



DPI CONFERENCE Sydney 2008
High Voltage, Data and Communications, Electronics, CCTV

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Rutherford Electrical Engineering Services

Presentation

Connecting High Voltage Insulation Testers



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Introduction

Electric shock incidents have highlighted the need for **CAUTION** when using High Voltage Insulation Testers. The following information has been provided to raise awareness. Our aim is to alert users of High Voltage Insulation Testers to the potential hazards explaining how and why in an attempt to prevent a reoccurrence of such incidents.



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Important Notice

There are numerous brands of High Voltage Insulation Testers with an output up to 10kV DC. These instruments are utilised for a variety of tasks. This information is provided as “food for thought” regarding your testing procedures. It however may not relate to more specialised applications.

The information is based solely on REES’s experience in routine testing of High Voltage Cables and apparatus.

This information may also conflict with the information provided by manufacturers and other parties.

REES make no warranty of any kind with regard to this material, including, but not limited to, fitness for a particular purpose.

REES shall not be liable for errors contained herein or for incidental consequential damages in connection with the furnishings, performance, or the use of this material.



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Assumptions.

This document assumes that an operator is;

Conducting routine High Voltage DC tests on a High Voltage System.

Conducting testing prior to energisation of a system.

Attempting to identify a device that is causing problems so that the device can be removed for repair.

It is assumed that the operator is NOT conducting specialised testing on a device in an attempt to determine the exact nature of a fault or discriminate between leakage current paths.

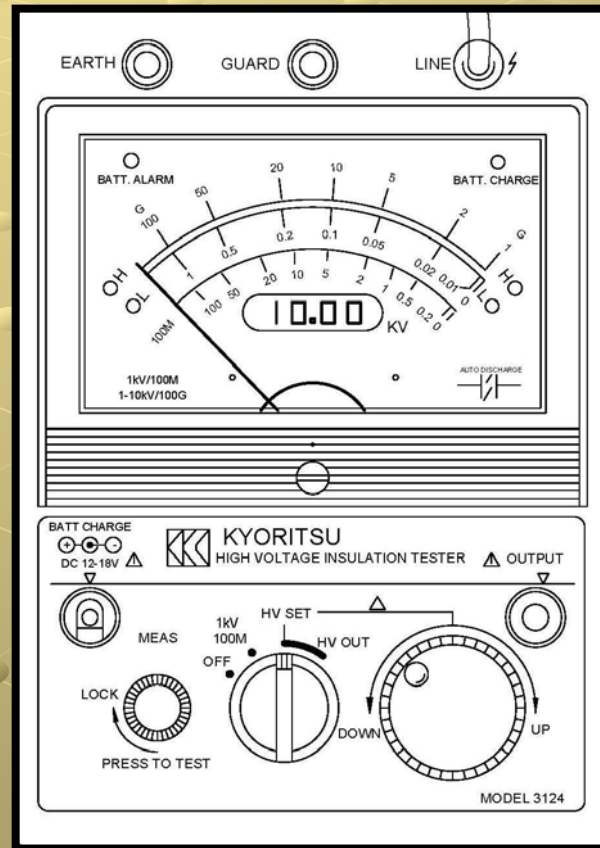
In summary, this information is provided for persons conducting routine insulation testing and basic fault finding



Recommended Test Procedure

Kyoritsu 3124

10kV Insulation Tester



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Initial Testing.

Testing was conducted by REES to determine the impact of various testing connections believed to be in use.

Testing was conducted using a model 3 core copper paper insulated lead sheath cable as per the drawing.

In reality the outcomes will vary dependant on cable construction, cable length etc.

This model typically represents a long cable with an insulation resistance of 60M ohm between phases and between each phase and earth.

All resistors are 60M ohm and capacitors are 4uF. Results were extrapolated due to the charge current conditions of the IT used for the testing. Extrapolated voltages of the following various connections are shown in blue with respect to the system earth.

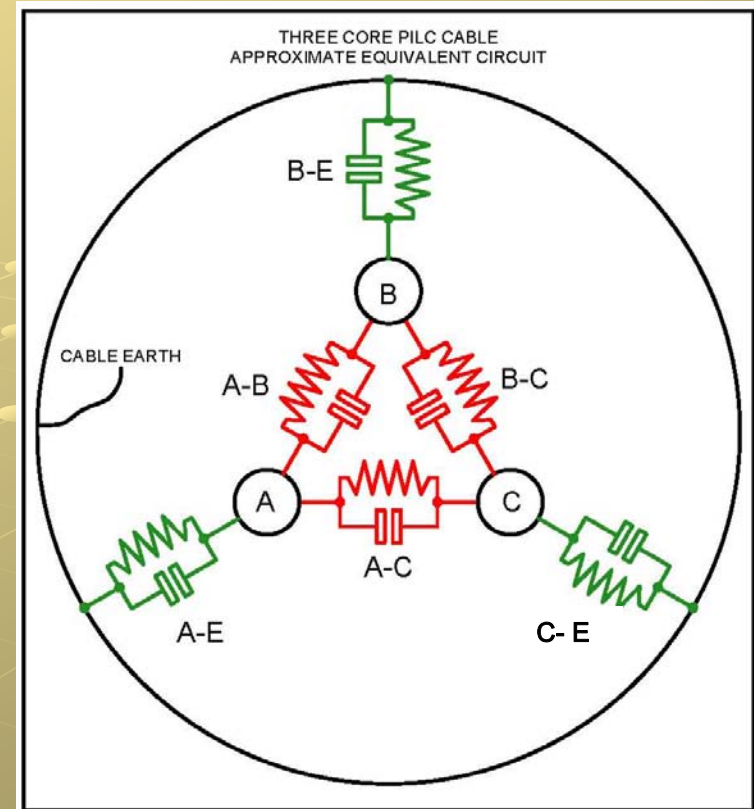


Figure 1, Case Explanation.

Extremely Hazardous where the test set has NOT been connected to the system earth. Operators often refer to this as “Phase to Phase Test”. In this situation internals of the tester and exposed conductive parts will rise to lethal voltages. The test leads connected to “earth” terminal will be exposed to voltages most likely beyond its rating.



Figure 2, Case Explanation.

Regarded as questionable due to the fact that the conductors that are not under test are charged a voltage away from earth.

Set at 10kV



Figure 3, Case Explanation.

Regarded as questionable due to the fact that the conductors that are not under test are charged to a voltage away from earth.

Set at 10kV



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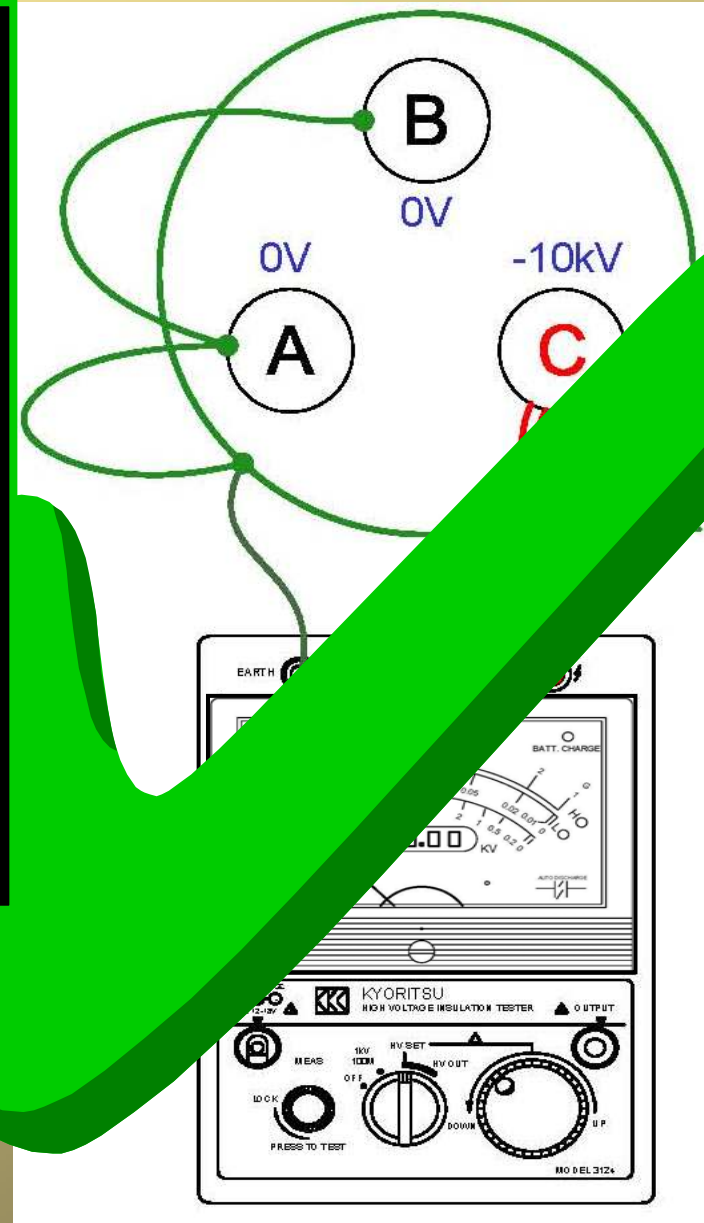
Figure 4, Case Explanation.

Considered the safest connection method for routine High Voltage Insulation Testing of Reticulation Systems. The following slide will clearly depict the method.

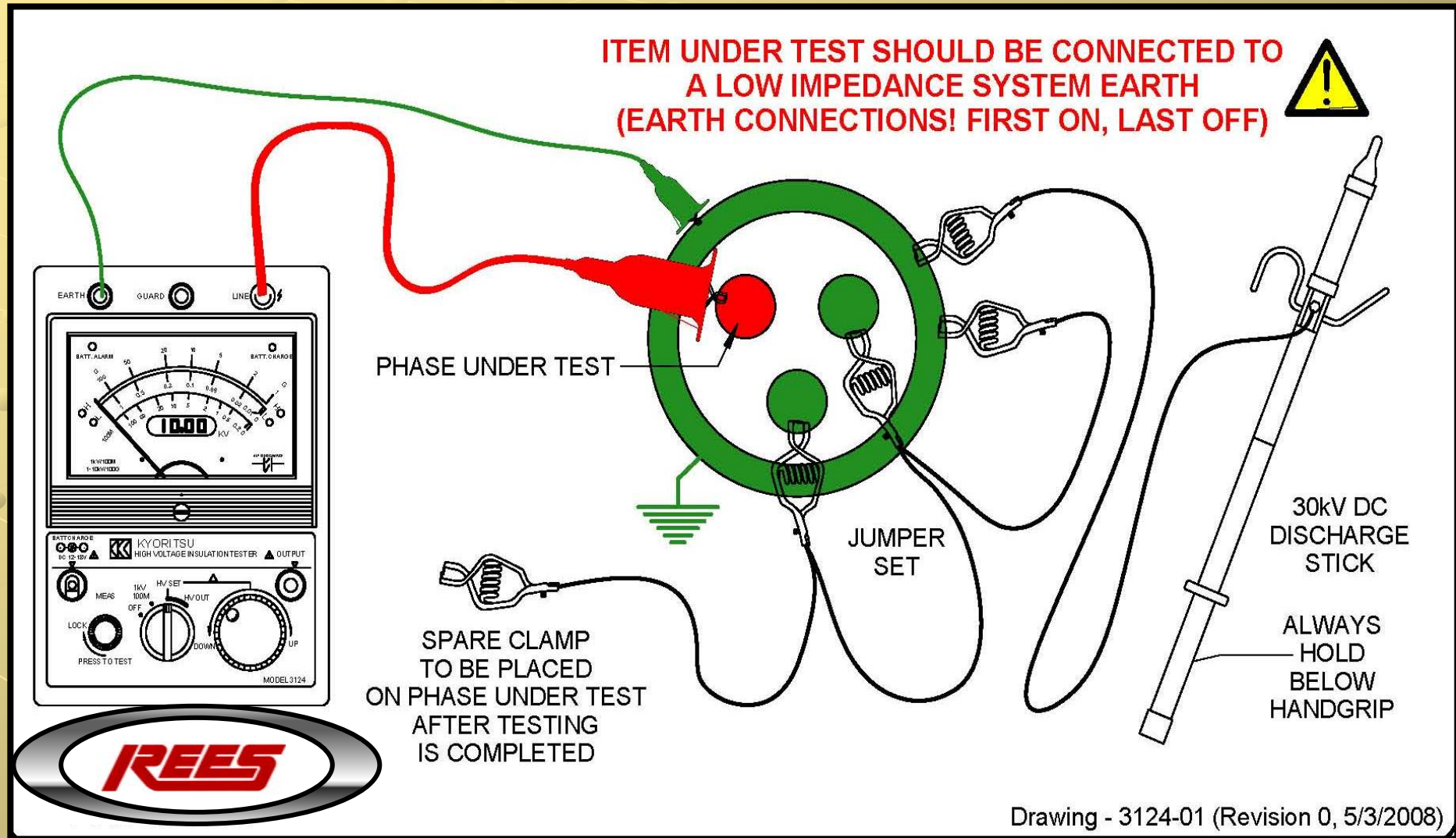
Set at 10kV



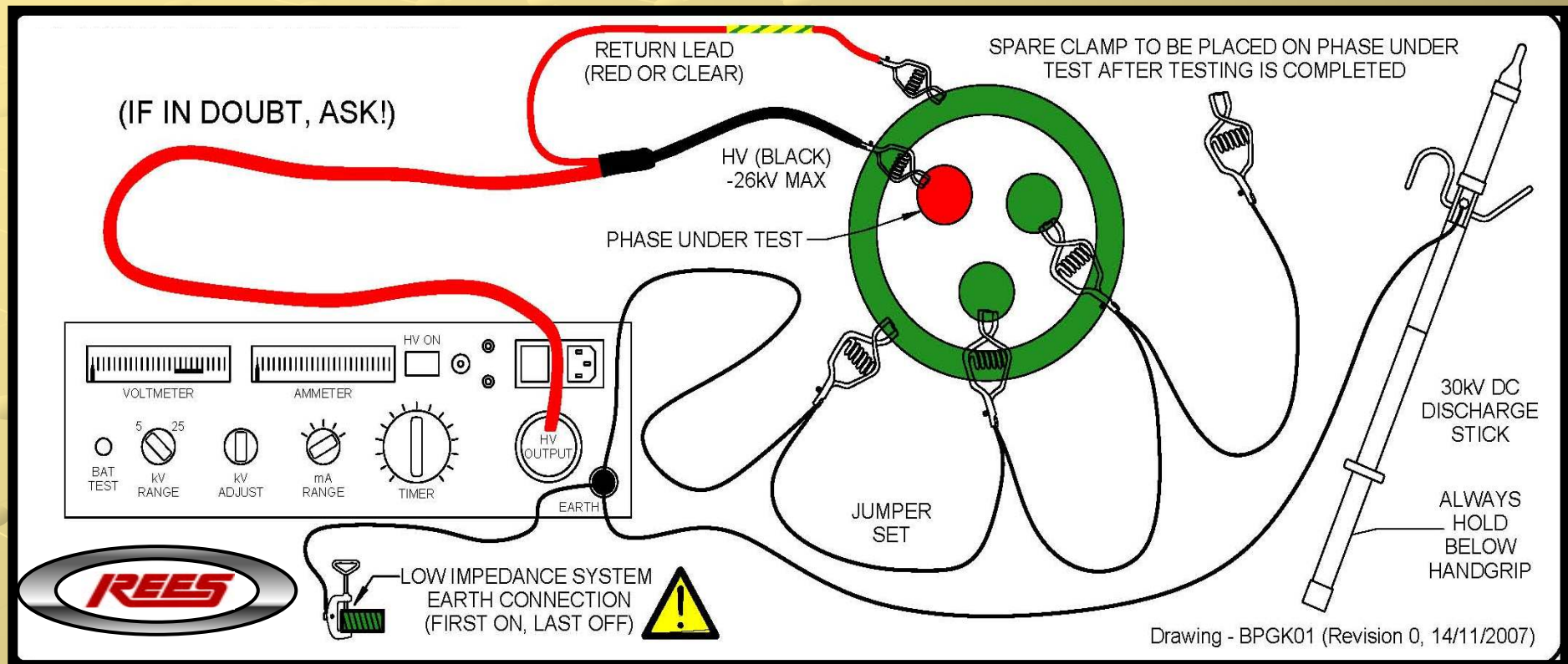
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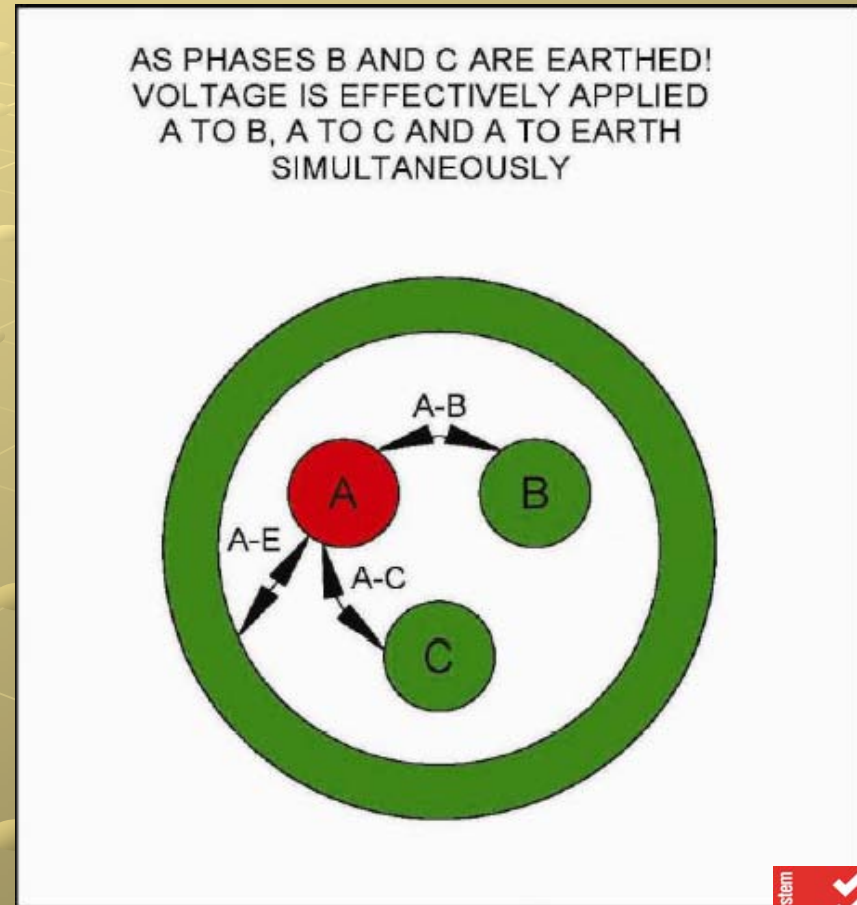
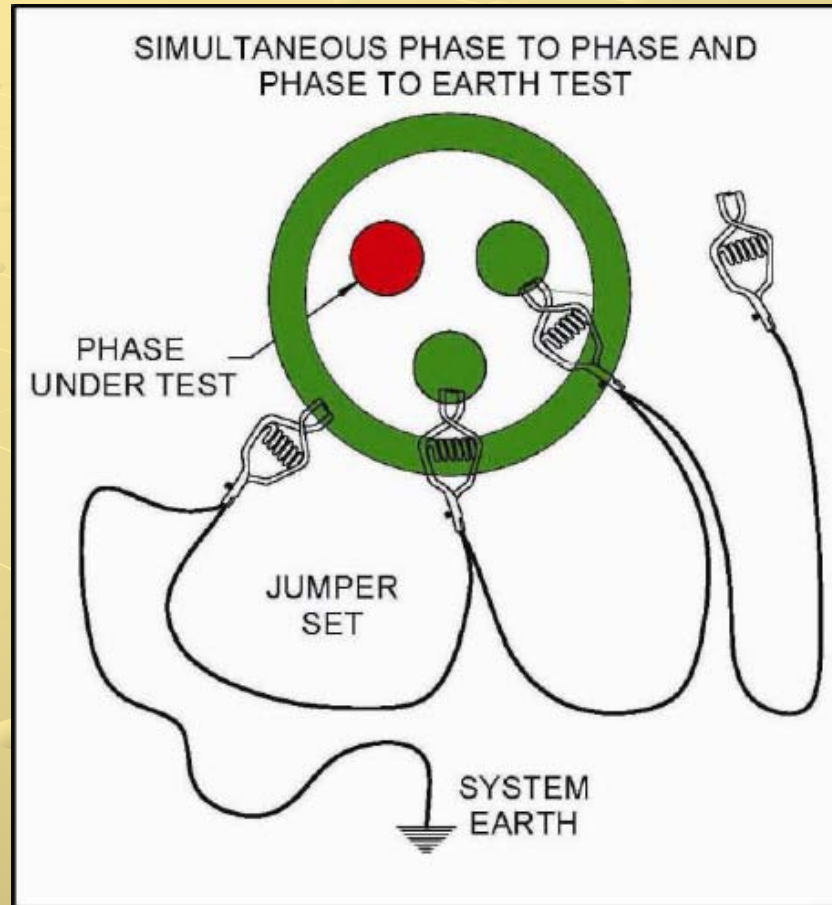
Recommended Kyoritsu 3124 Testing Connections



Recommended Baur PGK25 Testing Connections



Simultaneous Phase to Phase and Phase to Earth Test.



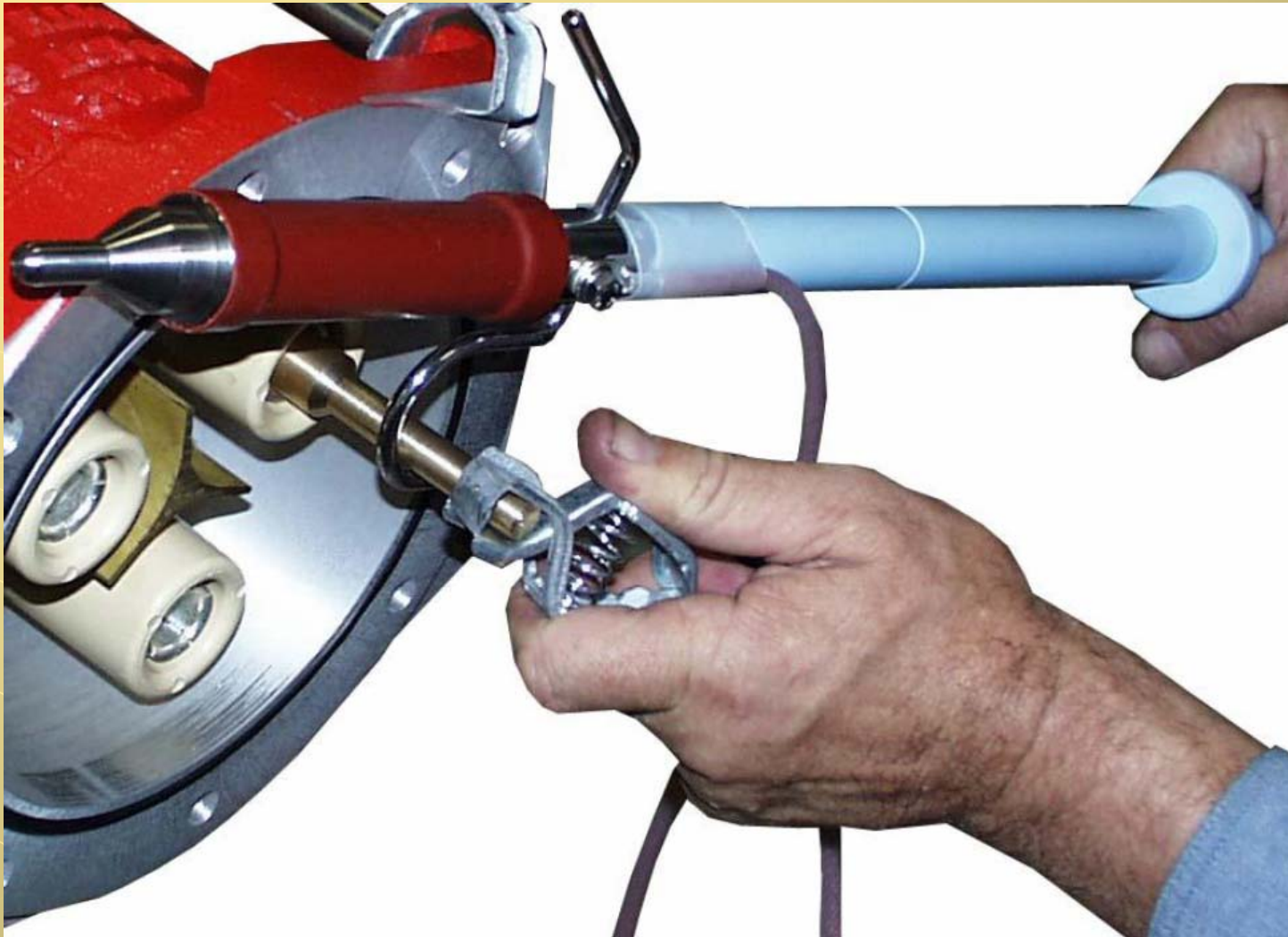
Testing.

Use a discharge stick and ensure that no conductors, other than solidly earthed are handled unless the earth probe or earth hook of a discharge stick is first in contact with the conductor.

It is recommended that operators DO NOT rely solely on the internal discharge mechanism of the test equipment. The discharge mechanism may be inoperative. Some insulation testers DO NOT have an inbuilt discharge mechanism. Be aware of potentially lethal energy levels stored in the capacitance of test specimens. Although most insulation testers have a maximum current of 100uA, the energy stored in a test specimen can be lethal.



Testing.



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Testing continued.

Regeneration of a DC potential after application and subsequent discharging **is not a myth**. This phenomenon can readily be demonstrated using any length of healthy PILC cable.

Ensure the test specimen is left in an earthed state after testing for a period of time at least equal to the test duration.

Example: If testing occurred for 5 minutes/phase then all conductors should remain earthed for at least 5 minutes after completion of testing.

Ensure that all connectors are securely attached during testing procedures.

As a good general practice when HV testing. **DO NOT** ground yourself either deliberately or inadvertently by touching surrounding conductive equipment such as water pipes, metallic walls of a switch room etc.



Batteries & Battery Charger

We have had several units in for repair with AA Alkaline batteries fitted in place of the rechargeable batteries designed for use in the unit.

This can cause major problems when the charger is applied to these batteries causing them to vent and spill acid on the main printed circuit board.

The slightly higher voltage of alkaline batteries as opposed to rechargeable batteries can also damage the display driver chip creating a relatively expensive repair. The unit is supplied with a universal type battery charger. The fitting is a 2 piece device and if separated can expose terminals. This may expose hazardous voltages if the device is incorrectly connected during testing. Fitting resin lined heat shrink to the plug will prevent separation.



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Battery Charger ..continued



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Important Observation

The colour coding leads connected to the various test equipment may differ between manufacturers. All Insulation testers are negative output with respect to ground.

Eg. Insulation Tester

Kyoritsu 3124 has Line output **RED** (-10kV)
Earth lead **GREEN**

HiPot Tester

Baur PGK25 has HV output **BLACK** (-25kV)
Earth Lead **RED**



Question?

Why do Insulation Testers use a Negative Output with respect to Earth ?



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Answer

Although modern insulating materials return insulation resistance readings practically independent of the applied DC voltage, many of the early insulating materials did not.

This phenomenon is called electroendosmosis causes older insulating material to exhibit a noticeably higher insulation resistance when the applied voltage is positive with respect to earth.

As a result insulation test sets were manufactured with the high voltage output negative with respect to earth so that the worst case reading is obtained.

This configuration became very much standard on all insulation testers and high potential test sets and remains the standard configuration for today's insulation measuring instruments.



High Voltage Insulation Test Kit



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