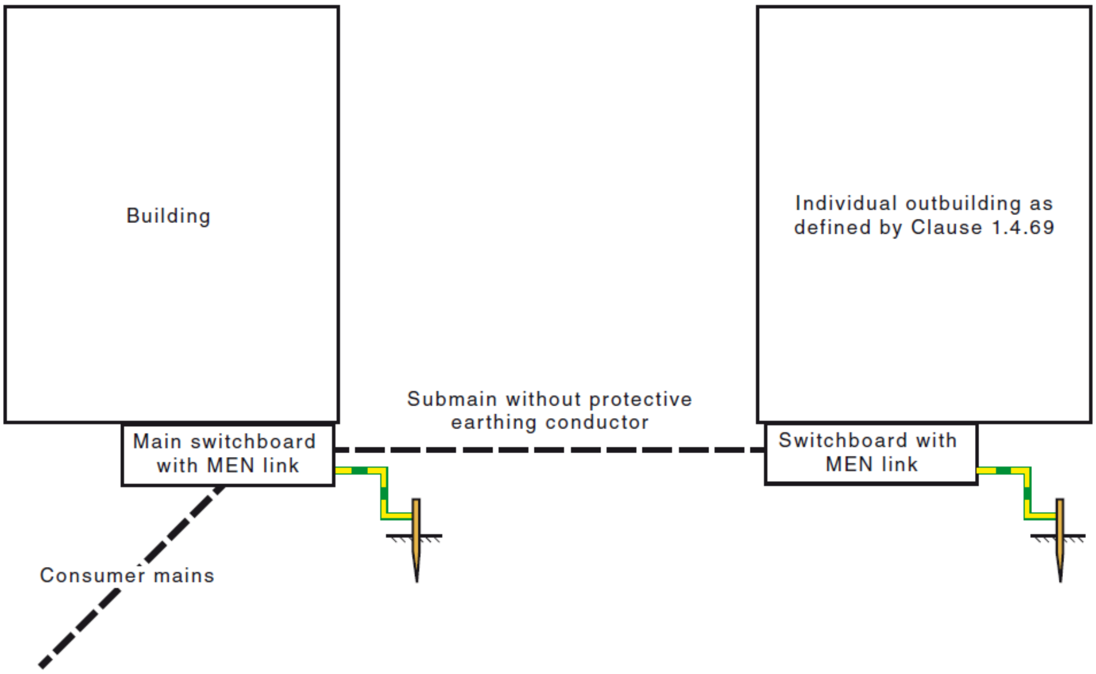


FIGURE 5.6(B) EARTHING ARRANGEMENT FOR CONDUCTIVE



NOTE: Combined outbuildings shall not be earthed as separate MEN installations.

FIGURE 5.5 EXAMPLE OF EARTHING OF COMBINED OUTBUILDINGS
[CLAUSE 5.5.3.1(b)]



NOTE: An individual outbuilding may also be earthed using a submain earth cable in lieu of its own MEN connection and earth electrode.

* FIGURE 5.4 EXAMPLE OF EARTHING OF AN INDIVIDUAL OUTBUILDING [CLAUSE 5.5.3.1(a)]

Video

https://www.youtube.com/watch?v=LcJu2tlhpiI

https://www.youtube.com/watch?v=vtyPt9MVUbA

https://www.youtube.com/watch?v=dMtxkhL6c8I

https://www.youtube.com/watch?v=X5VEtGTSrwg

Continuity and polarity of active switch wire and Straps

What is polarity testing?

Polarity testing is one of the tests that are required for initial testing of the installation under IEC 60364 standard.

This test will verify that all the switches installed in the system are connected in current carrying conductor and not in neutral. For example, if you isolate or switch the neutral of a circuit via a single-pole circuit breaker or switch, it would appear that the circuit is dead where in fact it is still live.

source: TLC-Direct UK

If polarity is not correctly determined there may be a risk of electric shock during maintenance procedures.

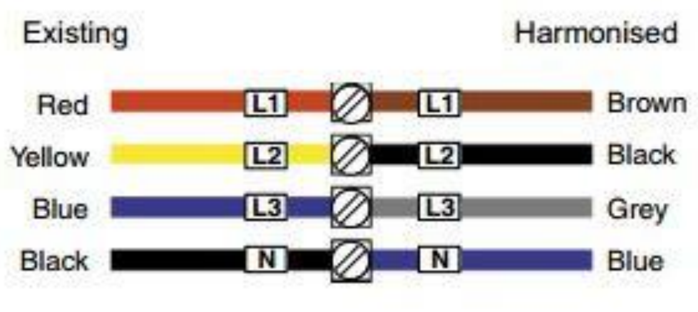
This would not be the case, as live conductors and connections would be present at fixed equipment, sockets and switches - this would be very dangerous.

There are three recognized methods of evaluation. All three methods have their advantages and possible dangers, if they are not carried out correctly.

Methods of polarity testing

1. Polarity by visual inspection

By using your knowledge and sight, correct termination of cables relating to core colors can be established.

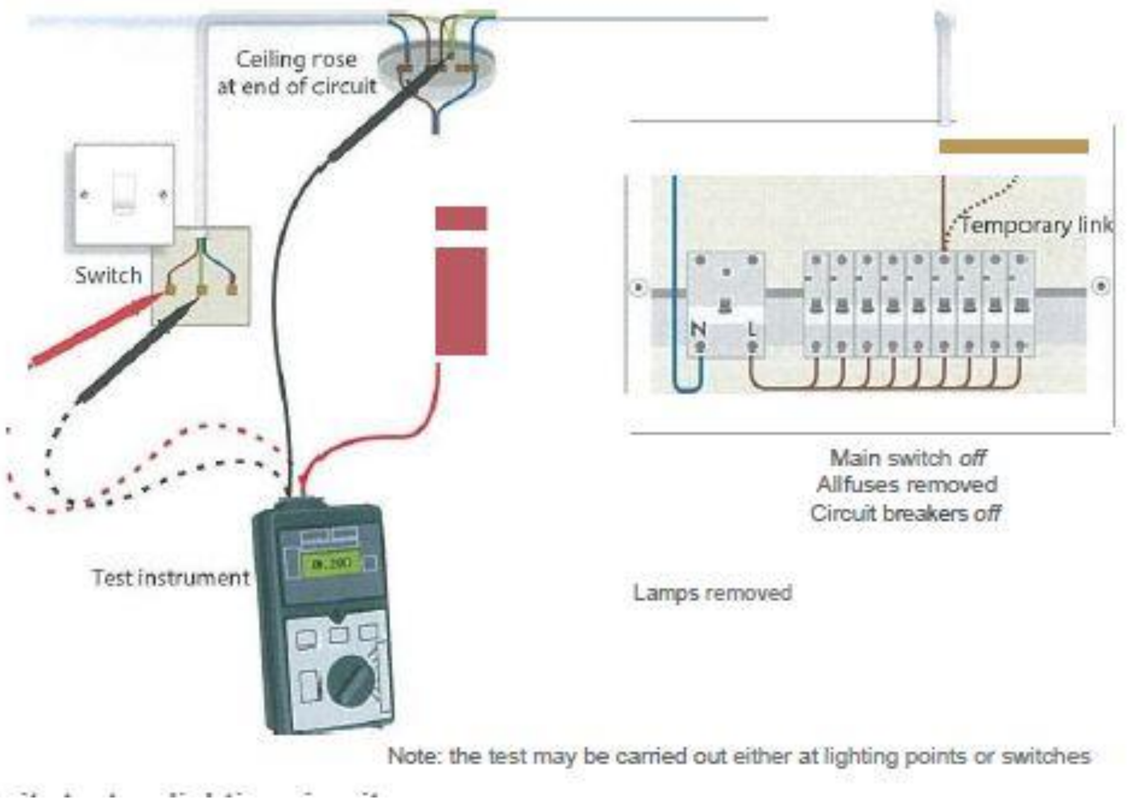


Color Coding Sample
Source: IEC

It is essential that polarity is checked visually during the process of installation, especially in cases where checking by testing is impractical.

2. Polarity by continuity testing

If visual inspection is not possible, you will need to use a low-resistance ohmmeter for this test. When you continuity test radial and ring final circuits, part of the process is to test and visually inspect the polarity of fixed equipment and socket outlets.

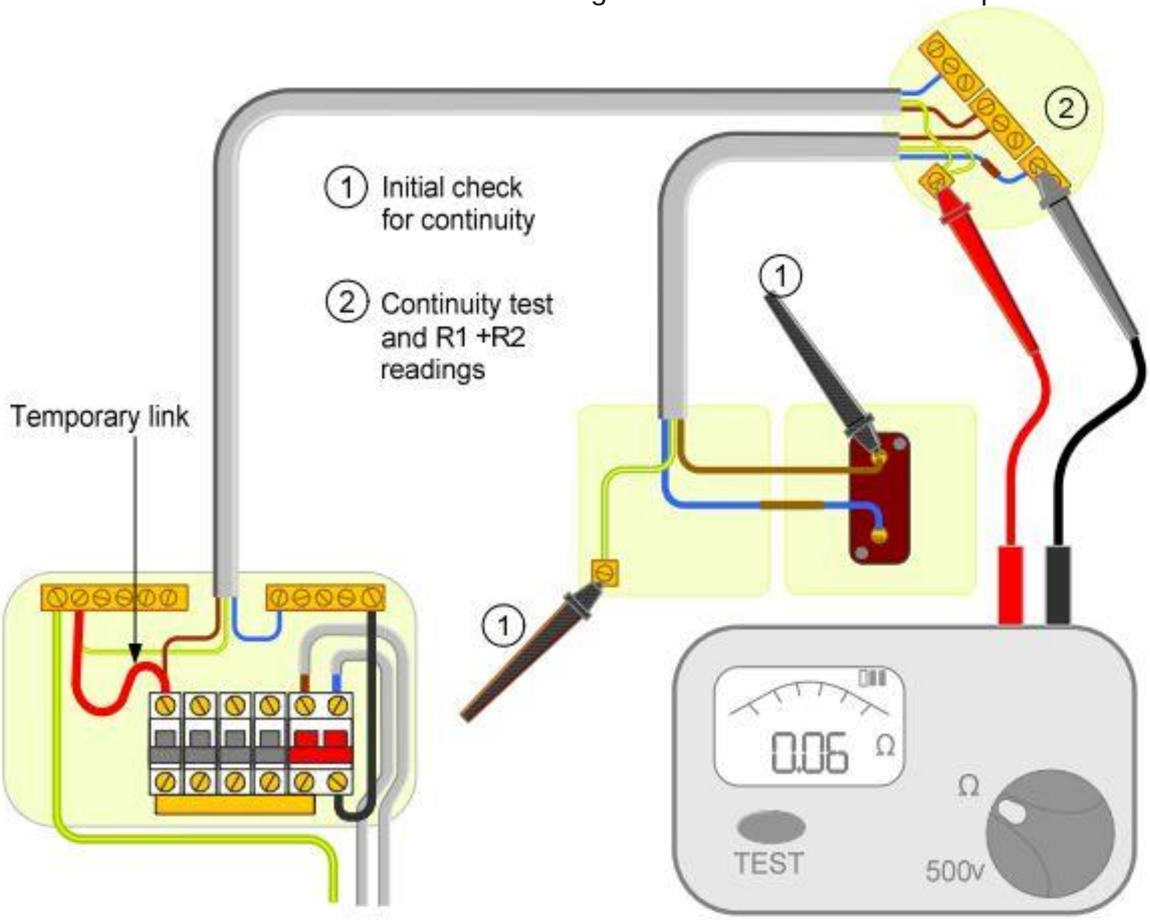


Polarity testing using low resistance ohmmeter
Source: City and Guilds

Steps:

1. Switch off the circuit breaker supplying the circuit.

2. From the specific circuit, put a temporary link that will connect the line conductor and the CPC or any equipotential bonding conductors. It will serve as a testing point for convenience
3. Conduct continuity testing by placing the test leads across the line conductor and the nearest CPC or any exposed conductive parts of the circuit.
4. If the instrument shows zero reading (with continuity sound) then the switch is connected properly to the line conductor.
5. If the instrument shows some significant ohmic value then the switch is not connected to the line conductor. Interchange the connections to fix the problem.

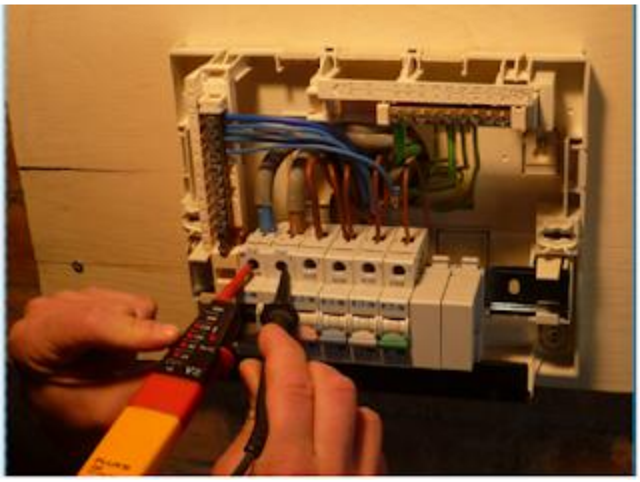


3. Live testing for polarity

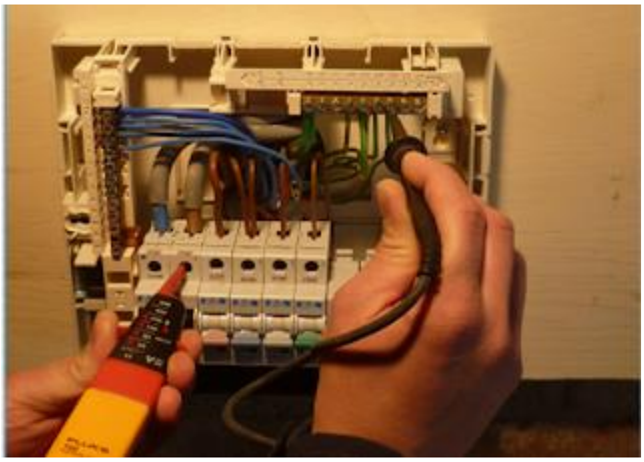
If the two methods are not possible due to urgency we can perform live polarity testing by using the approved voltage GS38.

Steps:

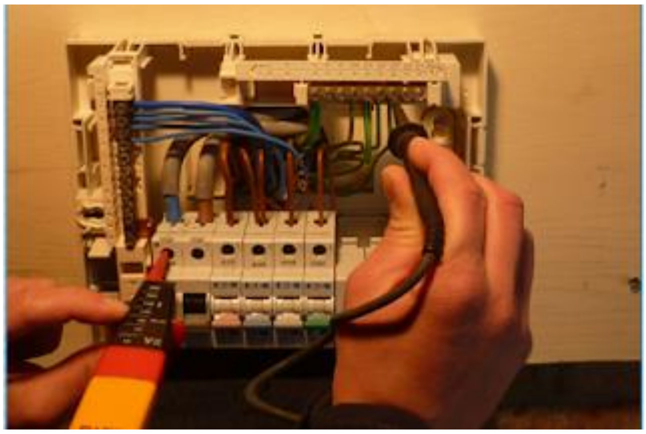
1. Test between LINE and NEUTRAL terminals



2. Test between LINE and EARTH terminals.



3. Test between NEUTRAL and EARTH terminals



The test instrument should indicate **full voltage (230V)** between Line-Neutral and Line-Earth conductors. **No voltage** should be detected between Neutral-Earth.

Source:

1. City and Guilds
2. BS 7671
3. TLC Direct

Testing & the Six 'Mandatory' tests

March 21, 2017Training8 Comments

Author: Harry Dreger, NECA Education & Careers LEA & LEI Teacher

The Wiring Rules require that we perform these tests on low voltage installations before they are connected to Supply. But do they REALLY matter? Will it REALLY affect an installation? Aren't they a waste of time? Many electricians feel they are, and it's not worth their time.

So are they important? YES!! Why?? To ensure the correct and safe (ongoing) operation of an electrical installation. That is their purpose, and this is what it's about:

1. **Test the continuity of the earthing system.** Put simply this ensures that an 'earth' exists and it is suitable to ensure the fuse/circuit breaker will operate before a piece of 'faulty' equipment becomes 'live', potentially killing somebody.
2. **Insulation resistance.** If this is too low, we risk equipment inadvertently becoming 'live', fires and overheating from 'leakage currents', and 'equipment damage' (particularly with electronics in equipment today.
3. **Polarity.** To ensure ACTIVE (A), NEUTRAL (N) and EARTH (E) wires are in the right position. Does that matter? Yes! I.e. swap A and E and risk livening the frame of a piece of equipment and somebody can die. Or, put the earth wire in the wrong place and it will carry load current, melt and cause a fire. (Remember, the earth wire is often smaller than the A and N.)
4. **Correct Circuit connections.** Ensures that circuits are not suitably connected in such a way that may cause safety hazards or incorrect operation. I.e. A piece of equipment being inadvertently connected to two (2) sources of supply is potentially life threatening to an electrician working on the circuit.
5. **Fault loop Impedance.** (This is associated closely with voltage drop). The Wiring Rules mandate that under fault, a maximum voltage of 50 V can exist on a piece of equipment for no longer than 0.4 seconds before the circuit protection operates (see touch voltage). If the fault loop impedance is incorrect, this will not happen.
6. **Operation of R.C.D.s.** Under the wiring rules, R.C.D.s are (currently) only required to be fitted to certain circuits where it has been deemed that safety is 'more than normally' likely to be a concern, i.e. kids sticking a fork in the toaster or socket outlet etc. For that reason it is crucial to ensure the R.C.D.s installed actually operate.

Video

https://www.youtube.com/watch?v=LcJu2tlhpiI

https://www.youtube.com/watch?v=ScD3Y1Ty5n8

https://www.youtube.com/watch?v=ZQuwbnyxPaY

https://www.youtube.com/watch?v=P-D6chUrRNk

https://www.youtube.com/watch?v=lmEnAYFSuzs

https://www.youtube.com/watch?v=xH5FxehSpM4

https://waypointinspection.com/what-is-reverse-polarity/

Insulation Resistance

What is insulation resistance test?

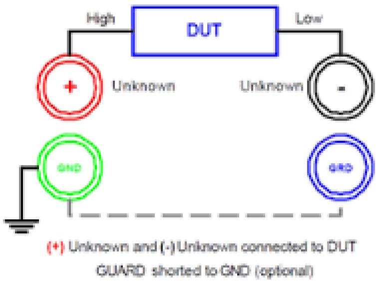


Figure 15: 2-Wire Ungrounded Connection

An insulation resistance (IR) test **measures the total resistance between any two points separated by electrical insulation**. The test, therefore, determines how effective the dielectric (insulation) is in resisting the flow of electrical current.

What is the minimum acceptable value of insulation resistance?

Insulation resistance should be **approximately one megohm for each 1,000 volts of operating voltage**, with a minimum value of one megohm.

Video

https://www.youtube.com/watch?v=TdeU6UCCfTY

https://www.youtube.com/watch?v=Ek1u2RjQffU

https://www.youtube.com/watch?v=FV0QavM9sN8

https://www.youtube.com/watch?v=yY8nsGn2xBo

https://www.youtube.com/watch?v=wxSL6oDkhGU

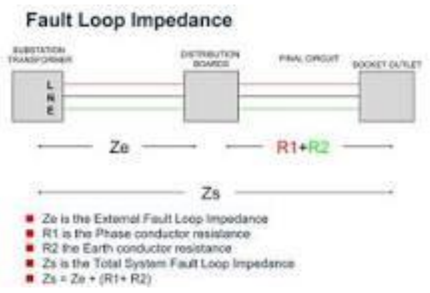
https://www.youtube.com/watch?v=_-n6BiFJy8w

https://www.youtube.com/watch?v=2_zHb0QvlUg

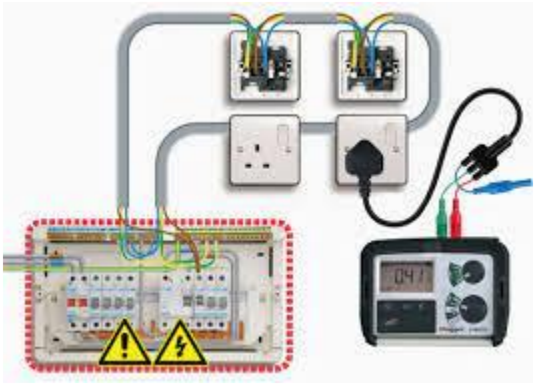
https://www.youtube.com/watch?v=eRE_8njFxZs

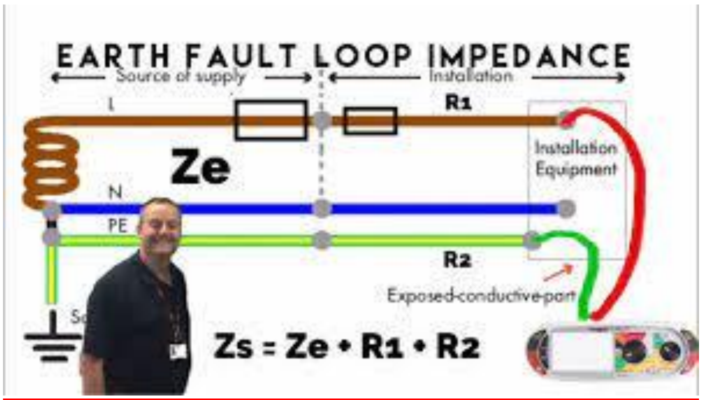
Fault Loop Impedance

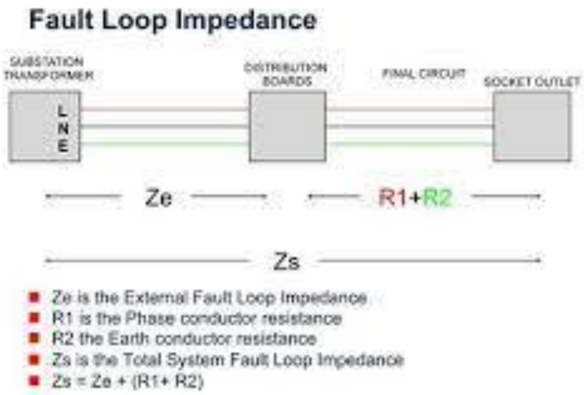
What is a fault loop impedance test?



Loop testing demystified. ... The main reason for earth loop impedance testing – which is often simply called loop testing – is to verify that, **if a fault occurs in an electrical installation, sufficient current will flow to operate the fuse or circuit breaker protecting the faulty circuit within a predetermined time.**၂၀၁၅- အောက် ၁




EARTH FAULT LOOP IMPEDANCE
Source of supply
Installation
L
R1
Ze
N
PE
Installation Equipment
R2
Exposed-conductive-part
Zs = Ze + R1 + R2


Fault Loop Impedance
SUBSTATION TRANSFORMER
DISTRIBUTION BOARDS
FINAL CIRCUIT
SOCKET OUTLET
L
N
E
Ze
R1+R2
Zs
Ze is the External Fault Loop Impedance
R1 is the Phase conductor resistance
R2 the Earth conductor resistance
Zs is the Total System Fault Loop Impedance
Zs = Ze + (R1+ R2)

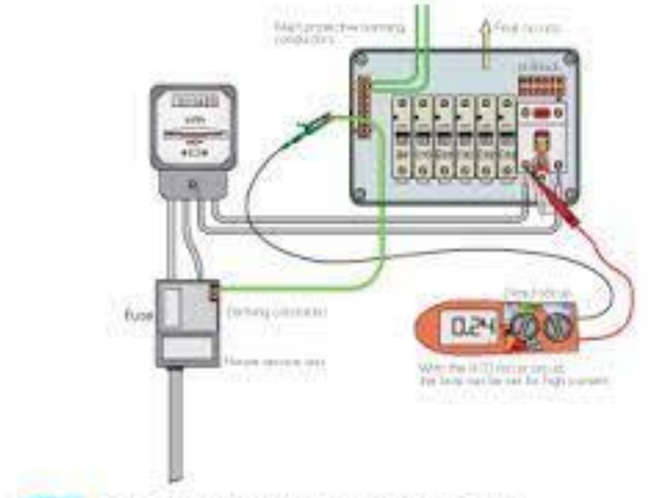
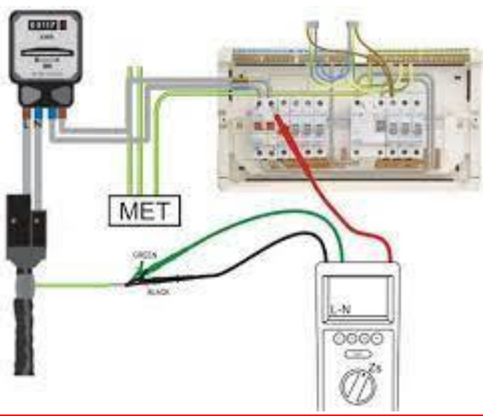
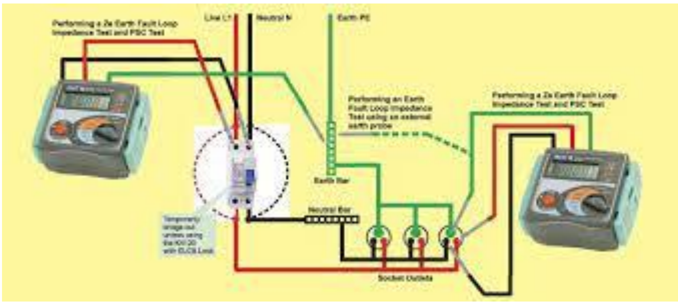
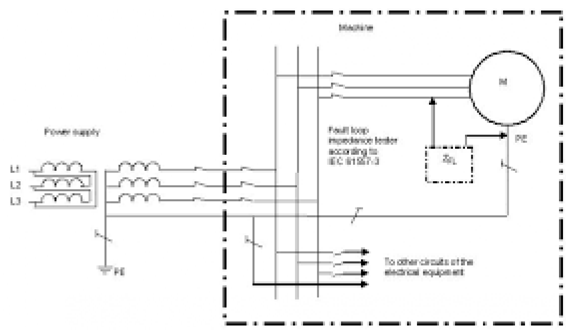


FIG 1 Earth fault loop impedance test on a single-phase installation







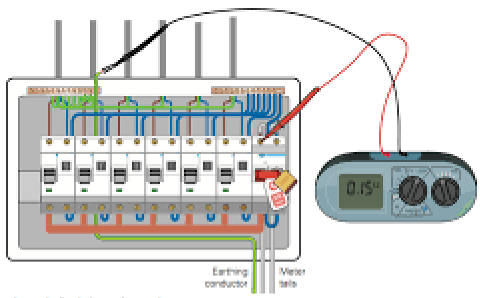


Fig 1 External earth fault loop impedance

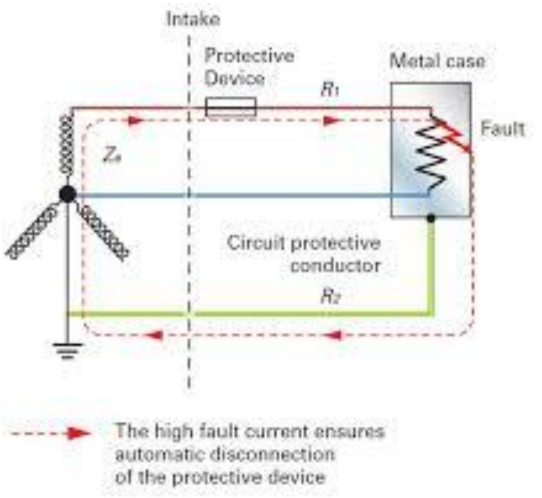
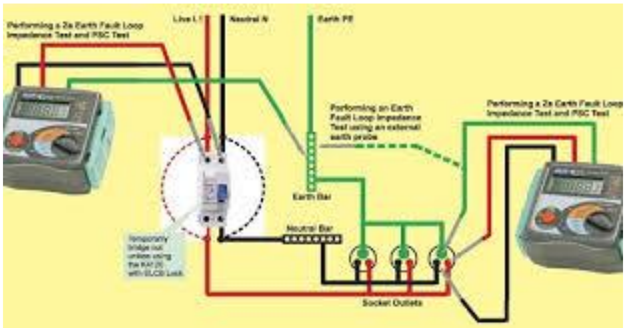


FIG 2 Earth fault loop path



https://www.youtube.com/watch?v=_twVvsGo81A

https://www.youtube.com/watch?v=F3rw1KwFboQ

https://www.youtube.com/watch?v=d6AI_RNTTdw

https://www.youtube.com/watch?v=Ax1MzklVtI0

Submain Polarity

Testing for correct polarity

Several installations have been identified where either people at the property, or at another property, have received electric shocks due to incorrect polarity of consumer mains or submains.

Incorrect polarity connections on consumer mains or submains supplying an outbuilding with a separate multiple earth neutral (MEN), will result in an energised earthing system.

Testing will ensure any incorrect connection is identified and rectified, to prevent the risk of electric shock.

The protective earth neutral (PEN) is the most important earthing conductor in an electrical installation. The impedance of the PEN must be low enough to pass the current necessary to operate the overcurrent protective device and be consistent with the length, cross sectional area and type of conductor material.

Correct polarity testing for low voltage connections to an electricity network or where an electrical installation in an outbuilding has a separate MEN connection in accordance with AS/NZS 3000:2018, Clause 5.5.3.1(c) must:

- include a visual inspection
- ensure the use of suitably designed and correctly rated test equipment
- ensure an effective independent earth is used
- ensure that any neutral bonding conductor (i.e.to raiser bracket) is disconnected
- prove the operation of the test equipment before and after testing
- prove the identity of the incoming active conductors
- prove the identity of the incoming neutral conductor
- prove the integrity of the supply neutral and connections
- confirm phase rotation
- ensure that any bonding conductor removed for testing is tested and reconnected
- ensure that all conductors are correctly connected, including the MEN connection
- ensure a final visual and verification of correct connections is completed.

For detailed information and guidance on conducting a polarity test for supply to electrical installations and neutral integrity tests for supply to electrical installations, refer to AS 4741 (Testing of connections to low voltage electricity networks).

Remember, polarity testers which are connected to a final subcircuit do not confirm mains polarity and will indicate that polarity is correct even if there is a reverse polarity.

Mains polarity verification testing

6 December 2018

We've added two new how-to infographics to the Electrical Workers Toolbox that demonstrate safety verification polarity tests with the use of an independent earth probe.

The Multiple Earth Neutral (MEN) system we have in New Zealand is only safe if the polarities of both the supply system and the installation are correct and the connections of the neutral conductor are reliable.

The wiring rules AS/NZS 3000.2007 list the compulsory electrical tests required to be carried out on an installation, one of which is polarity testing on mains and submains.

Transposed conductors in the consumer mains or a disconnected main neutral to an electrical installation can create significant risks of shock or electrocution, and property damage through overheating and fire.

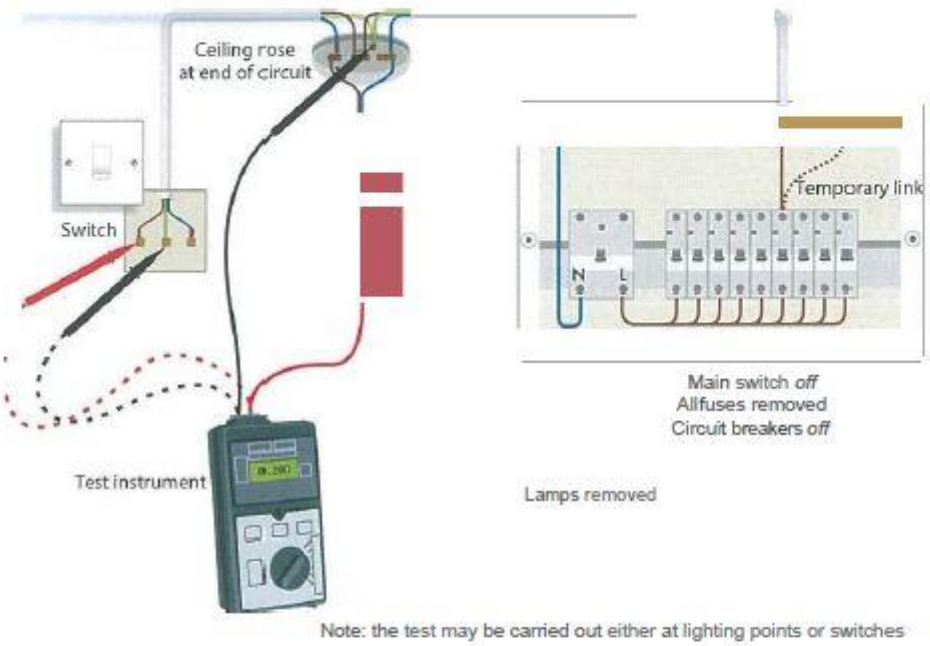
Polarity testing is absolutely critical and therefore must be independently verified by the installer, inspector, and person making a connection to an electricity supply.

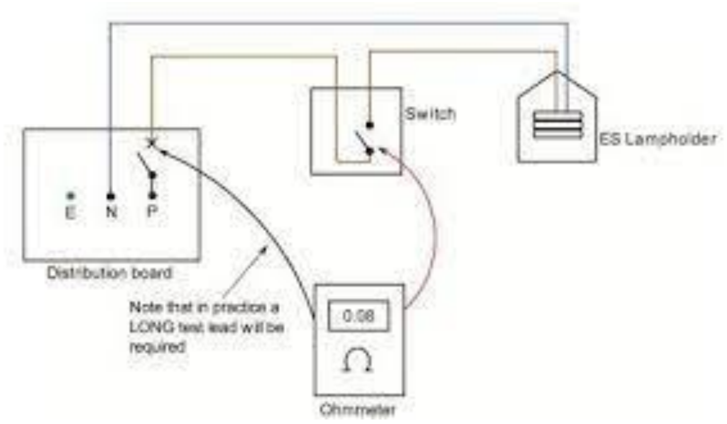
The underlying principle of mains polarity testing is to carry out all the necessary tests and checks that will ensure the phase and neutral conductors are not transposed, and that the neutral is continuous and earthed.

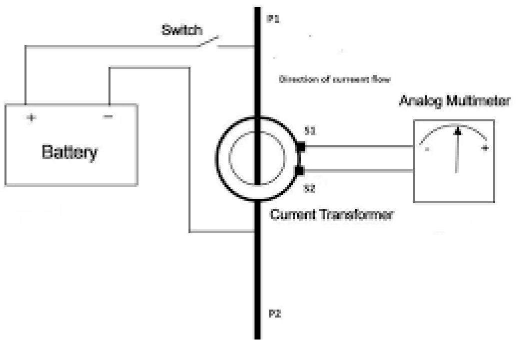
Never liven mains to carry out live polarity testing unless correct polarity has first been proven. Failure to do so can create an immediate and serious risk of electrocution, shock, or fire should the mains conductors be transposed. The safety verification polarity test is only to be carried out after correct polarity was previously established.

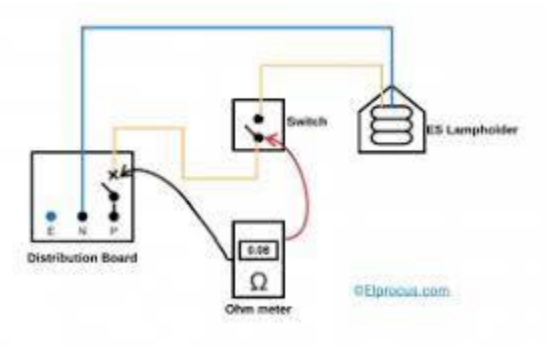
These tests and other practical guidance have been provided to assist electrical practitioners to achieve safe, compliant and competent electrical work, and to promote continued improvements in those areas.

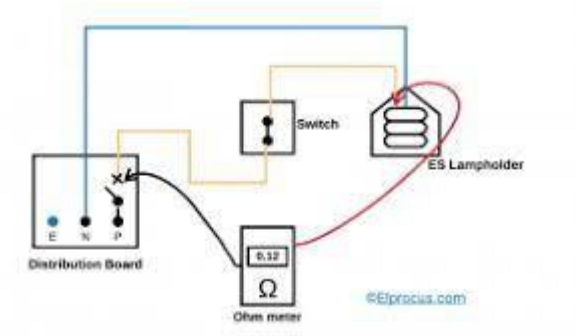
Guidance on mains polarity testing is provided in standard AS/NZS 3017:2007 Electrical Installations – Verification Guidelines. This standard is freely available to all licensed practitioners through a RealMe login from the EWRB homepage.











Consumer Main Polarity

TESTING FOR REVERSED POLARITY

BY PAUL SKELTON

28/06/2011

The growing number of smart meters installed across Australia has led to an increase in the number of reversed polarity incidents. But what is the correct way of conducting a reverse polarity test?

In the last edition of *Electrical Connection* we ran an article highlighting the growing number of reported reverse polarity incidents in Victoria in the past year, particularly surrounding the installation of new metering equipment.

While the danger is very real, and the number of incidents is assuredly growing, it turns out that the information we were presented isn't relevant to the vast majority (99.9%) of Australian installations.

Institute of Electrical Inspectors life member and former *Electrical Connection* contributor George Bosomworth says: "The test described does not prove what is claimed when applied in Australia or New Zealand (i.e. where the system of distribution used is our multiple earth neutral, MEN, system)."

The test described is only valid where the MEN connection is upstream of the reversal of polarity, he says.

"In the US there are many situations where this test would be valid – but not so in Australia or New Zealand.

"To put it simply, if the neutral and earth (US 'ground') are connected together downstream of the meter (as is the case for our MEN system) and the active (US 'hot') is transposed for the neutral upstream of that point, both the neutral and earthing conductors within the installation will be at the same (active/hot) potential.

"Therefore, testing voltages between the pins of an outlet (US receptacle) will indicate identical values whether the polarity is reversed or not and the fault will not be detected (i.e. with supply at correct polarity; A – N = 230V, A – E = 230V, N – E =~0V. Polarity reversed upstream of MEN connection; N – A = 230V, N – A = 230V, A – A =~0V.)

"For a test at an outlet to be valid in Australia/NZ, the reference point for testing must be an independent connection to mother earth (the soil) at a point clear of any material that could be connected electrically to the installation, such as underground water piping, etc. Typically a large screwdriver shaft driven into the soil may be used."

This leads to the next point that often arises in such a discussion, he says: "Reliance on the main earth."

"Many would say that the main earth will cause a fuse to blow. This would rarely be the case.

“Typical earth resistances for single electrodes driven 1.2m deep are in the range of 50Ω to 100Ω (or more). If we apply the nominal 230V to such a resistance Ohm’s Law dictates that the current flow will be in the range of 2A to 5A. Even if the earth resistance is lowered to 10Ω the current will only be 23A. Hence, relying on the main earth to operate protection is a fallacy.”

A further issue arising from all of this is the MEN system itself.

“When that system of distribution was adopted, the reticulated water system consisted of metallic piping that, when used as the main earthing system, acted as a backup to the supply neutral conductor.

“With the advent of non-conductive water reticulation and the use of single earth electrodes there is now no back up for the supply neutral and hence the rise in neutral related problems such as shocks.

“It may be that this system of distribution needs to be reviewed.

“The requirement to earth the neutral at each installation arises from the need to keep the supply neutral as close to true ground potential as practicable. (If there was no such connection the voltage between ground and the supply neutral would be about half that of the voltage drop along the length of the distribution circuit – think about it).”

Thus this requirement more correctly sits with the distributor.

“If this were to be the case, an RCD with a tripping current in the order of 300 – 400mA used as a main switch would protect the customer’s installation in the event of a supply neutral failure.”

How do you conduct a polarity test?

The Polarity Test sequence:

1. Select a GS 38 approved voltage indicator and locate the Main Switch. Test between Line and Neutral terminals.
2. Test between Line and Earth terminals.
3. Test between Neutral and Earth terminals.

Video

https://www.youtube.com/watch?v=PtmqaolzPL0

https://www.youtube.com/watch?v=I8FH9iTr-vs

https://www.youtube.com/watch?v=IS-C5hwJ-tI

https://www.youtube.com/watch?v=I8FH9iTr-vs

https://www.youtube.com/watch?v=X5VEtGTSrwg

Intermix Circuit

https://www.youtube.com/watch?v=AZenZfLQQgw

Safe isolation

The procedure for proving dead should be by use of a test lamp or two pole voltage detector as recommended in HSE Guidance Note GS38.
Non-contact voltage indicators (voltage sticks) and multi-meters should not be used. The test instrument should be proved to be working on a known live source or proprietary proving unit before and after use. All phases of the supply and the neutral should be tested and proved dead.

Test sequence and descriptions

The following tests are carried out with the **Consumers main switch isolated**

1. Extenal earth fault loop impedance
Reason: To establish that a good earth exists at the installation in order for the remaining tests to go ahead.

Method: Disconnect the main earthing conductor from the main earthing terminal. An earth fault loop impedance tester is connected at line and earth (main earthing conductor) at the supply side of the installation and a test performed. Reconnect the main earthing conductor. The result is Ze and recorded on the sheet. The prospective fault current is measured at the same time after the reconnection of the main earthing conductor.

2. Continuity of protective and bonding conductors
Reason: To check that all circuit protective conductors (green and yellow cables) are continuous and are present at every electrical accessory on the circuit. Also to check that the main earthing conductor and main bonding conductors are continuous and correctly connected.

Method 1: The line conductor is connected to the circuit protective conductor of the same circuit at the consumer unit and a measurement taken at ALL accesories on that circuit between line and c.p.c. The highest measurement obtained is recorded on the test report.
Test result is R1 + R2. The line conductor and neutral conductor are then connected and the above repeated to obtain R1 + Rn

Method 2 (used for main earth and main bonding conductors): A wandering lead is connected to one end of the conductor to be tested and a measurement taken between the other end of this lead and the other end of the conductor.
Test result is R2.
During this test polarity can be checked as well. The continuity of the neutral conductor can also be checked.

3. Continuity of ring final circuit conductors
Reason: This test ensures that all ring final circuits (sockets usually) are indeed a continuous ring with no interconnects or breaks within it.

Method: The line, neutral and earth conductors of the circuit are identified and a measurement from one end to the other end of each is taken. These results are r1, r2 and rn.
The incoming line conductor is then connected to the outgoing earth conductor and the outgoing line conductor is connected to the incoming earth conductor. A measurement is then taken at ALL socket outlets on the ring. The highest of which is recorded on the report.
This result is R1+R2 for that circuit. The above is then repeated using the neutral conductor instead of the earth conductor. This test provides R1+Rn which does not need to be recorded on the report but is essential to check the circuit correctly.

4. Insulation Resistance
Reason: This test checks whether the insulation around a cable is still intact and has not broken down over time. It is a good indicator of the age of an installation.

Method: An insulation resistance tester is connected across line and neutral tails at the origin of the supply. 500V are then pumped down the conductors to see if any voltage leaks across from one conductor to the other. The same is then done for the line and earth and the earth and neutral conductors.

5. Polarity
Reason: To check that all accesories are correctly connected to line, neutral and earth and that all switches and circuit breakers are connected in the line conductor only.

Method: The method for this is the same as for continuity and is usually done at the same time by operating switches etc whilst conducting the test.

6. Earth electrode resistance
Reason: To make sure that any earth electrode used is of a sufficiently low impedance to allow the timely operation of the RCD protecting the

installation.

Method: An earth fault loop impedance tester is connected between line and earth at the origin of the supply and a test performed. The result of which is considered the resistance of the electrode (Ra).

The following tests are carried out with the **Consumers main switch energised**

7. Live polarity test
Reason: To verify polarity of supply authorities system.

Method: An approved voltage indicator shall be used or test lamp to GS38. Using the approved voltage indicator, one probe shall be placed on the incoming neutral, and the other on the incoming line conductor, on the main breaker. The indicator should show it is live. One probe shall now be placed on the CPC and the other on the incoming line conductor. The indicator should show it is live. A test shall be preformed between CPC & incoming neutral. The indicator should show that it is not live.

8. Earth fault loop impedance
Reason: This test is done at the furthest point on a circuit in order to make sure the impedance of the earth path is not too high even at the furthest point so that sufficient current will flow under fault conditions to take out the circuit breaker protecting the circuit.

Method: An earth fault loop impedance tester is connected to line and earth at the furthest point on the circuit and the test performed.

9. RCD test
Reason: To make sure RCD's trip within the correct time

Method: An RCD tester is connected and a test at 1/2 times, 1 times and 5 times the trip current is performed on each side of the cycle and a time of trip obtained. Usually milli-seconds with the highest being recorded. The manual test button is then pressed.

10. Functional testing
Reason: To make sure all switches, isolators, MCB's etc. work as they should.

Method. Self explanatory.

Correct Circuit Connection

Electrical polarity (positive and negative) is **the direction of current flow in an electrical circuit**. Current flows from the positive pole (terminal) to the negative pole. ... In the context of electricity installations, a polarity test is used to confirm the correct connection of the line and neutral conductors.

UEEEL0039

2.Select wiring systems, cables, control and protection for general electrical installations

G063+G107

http://www.highlightcomputer.com/electricaltrade2021.htm#G063

http://www.highlightcomputer.com/electricaltrade2021.htm#G107

3.Install low voltage (LV) wiring and associated accessories

G103+G104

http://www.highlightcomputer.com/electricaltrade2021.htm#G103

http://www.highlightcomputer.com/electricaltrade2021.htm#G104

4.Install and connect LV appliances, switchgear and associated accessories

G063+G033

http://www.highlightcomputer.com/electricaltrade2021.htm#G063

http://www.highlightcomputer.com/electricaltrade2021.htm#G033

Capstone Test Questions

Capstone_Practical_Tutorial_Questions

Capstone Practical Test Question Version 4

Capstone Practical Test Question Version 5

Theory Assessment Response

Capstone Theory Test (1)

Capstone Theory Test (2)

Capstone Theory Test (3)

Capstone Theory Test (4)

Capstone Theory Test (5)

Capstone Theory Test (6)

REFERENCE NOTES

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crn-sc-010-inspection-and-testing-procedures-v11-apl-2016

Protection_Methods_Week_2_G063A_V1.4

VESI-Installation-Supply-Connection-Tests-and-Procedures-June-2017

Test and Verification Workbook

Electrical System Safety

Electrical Safe Work Practice

Capstone Process

Sample Employer Letter

Capstone Procession Check List