ASSOCIATED RESEARCH
A DIVISION OF KONIX USA

ELECTRICAL SAFETY TESTING 102

- Safety Tests Overview
- Understanding Test Requirements
- Standard Reference Guide Overview
- What to Avoid While Testing

Meet Our Team

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Webinar Notes

Please use the Q & A utility to ask us any questions concerning the material being presented.

Please contact Brittany Socha – on the chat line or email Brittany.socha@ikonixusa.com if you would like a copy of this presentation.

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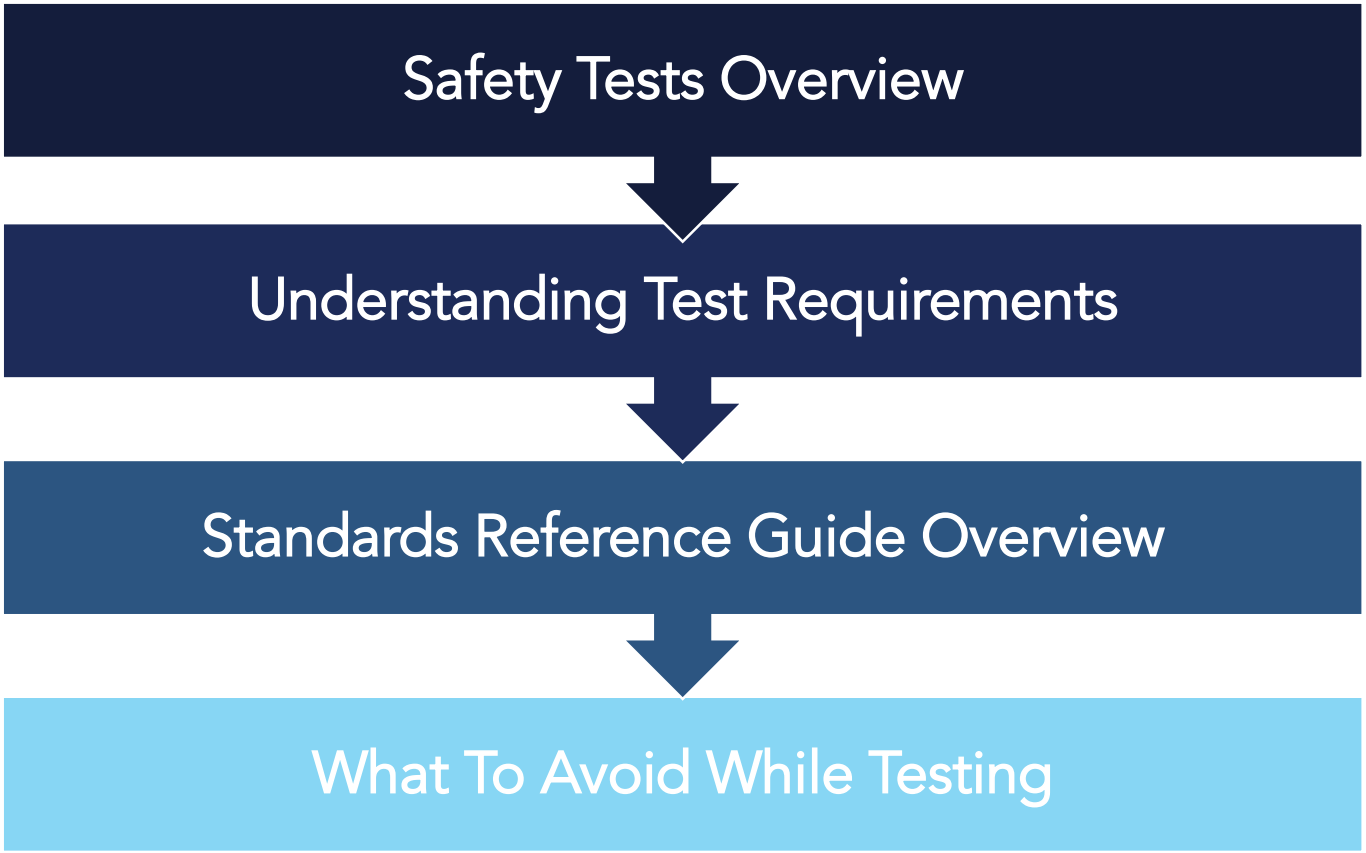
Learning Objectives



Type Vs. Routine Test

Type Test	Routine Test
Prototype Testing	100% Final Product Testing
Laboratory Environment/Conformance Testing	Production Line Testing After Final Assembly
	

Type Tests

Conducted at the engineering level on sample product.

Conducted by manufacturer and the safety agency.

Safety Standards are designed to ensure product safety.

Type tests verify the design integrity of a product.

Type tests are more rigorous than production line tests.

Routine Tests

Performed on **each** product at the end of production line or fully assembled products.

Designed to ensure safety of the end user of the product.

Dielectric Withstand, Ground Continuity/Ground Bond tests are commonly specified as 100% routine tests.

Additional tests may be specified as routine tests by the manufacturer and the safety agency to guarantee acceptable level of compliance with safety standards.

Common Electrical Safety Tests

Ground Continuity

AC Hipot

DC Hipot

Ground Bond

Insulation Resistance

Leakage Current

Poll Question

How comfortable do you feel explaining the test theory to others?

Ground Continuity Test

Verifies a connection between exposed conductive parts and the ground of the power cord on the product under test.

Routine production line test conducted on Class I products.

A low current DC signal is applied from the chassis of the product to the ground pin.

Ground Bond Test

GB test verifies the integrity of the ground connection between exposed metal and ground wire of the power cord.

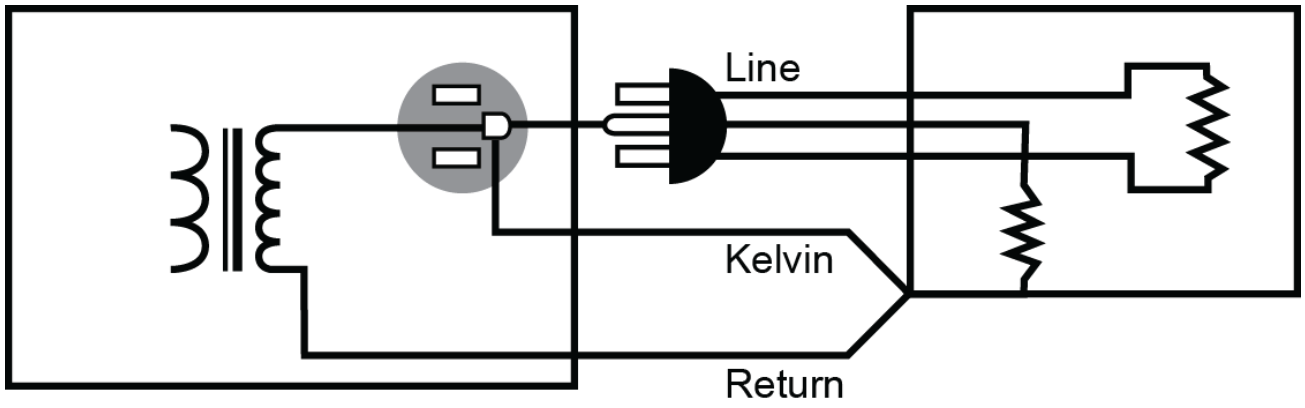
High current is injected into the ground pin of the product's power cord which flows through the chassis.

Determines if the safety ground wire is capable of handling excessive current flow in case a fault occurs and the product's insulation fails.

Ground Bond Test

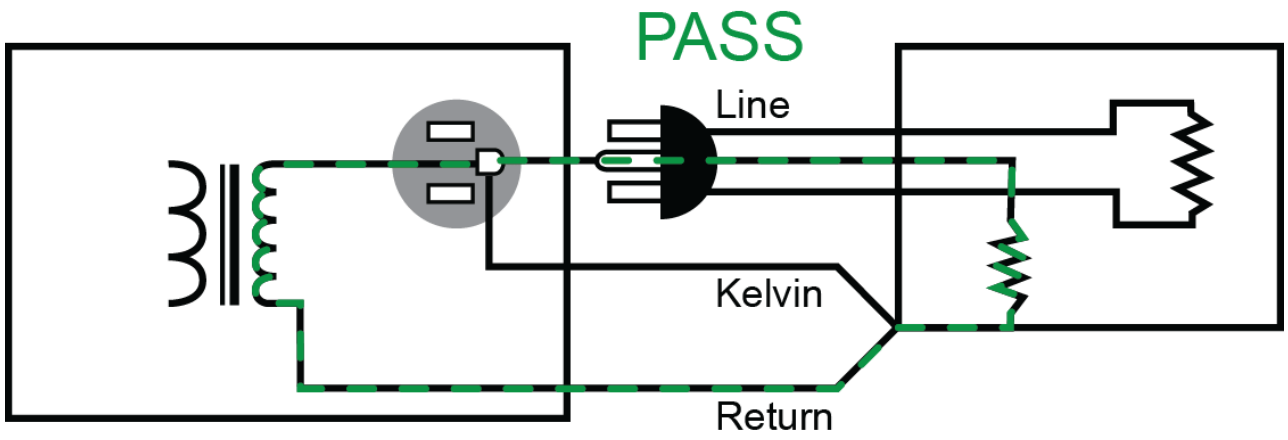
40A

Circuit for Ground Bond Test



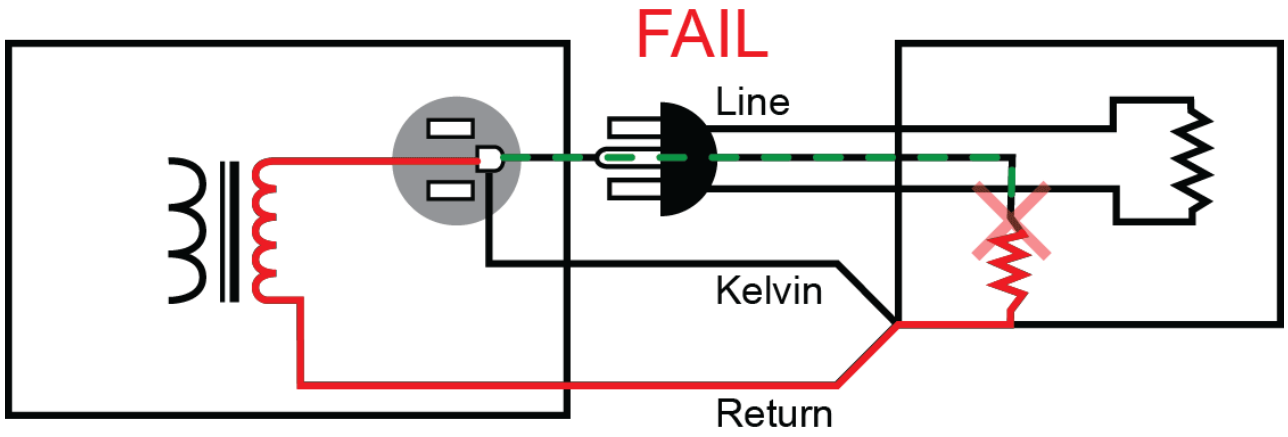
Ground Bond Test

40A



Ground Bond Test

40A



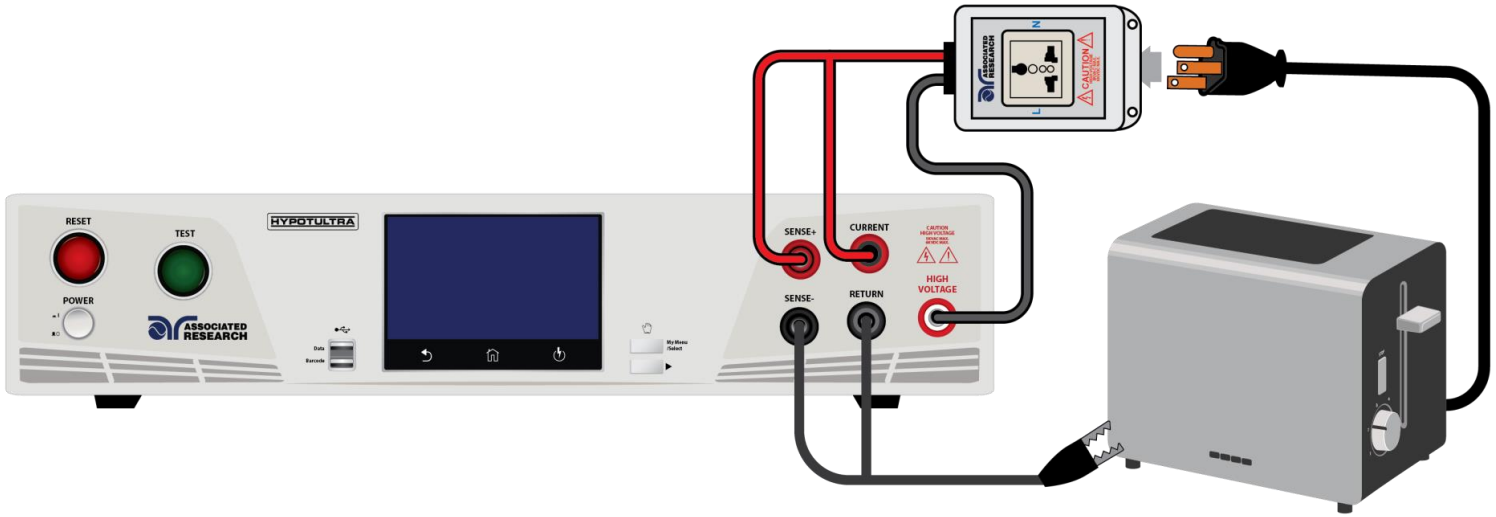
Ground Bond Test

40A

Ground Bond test is commonly considered a Type test and is generally performed *before* the Hipot test

The results of this test are displayed in Ohms (Ω).

The ground conductor of a product must have a low enough impedance to handle any fault current.



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Ground Bond Test

Test parameters for Ground Bond test vary from standard to standard.

Manufacturers must consult the safety standard which they are trying to comply with before setting test parameters.

For example, UL 60950 IT Equipment (Type Test) calls out for the test current to be twice the fuse rating of the product or twice the current rating of the circuit under test.

Test voltage is not to exceed 12V and the duration of the test to be 120 seconds.

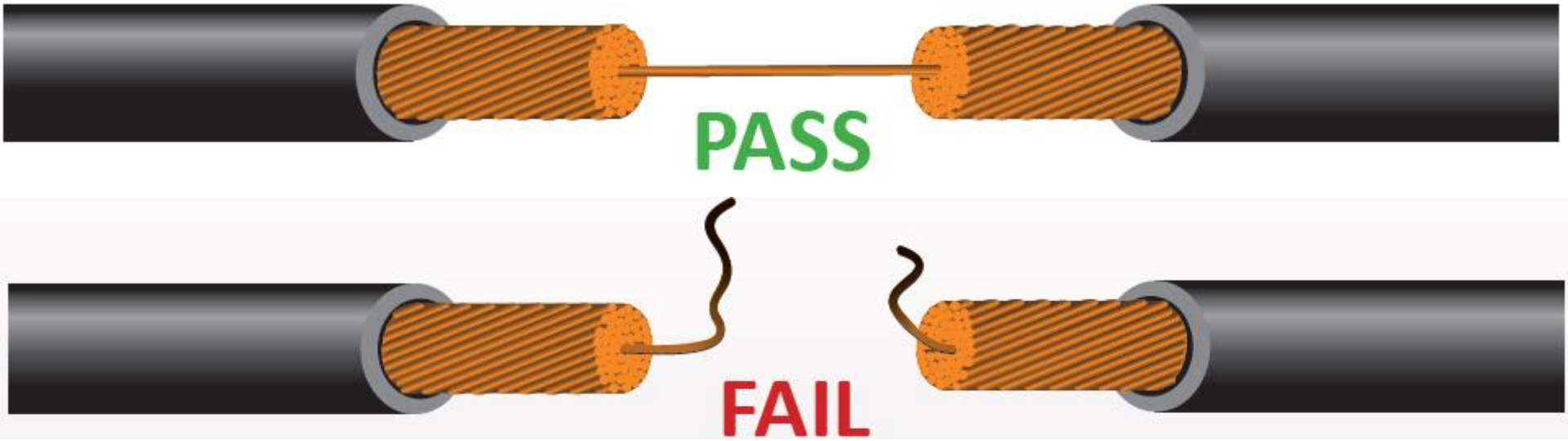
Video Demo of GB and GC


RESET
TEST
POWER
HYPOTULTRA
ASSOCIATED RESEARCH
001 CONT. PASS
3.0s 0.089Ω
002 GND PASS
30.00A 87mΩ
3.0s 2.63V
Data
Barcode

Ground Bond vs. Ground Continuity

Ground Continuity Test	Ground Bond Test
• Verifies the **existence** of a ground connection • Readings generally given in mΩ • The test is quick to set up and easy to perform • Usually used as an extra feature during the Hipot test	• Verifies the **integrity** of a ground connection • Readings generally given in mΩ • Provides more valuable safety information about DUT • Can be combined with a Hipot test for a more complete safety testing system

*The Ground Bond test is more stringent than the Ground Continuity test.



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Dielectric Withstand Test

Also referred to as Hipot test, it is used to determine whether the insulation of a product is able to withstand an over-voltage condition for a period of time without breaking down.

It is a deliberate application of high voltage potential between the mains input and any exposed dead-metal.

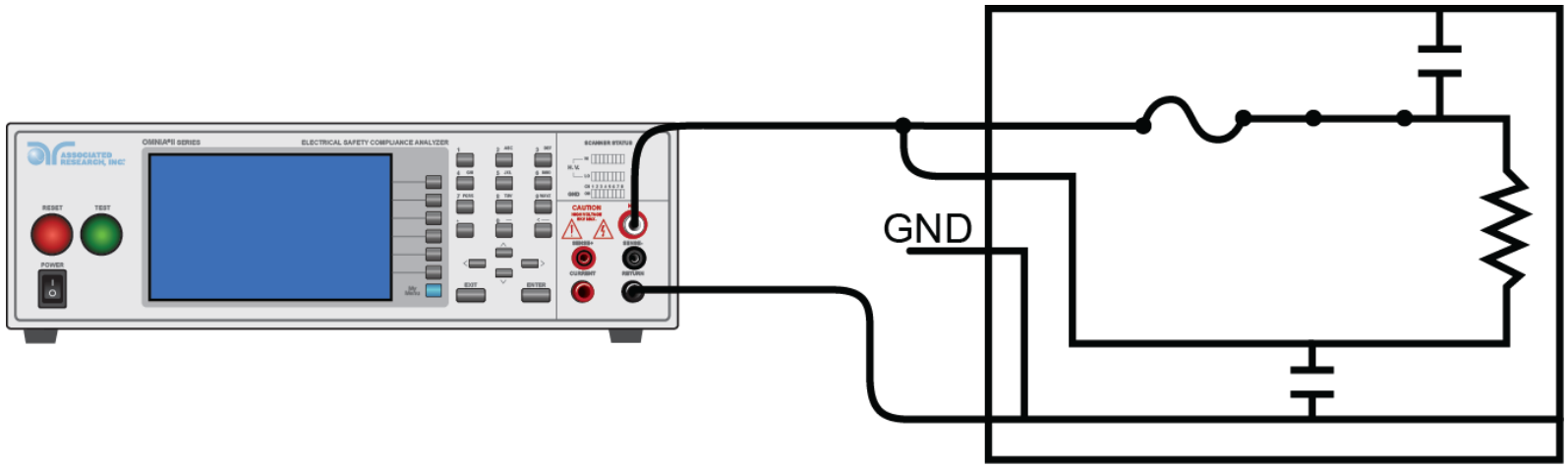
The resulting leakage current (due to the application of high voltage) is measured to determine whether a product's insulation is able to withstand the high voltage without breaking down.

This test verifies that the insulation of a product is capable of protecting the user from any leakage currents as a result of an electrical fault within the product.

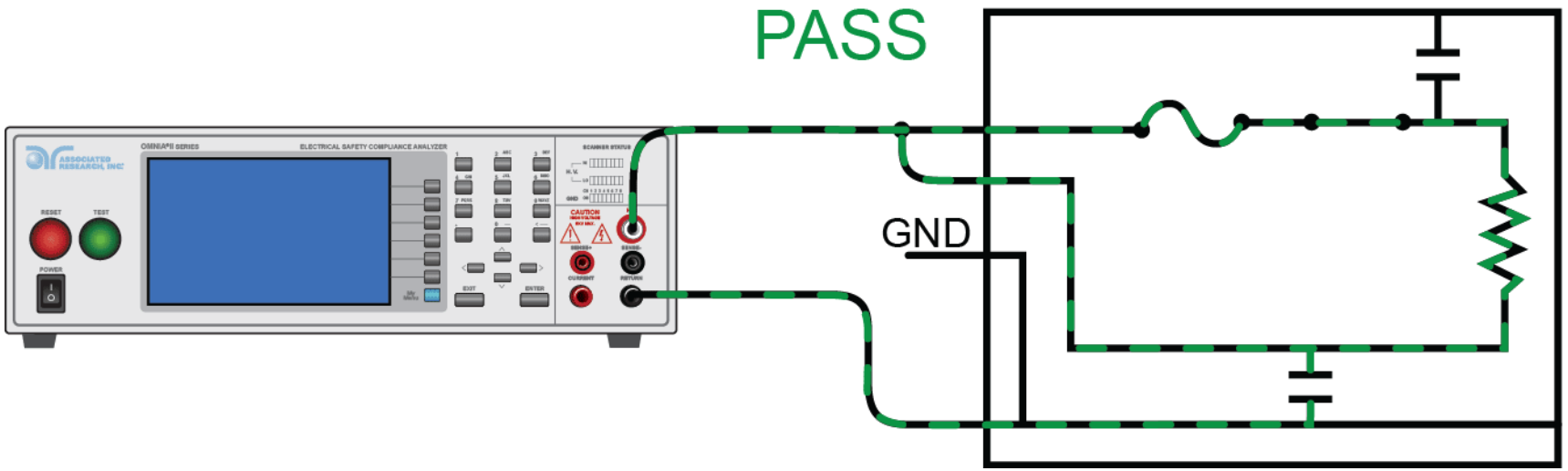
Dielectric Withstand Test

Can be a Type test or a Routine test.

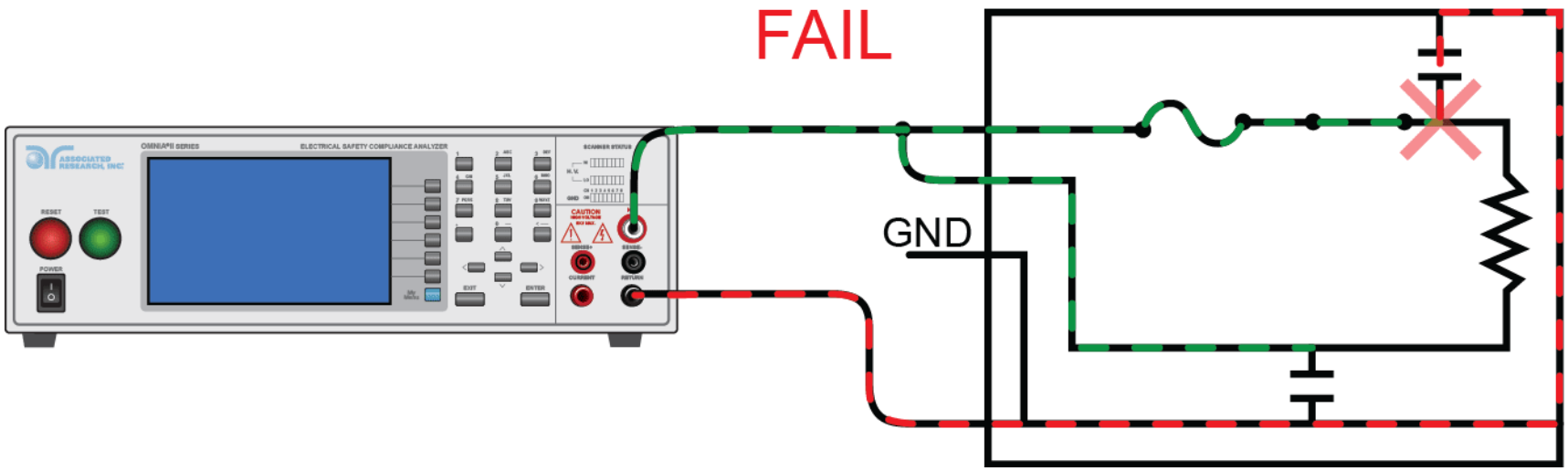
Used to detect possible defects in the design of a product and workmanship defects such as inadequate creepage and clearance distances.



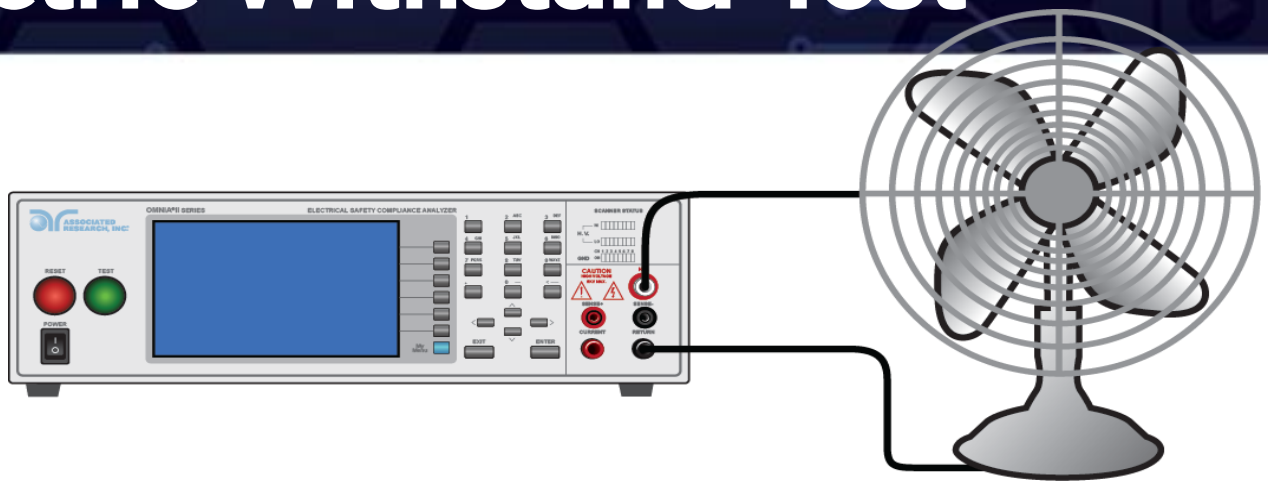
Dielectric Withstand Test



Dielectric Withstand Test



Dielectric Withstand Test



Leakage current is present in every product to some degree.

Leakage current becomes a problem when it reaches excessive levels due to dielectric breakdown.

Result is displayed in mA or µA depending on test type.

Dielectric Withstand Test

Test is performed on both Class I and Class II products.

Test can be performed in both AC and DC mode based on the safety standard, however AC hipot test is more stressful than the DC hipot test.

Test voltage and trip settings must be specified by the manufacturer in accordance with the safety standard.

Most standards specify the test voltage to be calculated using the following formula: 2 x Products Rated Voltage plus 1000V

Insulation Resistance Test

Similar to a DC Dielectric Withstand Test.

Stresses the same insulation on a product as the hipot test.

Provides a quantifiable value of the product's insulation in a resistance measurement .

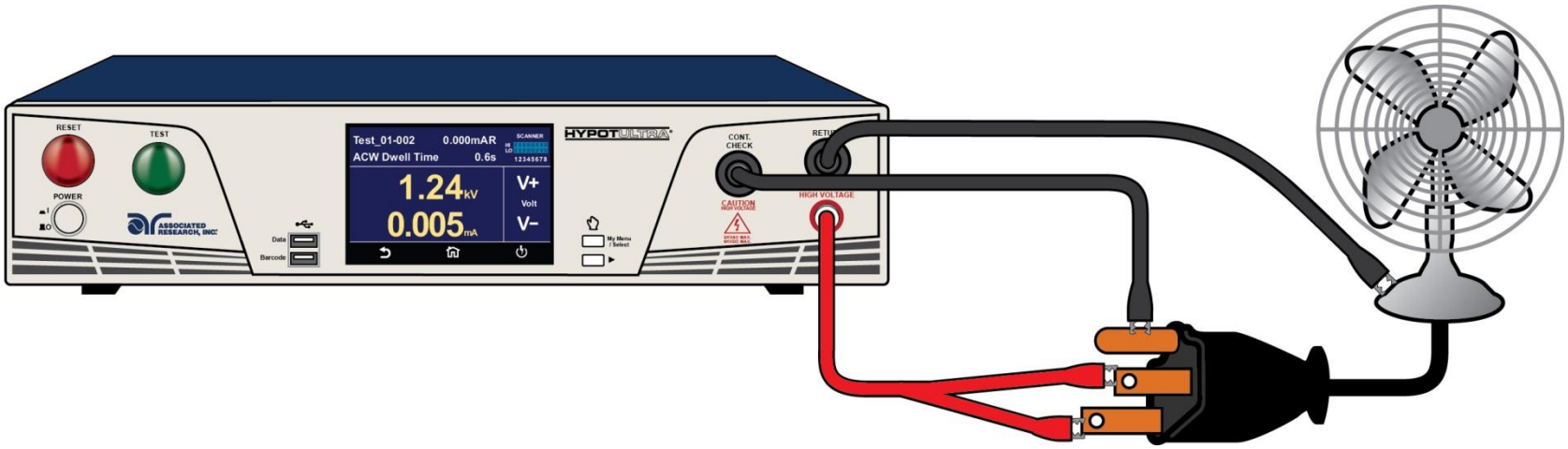
Commonly performed on serviced and repaired units to verify product integrity.

Most standards specify test voltage at 500 or 1000 Volts.

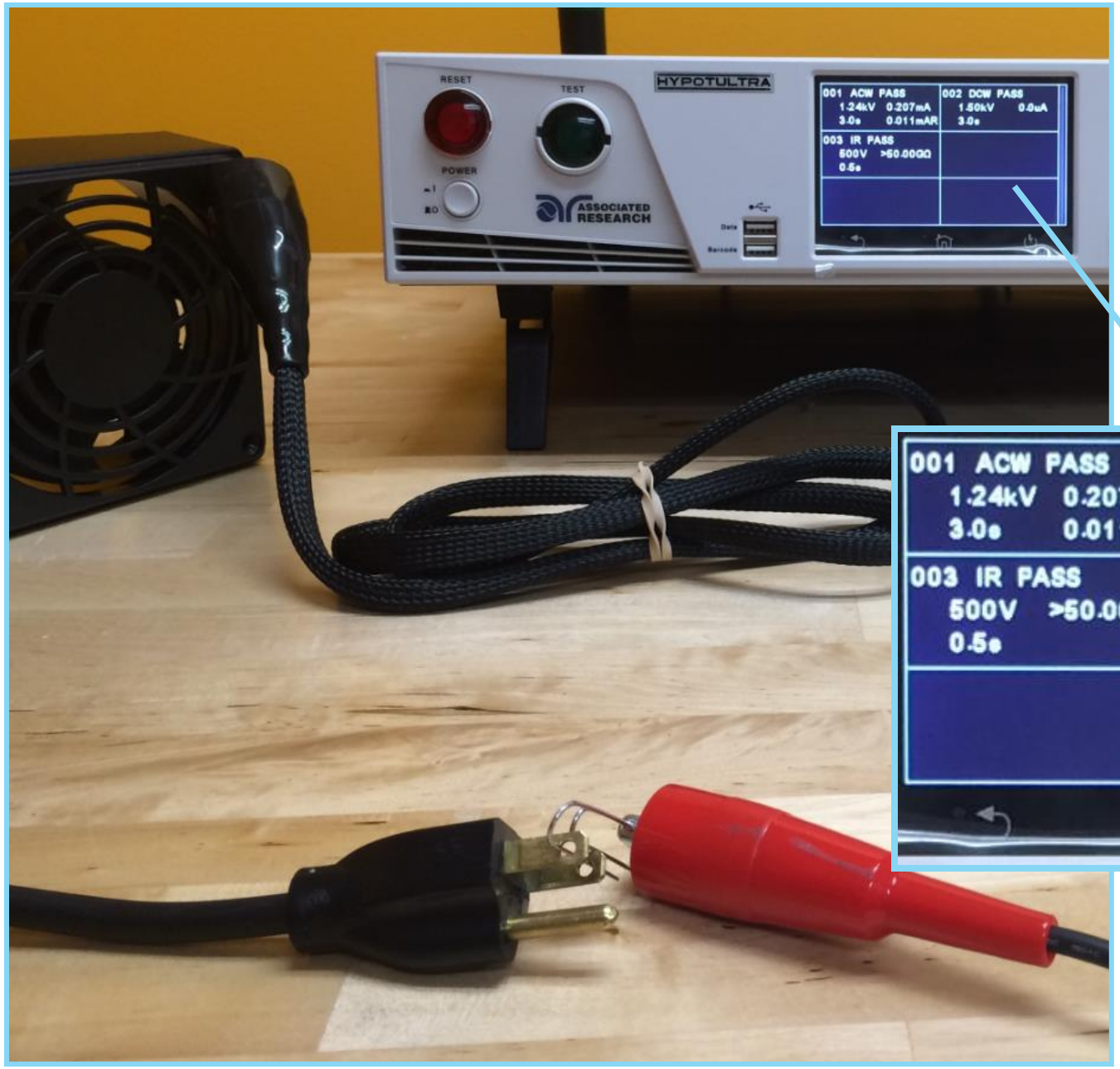
Insulation Resistance Test

Like other electrical safety tests, test parameters vary upon the standard.

EN 60204-1 Safety Of Machinery, specifies a 500V DC test between the power circuit conductors and protective bonding circuit, the resistance shall not be less than 1MΩ.



Video Demo of ACW, DCW & IR



001 ACW PASS
1.24kV 0.207mA
3.0s 0.011mAR
002 DCW PASS
1.50kV 0.0uA
3.0s
003 IR PASS
500V >50.00GΩ
0.5s

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Leakage Current Test

Line Current Test are performed on electrical products to measure the leakage current which could flow through a person while the product is operating.

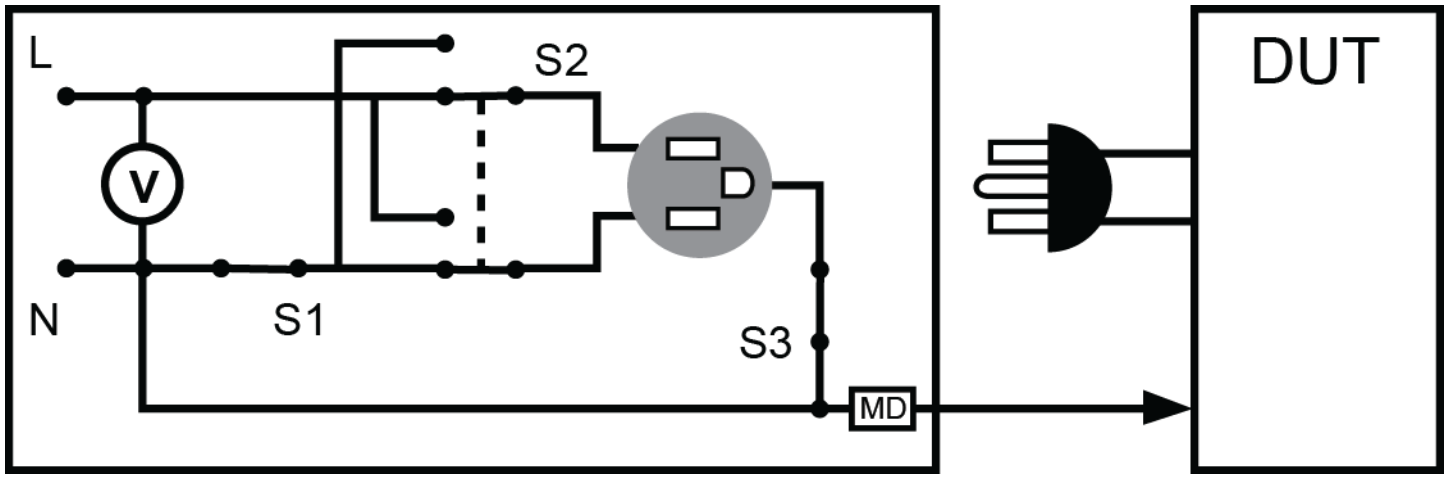
A measuring device (MD) is used to simulate the impedance of the human body under different conditions depending upon the application of the product.

Test is run under both normal and single fault conditions and reversed polarity on the input line power at 110% of rated input.

Most commonly performed on medical equipment.

Leakage Current Test

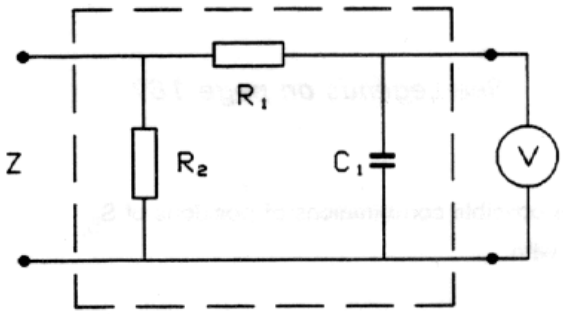
Typical circuit for Leakage Current test



Leakage Current Test

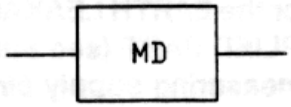
The MD can vary from standard to standard.

Measuring device for EN 60601-1 Medical Electrical Equipment.



R_1 = 10kΩ ± 5%[1)]
R_2 = 1kΩ ± 1%[1)]
C_1 = 0.015μF ± 5%[1)]

[1)] Non-inductive components
[2)] Impedance » measuring impedance Z



Equivalent to the above in subsequent figures.

Poll Question

What is best practice when performing a testing sequence on a class I product?

IEC 61010-1
3rd Edition

YOUR COMPLETE SOLUTION

OMNIA® II 8256/8257
6-in-1 Instrument

5.6.3 Limit Values for Accessible Parts (Leakage Current Test)	
REQUIREMENT	**PASS CRITERIA**
Tested in Normal Conditions (NC) and Single Fault Conditions (SFC) NOTE: AR Instruments contain leakage network A.1. Other networks must be manually built into our External MD.	Leakage Current (NC) ≤ 0.5 mA R.M.S. OR ≤ 0.7 mA Peak OR ≤ 2 mA DC Leakage Current (SFC) ≤ 3.5 mA R.M.S. OR 5 mA Peak OR 15 mA DC
★**SOLUTION:** LINECHEK® II 620L	

6.5.2.4 Impedance of Protective Bonding of Plug Connected Equipment (Ground Bond Test)	
REQUIREMENT	**PASS CRITERIA**
Current = 25 A AC or DC or 2 * highest rated current (whichever is greater) passed through protective earthing circuit Test time = 60 sec Frequency = Rated or DC	Impedance between ground pin and protectively earthed point(s) on the DUT ≤ 100 mΩ For DUTs with non-detachable supply cord, impedance of the DUT ≤ 200 mΩ
★**SOLUTION:** HypotULTRA® 7804 **or** HYAMP® III 3130/3140	

6.5.2.5 Impedance of Protective Bonding of Permanently Connected Equipment (Ground Bond Test)	
REQUIREMENT	**PASS CRITERIA**
Current of 2 * specified over current protection value passed through protective conductor and chassis points Test time = 60 sec	Voltage drop across circuit ≤ 10 V AC R.M.S. or DC
★**SOLUTION:** HypotULTRA® 7804 **or** HYAMP® III 3130/3140/3145	

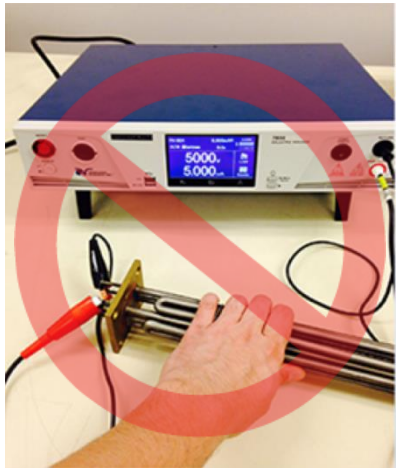
IEC 61010-1
3rd Edition Continued

6.8.3.1 The AC Voltage Test (AC Hipot Test)	
REQUIREMENT	**PASS CRITERIA**
Test voltage - Refer to Table 5 500 VA Equipment Required Test time = 5 sec ramp up, 60 sec dwell	No flashover or breakdown on product insulation
★**SOLUTION:** HypotULTRA® 7800 **or** Hypot® III 3780	

6.8.3.2 The DC Voltage Test (DC Hipot Test)	
REQUIREMENT	**PASS CRITERIA**
Test voltage - Refer to Table 5 Test time = 5 sec ramp up, 60 sec dwell	No flashover or breakdown on product insulation
★**SOLUTION:** HypotULTRA® 7850 **or** Hypot® III 3765	

Annex F - Routine Tests	
THE CONTINUITY TEST	**THE HIPOT TEST**
A continuity test to be run on the protective earth circuit No current value specified. Simple continuity test to show existence of protective earth circuit	Test voltage - Refer to Table F.1 No flashover or breakdown on product insulation
★**SOLUTION:** Hypot® III 3705	

What to AVOID When Testing



Touching DUT During Test

ESD Smock

Touch Test Leads During Test

Broken Ground Pin

Breaking Ground Pin On Test Equipment

What to AVOID When Testing

Do not attempt to perform tests on a product that are not meant to be performed for that product.

Do not attempt to use a testing device if not familiar with it.

Do not attempt to power up a test device with an unknown power source or outlet.

Do not assume anything about the functionality of a test device. Always read the manual.

What to AVOID When Testing

Do not attempt to defeat the protective ground on the power cord by using an extension cord without a protective conductor.

Do not replace the power supply cord with an improperly rated cord.

Do not attempt to perform any electrical safety tests in or around ESD test areas.

Do not cover or block the ventilation slits during operation.

What to AVOID When Testing

Grounding the test operator could lead to harmful or fatal electric shock.

Do not use accessories that are not approved by the manufacturer.

Do not disconnect any test leads while the test is running.

Do not attempt to use the tester in environmental conditions that are beyond the specifications of the tester.

Resources

Visit us online to view all of our Educational Resources
arisafety.com/support/educational-resources/

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Join Us

Our Next Webinar is

Electrical Safety Testing Circuit Theory

Wednesday, April 11th at 10 A.M. CT

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