Safe Isolation

1. Ask permission to turn off the power
2. Isolate sources of supply off-load (For larger installations re-close all breakers to connect remote distribution boards etc.)
3. Prove an approved (to GS38) voltage indicator using known supply or proving unit
4. Prove dead (Check voltage between L-N, L-E and N-E – Should be 0V. For three phase check L1-L2, L1-L3, L2-L3, L123-N, L123-E, N-E
5. Lock off, attach warning notice and remove key (key should be kept on your person)
6. Prove AVI again

Initial Verification (GN3 pg. 18) – Check installation (be sure to open back boxes, junction boxes, consumer units etc.)

**** IMPORTANT - Check all test gear and leads for condition, calibration and battery before commencing ****

Dead Testing

Continuity (Low resistance ohm meter) [Ω] – GN3 pg. 34

Always zero the meter when changing leads/links – ALWAYS!

1. Main bonding end to end (order of 0.05Ω - GN3 pg. 38) – **NOTE -** Disconnect from MET to avoid parallel paths
2. **OPTIONAL** - Continuity of protective conductors (CPC continuity is verified during subsequent steps as R1+R2 is measured which confirms continuity of CPC although confirming CPC separately is good practice and allows R1+R2 to say with some certainty that switches are in the line)
3. **Final radial circuits (and distribution circuits)**
    a. Link L to CPC
    b. Measure resistance of L to CPC with switches on (at furthest termination point – may need to test all), record maximum as R1+R2 for circuit. **NOTE:-** This may require switches to be toggled to ensure all circuits are tested (in 2 way lighting circuits for example)
    c. **IMPORTANT** - Remove link
    d. **Three Phase** – Perform three checks on L1 to CPC, L2 to CPC and L3 to CPC
4. **Final ring circuits (Numbers in brackets denote ring leg)**
    a. Measure resistance of L(1)-L(2), N(1)-N(2) and CPC(1)-CPC(2) to obtain r1, rn and r2 respectively. r1 and rn should be roughly the same, r2 is likely to be higher [For 2.5/1.5 cable, r2 ≈ 1.667 x r1]
    b. Link L(1)-N(2) and N(1)-L(2)
    c. Zero meter to account for leads being used (particularly if changing leads at different points – an FCU for example)
    d. Measure resistance between L-N at each termination point. Verify values for items on ring against (r1+rn)/4.
    e. Link L(1)-CPC(2) and CPC(1)-L(2)
    f. Measure resistance between L-CPC at each termination point (R1+R2). Record highest value for circuit R1+R2. Verify values for items on ring against (r1+r2)/4.

Insulation Resistance (Insulation resistance tester) [MΩ - 500V] – GN3 pg. 42

1. Ensure all bonding and earthing is connected (and has been verified using continuity check)
2. Warn persons in location about potentially hazardous voltages present on system
3. Remove all loads paying particular attention to sensitive items and items that could affect the results – e.g. lamps, neons, dimmers and consumer electronics. If it is not possible to remove all such items, then it is acceptable to link live conductors and then test between linked live conductors and earth but this should only be done for individual circuits
4. Test installation (Main isolator off, all other protective devices on, all FCUs on, all lighting circuits on), checking L-N, L-E and N-E
5. Limit is 1MΩ, but if meter does not max out, it is advisable to test circuits separately to establish if there is an issue
6. Test each circuit individually, checking L-N, L-E and N-E
7. **IMPORTANT** – If a link was installed for this testing, remove it – If testing a circuit including SWA, ensure that SWA is connected to the earthing system

SELV/PELV – 250V Min 0.5MΩ, **Circuits not more than 500V** – 500V Min 1MΩ, **Circuits over 500V** – 1000V Min 1MΩ
SELV/PELV Separation From Supply – 500V Min 1MΩ, **SELV/PELV in same cable as mains** – 500V Min 1MΩ

Three Phase Test Sequence– L1-L2, L1-L3, L2-L3, L123-N, L123-E, N-E
If devices present that can be damaged – Test live conductors connected together to CPC

Live Testing - Be sure to replace any isolation links that may have been removed during isolation!

Supply Polarity And Phase Rotation (Voltmeter or AVI) [V]

1. **Single Phase -** Test voltage between L-N (230V), L-E (230V), N-E (0V)
2. **Three Phase -** Test voltage between L1-L2, L1-L3, L2-L3 (400V), L123-N (230V), N-E (0V) – Check Phase Rotation

IMPORTANT - Different results = Connection problem which should be reported to DNO immediately!

External Earth Fault Loop Impedance (Loop impedance tester) [L-PE/Z – 2Hi] - Ze and PEFC – GN3 pg. 57

1. Isolate CU (Turn main isolator off – Seek permission if system is not already dead)
2. Disconnect main earthing conductor (When measuring at main DB only – If measuring at sub DB do not disconnect)
3. Connect meter to main earth conductor with crocodile clip
4. **Single Phase -** Conduct test by applying other lead to L at CU incomer
5. **Three Phase -** Conduct test by applying other lead to L1, L2 and L3 at main incomer (use highest value as Ze
6. Reconnect main earthing conductor
7. Record results for Ze
8. Conduct another test to obtain PEFC (for three phase, repeat on L1, L2 and L3, use highest value for PEFC)
    a. Maximum Ze values (Western Power Distribution) – TNS 0.8Ω*, TNCS 0.35Ω*, TT 200Ω - *These values may be exceeded if the connection originates from a long overhead line network or small pole mounted transformer

Prospective Short Circuit Current (Loop impedance tester) [L-N/Z – 2Hi] – PSCC

1. **Single Phase -** Conduct test by applying leads to L and N at CU incomer
2. **Three Phase -** Conduct test by applying leads to L1-L2, L1-L3 and L2-L3 (use highest value as PSCC) or L1-N, L2-N and L3-N (use highest value x2 as PSCC)
3. Record highest of PEFC and PSCC as PFC for installation
4. Maximum PFC value – Check breaking current of devices (e.g. Circuit breaker typically 6KA)

Earth Fault Loop Impedance (Loop impedance tester) [L-PE/Z – 3Lo] – Zs

1. Energise CU if it is not already energised
2. Energise circuit under test
3. Test at further point of circuit using either plug lead or 3 probes. If unsure of furthest point, check all points and record highest as Zs for the circuit. Refer to Regs pg. 57 (@70^{o}c, compensate with x0.8) and OSG Apdx B pg. 119 (@20^{o}c) for full list of maximum permissible values

Phase Rotation (Voltmeter or AVI) [V]

1. For each item of equipment or accessory supplied with a three phase circuit, check phase rotation

RCD (RCD tester) [Auto/IΔn] – GN3 pg. 64

1. Energise CU if it is not already energised
2. Energise a circuit connected to the RCD to be tested
3. Connect to the circuit under test and initiate test (will require you to reset the RCD four times)
    a. IΔn/2 – No trip
    b. IΔn @ 0° and 180°- (300ms) – Record slowest time
    c. 5IΔn @ 0° and 180° - (40ms) – Record slowest time
4. Functional test – Press RCD test button

Functional Test

1. **Lighting** – Install lamps and check correct operation of switching
2. **Rings and Radial Power** – Test sockets with a suitable socket tester and/or energise fixed equipment if applicable

Useful Information

Standards For Devices (OSG pg. 193)

- Main Switch - BSEN 60947
- RCD – BSEN 61008-1
- MCB B,C,D – BSEN 60898
- RCBO – BSEN 61009-1
- Main Fuse – BS88 or BS1361
- Consumer Unit – BSEN 61439-3

Max Zs Ω (OSG pg.119) – 0.4s Disconnect (MCB and Fuses)

Type B MCB – 3A/11.66 – 6A/5.82 – 10A/3.49 - 16A/2.18 – 20A/1.75 – 25A/1.39 –32A/1.10 – 40A/0.87 – 45A/0.77 – 50A/0.69 – 63A/0.55 – 80A/0.43 - 100A/0.34

BS1361 Fuse + BS1362 Fuse (Plug fuse) – 3A/12.48 – 5A/7.94 - 13A/1.83 – 15A/2.48 – 20A/1.29 – 30A/0.87

RCDS – 30mA/1667 – 100mA/500 – 300mA/167 – 500mA/100

Adjusted values (80% of tables 41.2, 41.3 and 41.4)

Standard Cable Sizes (OSG pg. 145)

csa/cpc mm² - 1.0/1.0 *(11A/13A/15A/17A)* – **1.5/1.0 *(14A/16.5A/19.5A/22A)*** – 2.5/1.5 *(18.5A/23A/27A/30A)* – **4.0/1.5 *(25A/30A/36A/40A)*** – 6.0/2.5 *(32A/38A/46A/51A)* - **10.0/4.0 *(43A/52A/63A/70A)*** – *(Max Current - Ref method A/B/C/E)*

Bonding clamps OSG pg. 54	BS951 – Must have 'Safety Electrical Connection – Do Not Remove' label on or near	Must be within 600mm of valve/transition from plastic to metal pipe on consumer side	**RCDs** – 30mA, 100mA for fault, 300mA for fire **Construction site** – Socket >32A 500mA **Agricultural** – Max 300mA – Socket <32A 30mA, Socket >32A 100mA
Bathroom/Shower Zones EGBR pg. 70	**Zone 0** – The basin **Zone 1** – Above the basin to a height of 2.25m from the floor or the top of the shower head if fixed **Zone 2** – Ends 0.6m from edge of Zone 1 **No accessories within 3m of edge of zone 1**	**Outside Zones**- IPXXB/IP2X, with IPXXD/IP4X for horizontal top surfaces **Outdoors** – IP54 (+30mA RCD) or IP55 for junction boxes	**Zone 0** – IPX7 - SELV 12v AC/30v DC (source outside zones or in Zone 2 with RCD) **Zone 1** - IPX4 (IPX5 with water jets) – SELV 25v AC/60v DC (source outside zones or in Zone 2 with RCD) **Zone 2** – IPX2 indoors, IPX4 outdoors (IPX5 with water jets) SELV 50v AC/120v DC (if source in Zone 2 with RCD). Only SELV accessories or pull cord from LV accessory
Kitchens EGBR pg. 68	No accessories within 300mm of sink or 100mm of cooker	Cooker switch within 2m of appliance(s) and not above hobs	Sockets 150mm above worktop
Accessibility (Part M) EGBR pg. 163	Bottom of accessories no lower than 450mm from finished floor surface	Top of accessories no higher than 1200mm from finished floor surface	Consumer units mounted so switches are between 1350mm and 1450mm above finished floor surface
Cable identification EGBR pg. 167	**OLD** LINE 1 (1 + 3 PHASE) LINE 2 (3 PHASE) LINE 3 (3 PHASE) NEUTRAL (1 + 3 PHASE) **EARTH**	**NEW** LINE 1 (1 + 3 PHASE) LINE 2 (3 PHASE) LINE 3 (3 PHASE) NEUTRAL (1 + 3 PHASE) **EARTH**	**Buried Cables** Minimum of 500mm with tape at 150mm. Where double digging will occur, minimum of 600mm. Ideally put cable tiles 150mm above cable.

Western Power

Emergencies
0800 6783105
General
0800 0963080

Earthing/Bonding
Main earthing – 16mm²
Main equipotential bonding– 10mm²

Reference Methods
A – In conduit in thermally insulating wall
B – In conduit on wall
C – Clipped direct
E – In free air

Notches
In zone 0.07 to 0.25 x span from support
Not more than 0.125 x depth deep
Holes
Max. diameter 0.25 x depth
In centre of joist 3 diameters apart
In zone 0.25 to 0.4 x span
Gas Installation
150mm away from supply equipment
25mm away from equipment and cables

Earth Electrode Resistance Test

1. Seek permission to isolate, then safely isolate all sources of supply, lock off
2. Earth electrode under test is L meters in length
3. Put current electrode 10xL m away from electrode under test
4. Take readings with potential electrode 4xL m, 5xL m and 6xL m away from electrode under test
5. Use average value of the three readings. The individual readings should be within 5% of each other. If not, extend the test distances (potential should be half way between electrode under test and the current spike, then moved 10% of total distance either side of the centre). If still not good, consider using an alternative method

IMPORTANT NOTE – L123-N means conduct test as L1-N, L2-N, L3-N – Similarly L123-E means L1-E, L2-E and L3-E