

# Testing the Ground Circuit



- 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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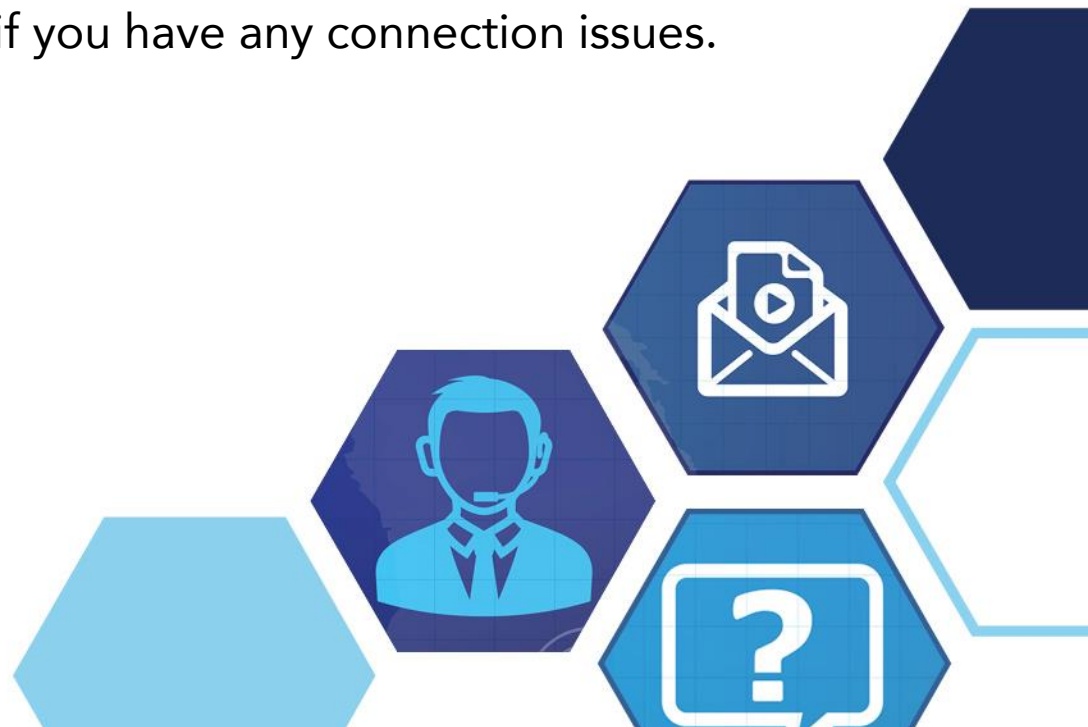


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Please contact Brittany Socha – on the chat line or email [Brittany.socha@ikonixusa.com](mailto:Brittany.socha@ikonixusa.com) if you have any connection issues.



# 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

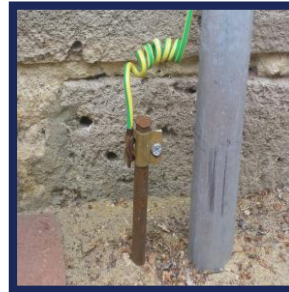
## Bond vs. Continuity

- Comparing the Ground Bond and Ground Continuity tests
- Example of Ground Bond vs Ground Continuity

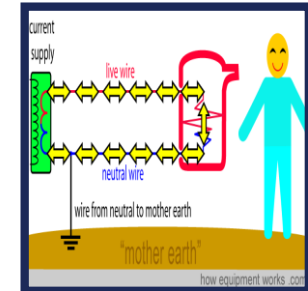
# What is Ground?



Reference point  
for an electrical  
circuit



Second line of  
defense against  
electrical shock<sup>1</sup>



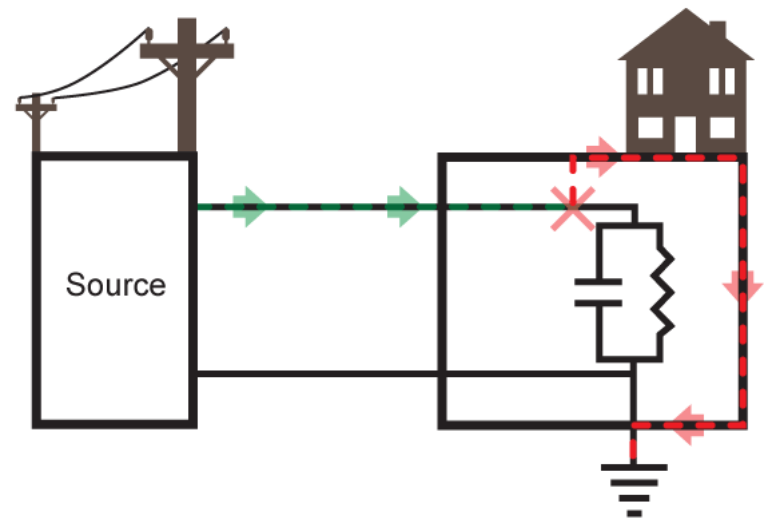
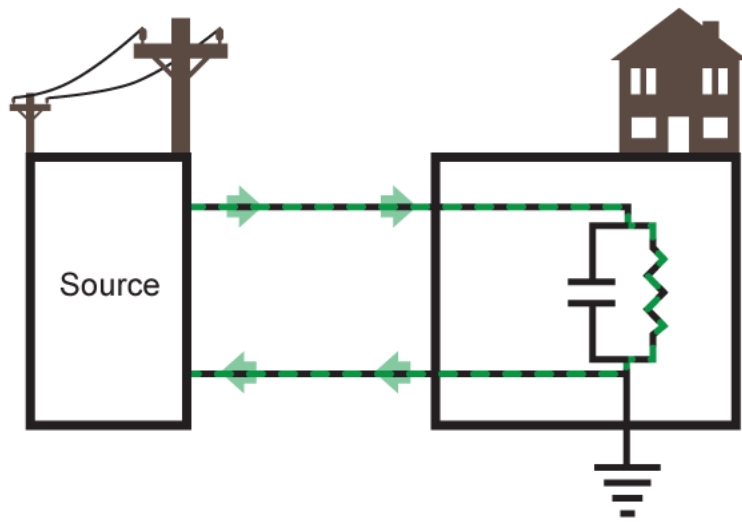
Common return  
path for electrical  
current<sup>2</sup>

**Ground or “earth” can have numerous functions and meanings. The main purpose of a ground is to reduce the risk of electrical shock.**

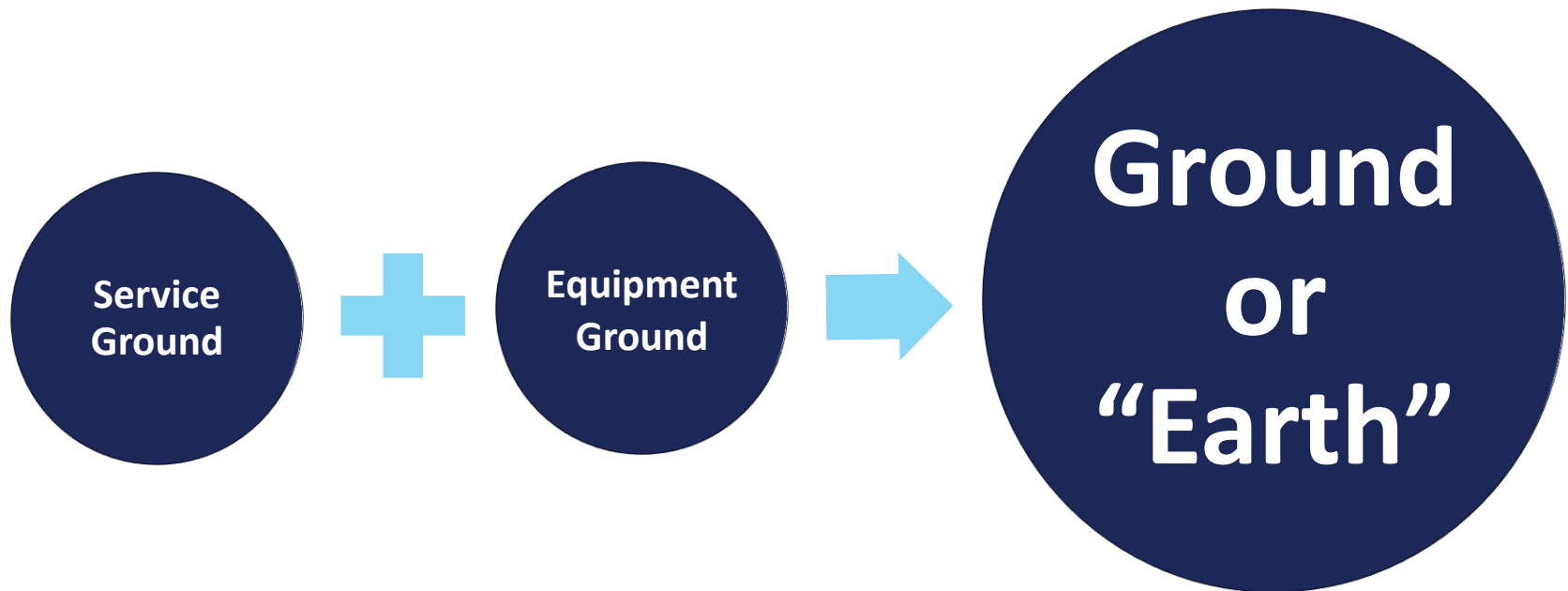
1 – [http://en.wikipedia.org/wiki/Ground\\_%28electricity%29#mediaviewer/File:HomeEarthRodAustralia1.jpg](http://en.wikipedia.org/wiki/Ground_%28electricity%29#mediaviewer/File:HomeEarthRodAustralia1.jpg)

2 - [http://www.howequipmentworks.com/physics/electricity/elec\\_safety/electrical\\_safety.html](http://www.howequipmentworks.com/physics/electricity/elec_safety/electrical_safety.html)

# 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

## Electrical products can be classified according to insulation type

### Class I Products



- Terminate in 3 prong line cord (line, neutral and ground).
- Ground prong connects to product chassis.
- Safety through basic insulation and proper grounding.

### Class II Products



- Double insulated products.
- Terminate in 2 prong line cord (line and neutral).
- Safety through dual layer of insulation.

**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.**



# What is Good Ground?

## National Electrical Code

- NFPA 70
- Protect people and property from electrical hazards

## NEC 250-45

- "Any exposed non-current carrying metal parts of cord & plug connected equipment which may become energized shall be grounded."

## NEC 250-51

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

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.

# 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

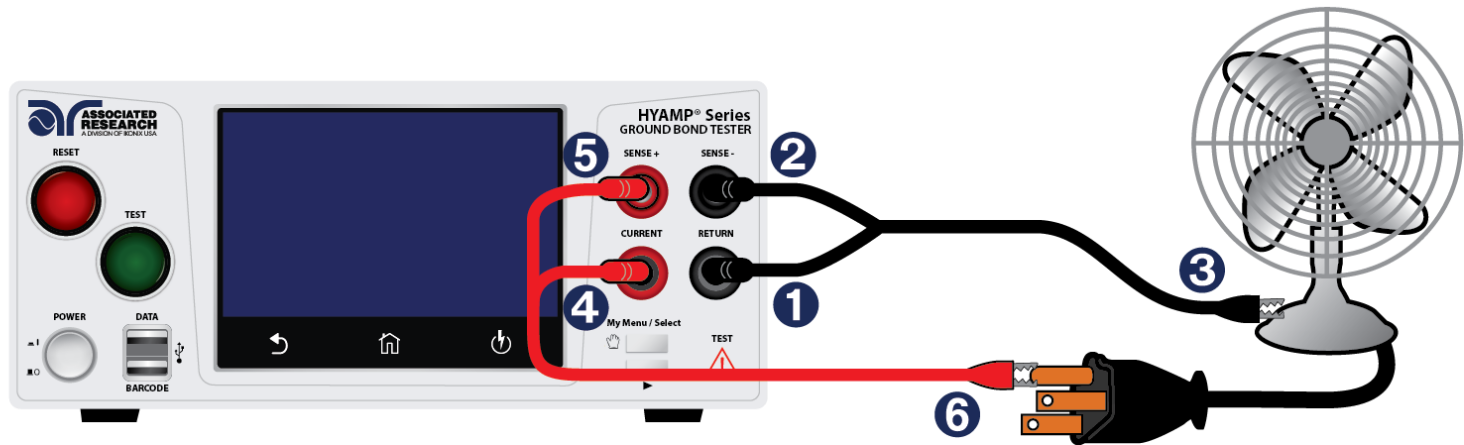
- Permanent and Continuous
- Capacity to conduct fault current
- Low impedance to limit voltage to ground.

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

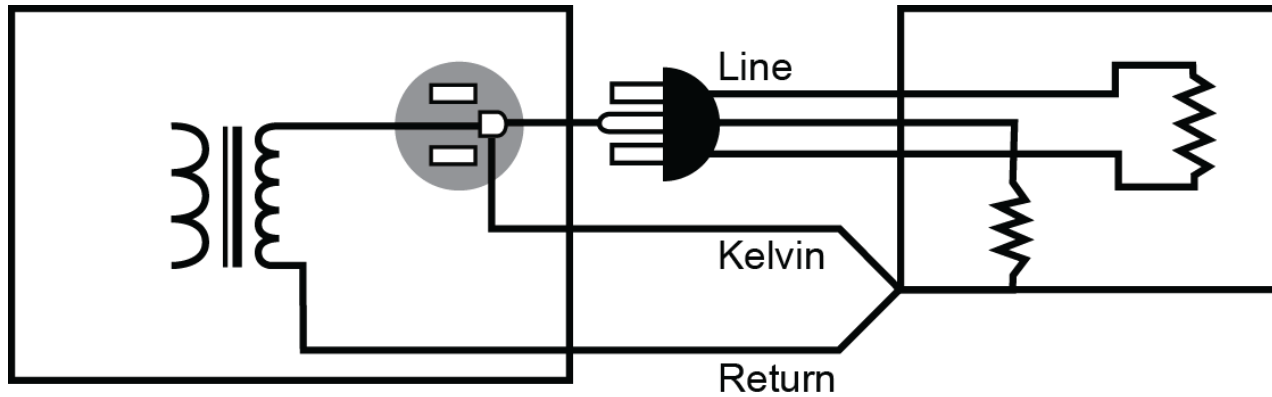
Which of the following best represents the result of a ground Bond test?

# The Ground Bond Test

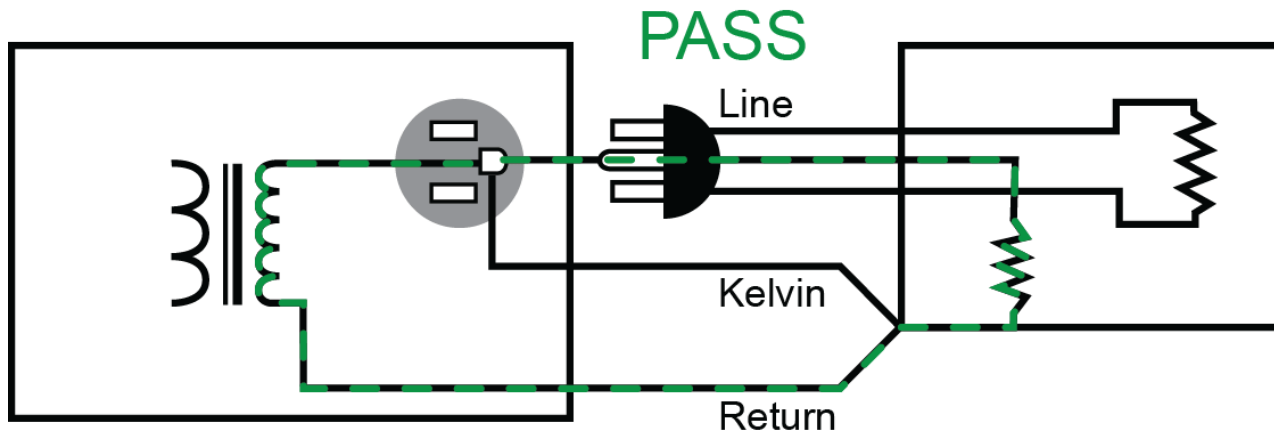


Associated Research HYAMP connected to  
a DUT (Device Under Test)

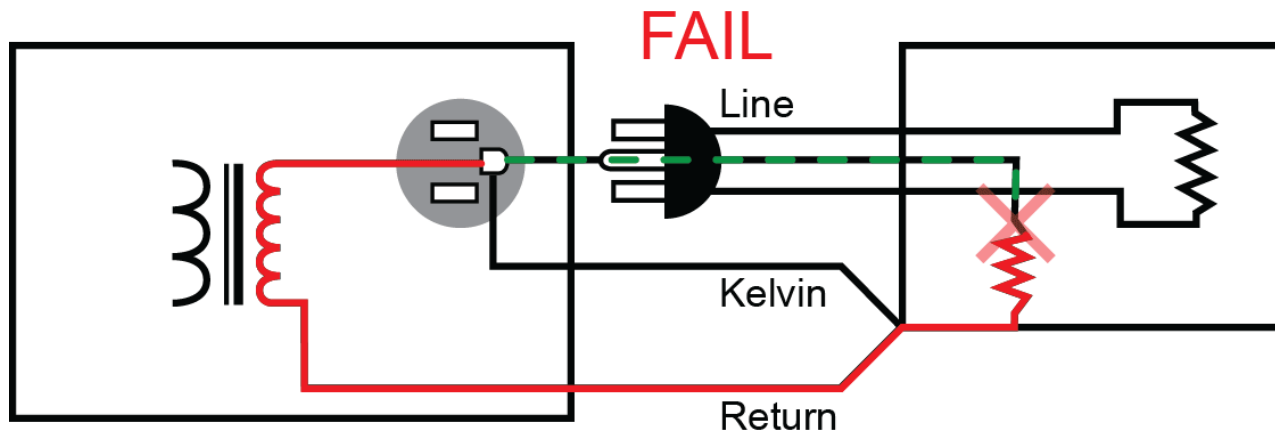
# Ground Bond Testing



# Ground Bond Testing



# Ground Bond Testing





# By the Numbers – What the Standards State

## IEC/UL 60601-1 3<sup>rd</sup> Edition

### 8.6.4 Impedance and Current Carrying Capability (AC Ground Bond Test)

REQUIREMENT	PASS CRITERIA
Current = 25 A OR 1.5 * highest rated current (whichever is greater $\pm 10\%$ ) passed through protective earthing circuit. Frequency = 50 or 60 Hz, no load voltage $\leq 6$ V	Impedance protective earthing circuit on the DUT $\leq 100$ m $\Omega$ For DUTs with non-detachable supply cord, impedance for DUT $\leq 200$ m $\Omega$

# By the Numbers – What the Standards State

## UL 1598/CSA C22.2 No. 250.0-08 3<sup>rd</sup> Edition Luminaires

### 17.2 Bonding Circuit Impedance (Ground Bond Test)

#### REQUIREMENT

Test current = 30 A passed between earthing contact point and accessible conductive parts  
No load voltage  $\leq 12$  V AC or DC  
Test time = 60 - 120 sec (Refer to clause 17.2.4)

#### PASS CRITERIA

Impedance protective earthing circuit on the DUT  $\leq 100$  m $\Omega$

# By the Numbers – What the Standards State

## IEC/UL 60335-1 5<sup>th</sup> Edition

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

REQUIREMENT	PASS CRITERIA
Current = 25 A OR 1.5 * highest rated current (whichever is greater) passed through protective earthing circuit. No load voltage $\leq 12$ V AC or DC	Impedance protective earthing circuit on the DUT $\leq 100$ m $\Omega$

# Ground Continuity Testing

## 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.

**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.**

# By the Numbers – What the Standards State

## IEC/UL 61010-1 3<sup>rd</sup> Edition

### Annex F - Routine Tests

#### THE CONTINUITY 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

#### THE HIPOT TEST

Test voltage - Refer to Table F.1  
No flashover or breakdown on product insulation

# By the Numbers – What the Standards State

## IEC/UL 60335-1 5<sup>th</sup> Edition

### Annex A (Routine Tests)

#### ROUTINE GROUND BOND

Test Current = 10 A  
No load voltage  $\leq 12$  V AC or DC  
Impedance of earthing conductor for cord connected equipment  $\leq 200$  m $\Omega$   
Impedance for all other appliances  $\leq 100$  m $\Omega$

#### ROUTINE HIPOT

Test voltage - Refer to Table A.1  
Leakage current limit  $\leq 5$  mA  
Leakage current limit for high leakage appliances  $\leq 30$ mA

# Ground Bond Vs. Ground Continuity

Ground Continuity Test	Ground Bond Test
<ul style="list-style-type: none"><li>• Verifies the <b>existence</b> of a ground connection</li><li>• Readings generally given in <math>\Omega</math>s</li><li>• The test is quick to set up and easy to perform</li><li>• Usually used as an extra feature during the Hipot test.</li></ul>	<ul style="list-style-type: none"><li>• Verifies the <b>integrity</b> of a ground connection</li><li>• Readings generally given in <math>m\Omega</math></li><li>• Provides more valuable safety information about DUT</li><li>• Can be combined with a Hipot test for a more complete safety testing system.</li></ul>

**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.

# Ground Bond Vs. Ground Continuity



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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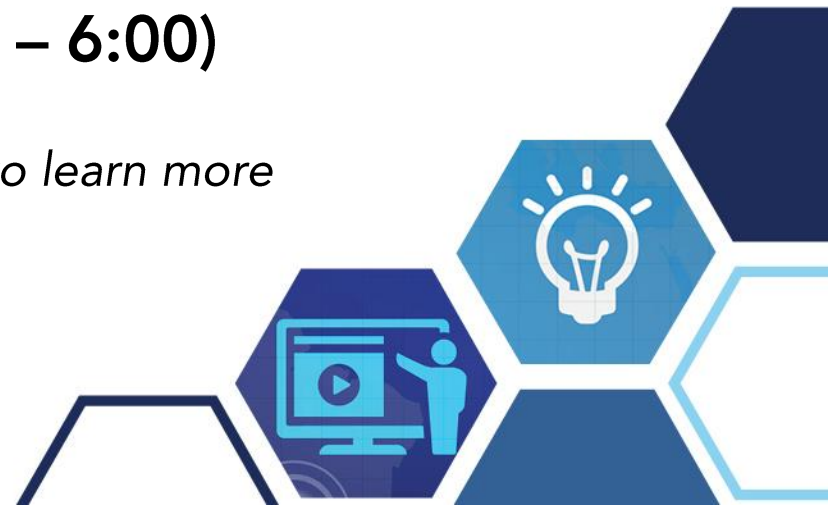
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