• Ground of electrical products
• Class I vs. Class II products
• Ground Continuity Test
• Ground Bond Test
• What is tested during each test
Meet Our Team

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

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# Ground Bond & Ground Continuity Testing Learning Objectives

## Ground
- What is Ground?
- Grounding of electrical products
- Class I vs. Class II products

## Ground Bond
- The Ground Bond Test – What is it?
- Ground Bond Standards Information
- Ground Bond Testing Examples

## Ground Continuity
- The Ground Continuity Test – What is it?
- Ground Continuity Standards Information
- Ground Continuity Testing Examples

## Bond vs. Continuity
- Comparing the Ground Bond and Ground Continuity tests
- Example of Ground Bond vs Ground Continuity
Ground or “earth” can have numerous functions and meanings. The main purpose of a ground is to reduce the risk of electrical shock.

Modern Power Distribution
Different Functions of Ground

- **System or Service ground** – designed to protect machines, tools and insulation.
- **Equipment Ground** – Designed to protect operator from electrical shock hazards.
## Class I vs. Class II Electrical Products

<table>
<thead>
<tr>
<th>Class I Products</th>
<th>Class II Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Terminate in 3 prong line cord (line, neutral and ground).</td>
<td>• Double insulated products.</td>
</tr>
<tr>
<td>• Ground prong connects to product chassis.</td>
<td>• Terminate in 2 prong line cord (line and neutral).</td>
</tr>
<tr>
<td>• Safety through basic insulation and proper grounding.</td>
<td>• Safety through dual layer of insulation.</td>
</tr>
</tbody>
</table>

Class I products provide electrical protection by employing basic insulation and a grounded chassis. Class II products employ a double layer of insulation so a grounded chassis is not necessary.
NFPA (National Fire Protection Agency) stipulates the NEC which is adopted in all 50 U.S. States. The NEC gives requirements for grounding products and installations. The NEC defines a “good” ground.

### What is Good Ground?

<table>
<thead>
<tr>
<th>National Electrical Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>• NFPA 70</td>
</tr>
<tr>
<td>• Protect people and property from electrical hazards</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NEC 250-45</th>
</tr>
</thead>
<tbody>
<tr>
<td>• “Any exposed non-current carrying metal parts of cord &amp; plug connected equipment which may become energized shall be grounded.”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NEC 250-51</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Permanent and Continuous</td>
</tr>
<tr>
<td>• Capacity to conduct fault current</td>
</tr>
<tr>
<td>• Low impedance to limit voltage to ground.</td>
</tr>
</tbody>
</table>
Ground Bond and Continuity Tests

**Purpose**
- Ground Bond and Ground Continuity tests are designed to "check" the ground connection on a product or system.
- How you ensure you have a proper ground.

**Method**
- Apply a current to the ground point of a product or system.
- Measure potential drop across the ground circuit and calculate the circuit resistance.

**Testing**
- Permanent and Continuous
- Capacity to conduct fault current
- Low impedance to limit voltage to ground.

These two types of tests are used to prove and verify that there is a low impedance path to the ground for electrical products and systems. This ensures proper grounding.
Quiz Question

Which of the following best represents the result of a ground Bond test?
The Ground Bond Test

Associated Research HYAMP connected to a DUT (Device Under Test)
Ground Bond Testing
Ground Bond Testing
Ground Bond Testing
**By the Numbers – What the Standards State**

**IEC/UL 60601-1 3rd Edition**

<table>
<thead>
<tr>
<th>REQUIREMENT</th>
<th>PASS CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current = 25 A OR 1.5 * highest rated current (whichever is greater ±10%) passed through protective earthing circuit. Frequency = 50 or 60 Hz, no load voltage ≤ 6 V</td>
<td>Impedance protective earthing circuit on the DUT ≤ 100 mΩ For DUTs with non-detachable supply cord, impedance for DUT ≤ 200 mΩ</td>
</tr>
</tbody>
</table>
By the Numbers – What the Standards State

**UL 1598/CSA C22.2 No. 250.0-08 3rd Edition Luminaires**

<table>
<thead>
<tr>
<th>17.2 Bonding Circuit Impedance (Ground Bond Test)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>REQUIREMENT</strong></td>
</tr>
<tr>
<td>Test current = 30 A passed between earthing contact point and accessible conductive parts</td>
</tr>
<tr>
<td>No load voltage ( \leq 12 , \text{V AC or DC} )</td>
</tr>
<tr>
<td>Test time = 60 - 120 sec (Refer to clause 17.2.4)</td>
</tr>
</tbody>
</table>
### IEC/UL 60335-1 5th Edition

#### 27.5 Provision for Earthing Test (AC Ground Bond Test)

<table>
<thead>
<tr>
<th>REQUIREMENT</th>
<th>PASS CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current = 25 A OR 1.5 * highest rated current (whichever is greater) passed through protective earthing circuit. No load voltage ≤12 V AC or DC</td>
<td>Impedance protective earthing circuit on the DUT ≤ 100 mΩ</td>
</tr>
</tbody>
</table>
Ground Continuity testing is the same concept as Ground Bond testing. You’re simply checking for a continuous path on a ground circuit. However, there are key differences between these two tests.

**Purpose**
- A DC low current test to check circuit resistance.
- Similar concept to the Ground Bond testing.

**Method**
- Not all readings display on Ohmic value
- Light/buzzer meters to check whether continuity exists.
### IEC/UL 61010-1 3rd Edition

**Annex F - Routine Tests**

<table>
<thead>
<tr>
<th>THE CONTINUITY TEST</th>
<th>THE HIPOT TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td>Test voltage - Refer to Table F.1 No flashover or breakdown on product insulation</td>
</tr>
</tbody>
</table>
### IEC/UL 60335-1 5th Edition

**Annex A (Routine Tests)**

<table>
<thead>
<tr>
<th>ROUTINE GROUND BOND</th>
<th>ROUTINE HIPOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Current = 10 A</td>
<td>Test voltage - Refer to Table A.1</td>
</tr>
<tr>
<td>No load voltage ≤ 12 V AC or DC</td>
<td>Leakage current limit ≤ 5 mA</td>
</tr>
<tr>
<td>Impedance of earthing conductor for cord connected equipment ≤ 200 mΩ</td>
<td>Leakage current limit for high leakage appliances ≤ 30mA</td>
</tr>
<tr>
<td>Impedance for all other appliances ≤ 100 mΩ</td>
<td></td>
</tr>
</tbody>
</table>
## Ground Bond Vs. Ground Continuity

<table>
<thead>
<tr>
<th>Ground Continuity Test</th>
<th>Ground Bond Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Verifies the <strong>existence</strong> of a ground connection</td>
<td>• Verifies the <strong>integrity</strong> of a ground connection</td>
</tr>
<tr>
<td>• Readings generally given in $\Omega$s</td>
<td>• Readings generally given in m$\Omega$</td>
</tr>
<tr>
<td>• The test is quick to set up and easy to perform</td>
<td>• Provides more valuable safety information about DUT</td>
</tr>
<tr>
<td>• Usually used as an extra feature during the Hipot test.</td>
<td>• Can be combined with a Hipot test for a more complete safety testing system.</td>
</tr>
</tbody>
</table>

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

Example: 64 strand wire with all but one strand connected.
Example: 64 strand wire with all but one strand connected. A ground continuity test would pass this wire because the instrument reads a continuous path.
Ground Bond Vs. Ground Continuity

Example: A Ground Bond test load the wire with high current. This would “burn up” the connection and cause a FAIL.
Poll Question

When are you performing the Ground Bond test on your product?
Video Demonstration
Educational Resources

Visit us online to view all of our Educational Resources
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