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# Coaxial Cable Acceptance Test

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# **RG217 V2-V2 Coaxial Cable Acceptance Test**

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**REVISION LOG**

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## **1.0 INTRODUCTION**

The ECSE Solid State Pulsed Power unit is a high current, high power solid-state pulse modulator. The RG217 V2-V2 Coaxial Cable Assembly is the interface cable between the Solid State Pulser and the load.

## **2.0 PURPOSE**

This document covers the testing procedure for the RG217 V2-V2 Coaxial Cable Assembly. This assembly is comprised of RG217 Coaxial Cable with a LRU Connector on either end. This test procedure verifies the cable is undamaged and assembled correctly, the correct cable connectors are installed properly onto the cable, and that the entire assembly meets conductivity and holdoff voltage requirements.

## **3.0 TEST OBJECTIVES**

This procedure will verify that the RG217 Coaxial Cable Assembly meets all assembly and functional requirements. In particular, this procedure verifies the Cable Shield and Center Conductor meet conductivity requirements by testing their resistances. Additionally, this procedure ensures the RG217 Coaxial Cable Assembly meets holdoff voltage requirements by applying high voltage and verifying the RG217 Coaxial Cable Assembly does not experience any breakdowns or arcing.

## **4.0 OBJECTIVE DEMONSTRATIONS**

The test specification identifies specific functional tests that will be performed on the RG217 Coaxial Cable Assembly. These tests ensure the RG217 Coaxial Cable Assembly meets all design and manufacturing requirements.

### **4.1 RG217 COAXIAL CABLE ASSEMBLY VISUAL INSPECTION**

This inspection verifies the RG217 Coaxial Cable Assembly was manufactured and assembled according to drawing specifications. This inspection also verifies there is no damage to any part of the RG217 Coaxial Cable Assembly.

### **4.2 CABLE SHIELD CONDUCTIVITY TEST**

This test verifies the conductivity of the Cable Shield meets design requirements for the full length of the RG217 Coaxial Cable Assembly.

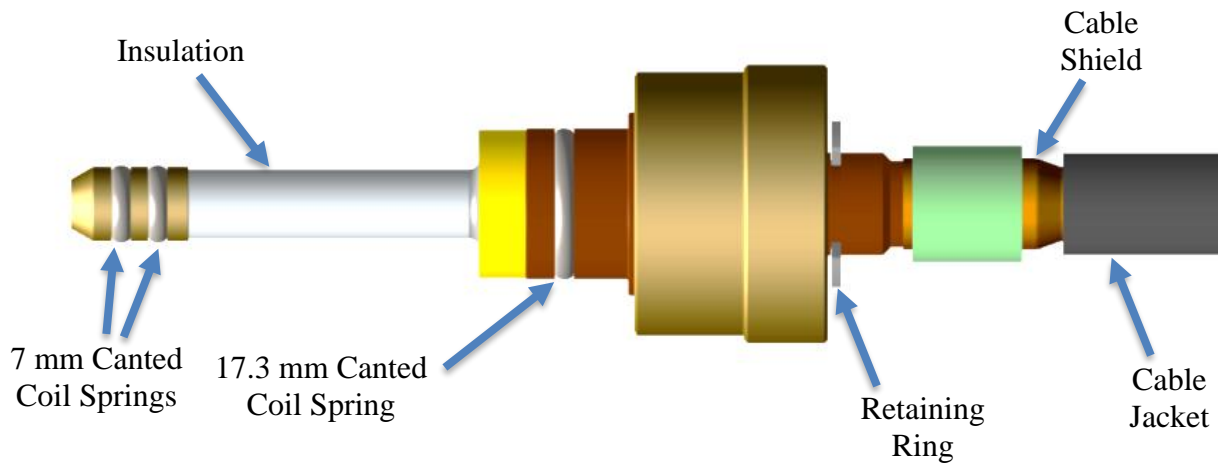
### **4.3 CENTER CONDUCTOR CONDUCTIVITY TEST**

This test verifies the conductivity of the Center Conductor meets design requirements for the full length of the RG217 Coaxial Cable Assembly.

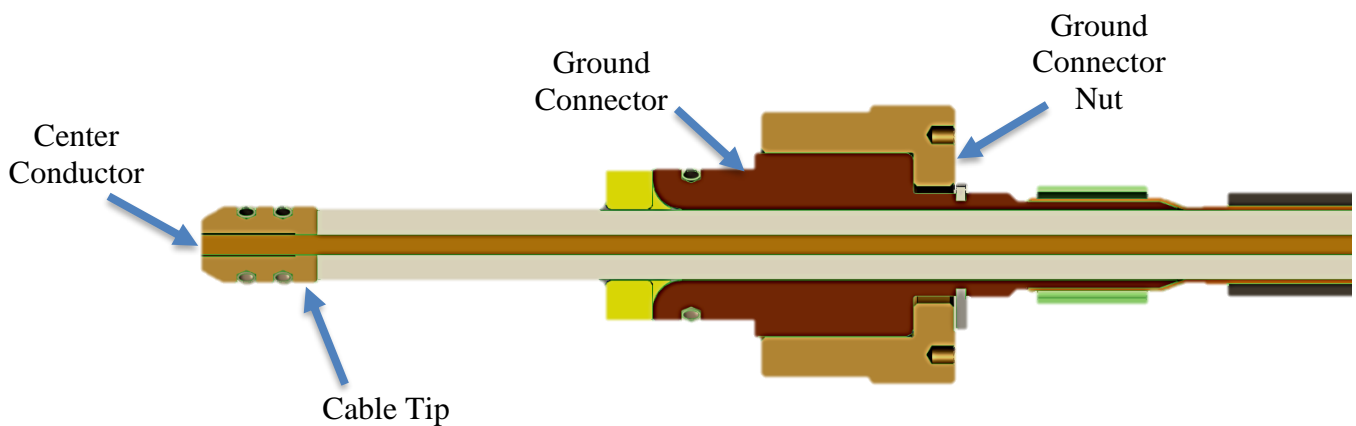
**4.4 CABLE ASSEMBLY HI-POT TEST**

This test verifies the Insulation is capable of holding off more than 40 kV at fewer than 1000  $\mu$ A for the full length of the RG217 Coaxial Cable Assembly. Additionally, this test verifies the Insulation is present and provides resistance between the Cable Shield and Center Conductor.

**5.0 TEST ARTICLE DESCRIPTION**



**Figure 1. LRU Connector**

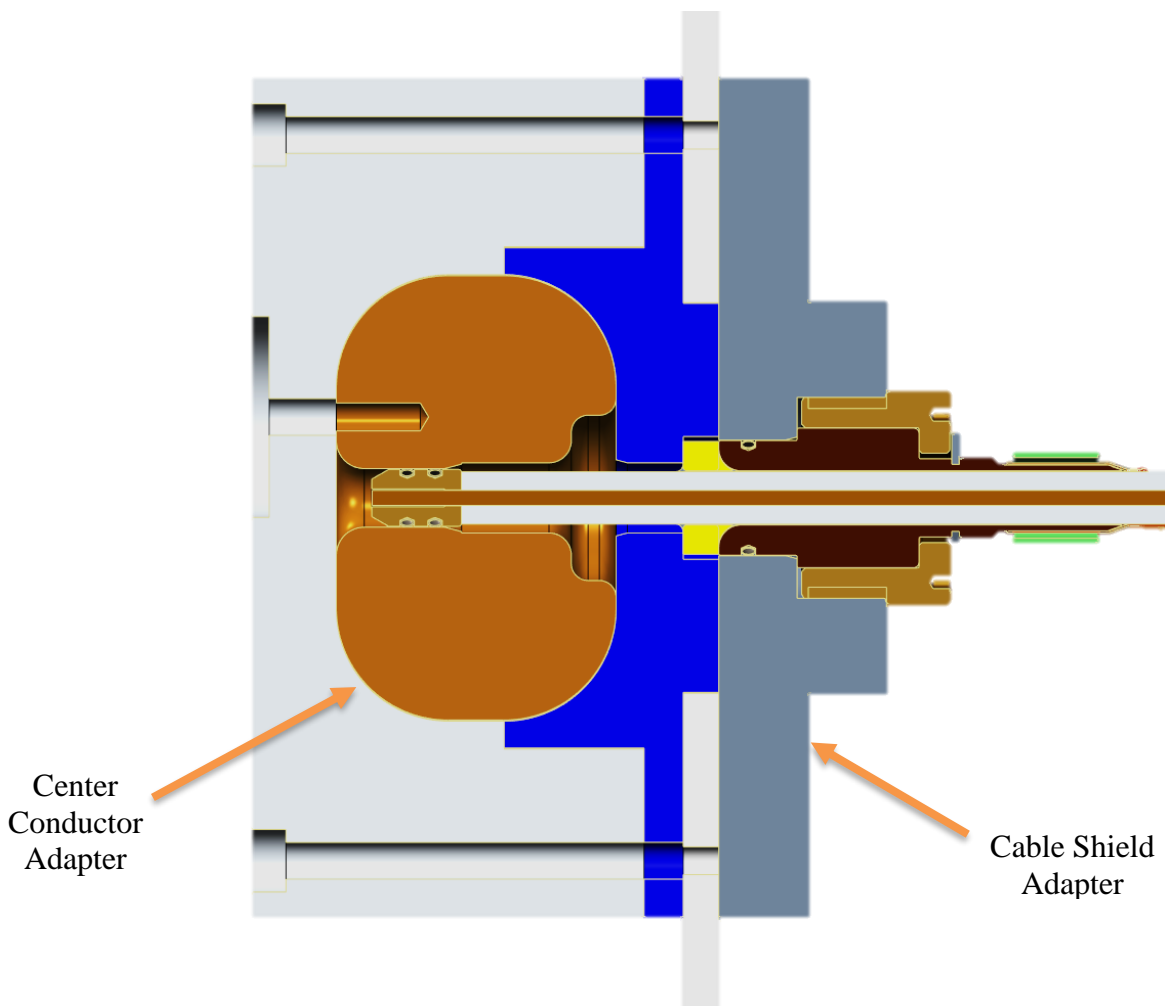


**Figure 2. LRU Connector Section View**

**6.0 TEST BED DESCRIPTION**

**Table 1. Test Bed Equipment**

Part Number	Description	Qty.
1010601299	Universal Cable Test Fixture	2
	Mesh Testing Cage	1
	Insulated Grounding Stick	1



**Figure 3. Cable Installed in One Side of Universal Cable Test Fixture**



**FIGURE 4. Mesh Testing Cage**

## 7.0 TEST INSTRUMENTATION AND CALIBRATION

**Table 2. Test Instrumentation**

Qty.	Test Equipment	Model
1	Micro-ohmmeter	AEMC 6255-NO Micro-Ohmmeter 10A, Instantaneous, Continuous, Multiple Test, Manual/Auto Temperature Compensation, No Kelvin Clips or Probes
1	Micro-ohmmeter Cables Set	AEMC 1017.84 Kelvin Clips Test Leads, 10 ft., (10A - Hippo)
1	Hi-POT Tester	Phenix 4100-10 Portable DC Hipot Dielectric Test, 100 kVDC 10mA (120V)

## 8.0 TEST PROCEDURES

This is the step-by-step procedure required for safe operation during cable testing.


### 8.1 RG217 COAXIAL CABLE ASSEMBLY VISUAL INSPECTION

See Figure 1 and Figure 2 for reference in visual inspection.	
Step	Action
1	Verify LRU Connector is installed according to drawing on one end of cable and that all parts are present.
2	Verify LRU Connector is installed according to drawing on other end of cable and that all parts are present.
3	Verify Center Conductor and Insulation are not damaged.
4	Verify Cable Shield and Jacket are not damaged.
5	Verify all canted coil springs and O-rings are not damaged and are installed correctly. Canted coil springs should be canted the same direction.
6	Verify crimp is installed according to drawing and has not damaged the Ground Connector.
7	If Steps 1-6 are all true, <b>record</b> in test record in Section 10.0.

### 8.2 INSTALLATION OF RG217 COAXIAL CABLE INTO TEST FIXTURE

See Figure 1, Figure 2, and Figure 3 for reference in installation.	
Step	Action
1	Push one side of RG217 Coaxial Cable Assembly into the Center Conductor Adapter on one side of Universal Cable Test Fixture.
2	On the same side, thread Ground Connector Nut into Center Conductor Adapter.
3	Repeat Steps 1-2 on other side of cable.
4	Ensure Universal Cable Test Fixture and all parts of RG217 Coaxial Cable Assembly are inside Mesh Testing Cage.
5	<b>SAFETY:</b> Put up safety barriers around high-voltage area.
6	Verify ambient temperature is $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ .

**8.3 CABLE SHIELD CONDUCTIVITY TEST**


See Figure 1, Figure 2, and Figure 3 for reference in testing.	
Step	Action
<p><b>PAUSE:</b> If any verification step in the procedure below fails, or if there are any observed signs of arcing, equipment abnormalities, damage, or erroneous waveforms, <b>PAUSE WORK</b> and <b>DO NOT PROCEED</b>. Follow Off-Normal Procedure listed below:</p> <ol style="list-style-type: none"> <li>Turn off ALL equipment.</li> <li>Safe test stand according to procedure in Section 9.1.</li> <li>Review Sections 8.1 and 8.2 to ensure proper cable assembly and test stand set up.</li> <li>Rectify any issues with equipment.</li> <li>Return to Step 1 of Section 8.3 Cable Shield Conductivity Test.</li> </ol>	
1	<p><b>SAFETY:</b> Ensure test stand is set up correctly according to Section 8.2, including safety barriers.</p>
2	<p>Connect test leads to Micro-ohmmeter.</p> <ol style="list-style-type: none"> <li>Connect Micro-ohmmeter <b>red</b> cable clips to the Micro-ohmmeter <b>C1</b> and <b>P1</b> input terminals.</li> <li>Connect Micro-ohmmeter <b>black</b> cable clips to the Micro-ohmmeter <b>C2</b> and <b>P2</b> input terminals.</li> </ol> 
3	<p>Connect test leads to RG217 Coaxial Cable Assembly.</p> <ol style="list-style-type: none"> <li>Connect other end of <b>red</b> cable clip to RG217 on <b>Cable Shield Adapter ring lug</b> on one end of RG217 Coaxial Cable Assembly.</li> <li>Connect other end of <b>black</b> cable clip to RG217 on <b>Cable Shield Adapter ring lug</b> on other end of RG217 Coaxial Cable Assembly.</li> </ol>

**Figure 5. Micro-ohmmeter Terminal Connections for Cable Shield Test**

<p>4</p>	<p>Set up Micro-ohmmeter settings.</p> <ol style="list-style-type: none"> <li>a. Turn dial to “10 A 250 mΩ”.</li> <li>b. Verify meter reads “AUTO”.</li> <li>c. Press Start/Stop button.</li> <li>d. Verify meter reads “OPER”.</li> </ol> <div data-bbox="656 485 1166 926" data-label="Image"> </div> <p style="text-align: center;"><b>Figure 6. Micro-ohmmeter Settings for Cable Shield Test</b></p>
<p>5</p>	<p>Read resistance value of Cable Shield.</p> <ol style="list-style-type: none"> <li>a. Verify resistance is 1 mΩ – 50 mΩ.</li> <li>b. <b>Record</b> resistance value in test record in Section 10.0.</li> </ol>
<p>6</p>	<p>Turn Micro-ohmmeter off.</p> <ol style="list-style-type: none"> <li>a. Press Start/Stop button.</li> <li>b. Verify meter reads “OPER”.</li> <li>c. Turn dial to “OFF”.</li> </ol>
<p>7</p>	<p><b>SAFETY:</b> Safe test stand according to procedure in Section 9.1.</p>
<p>8</p>	<p>Disconnect Micro-ohmmeter test leads from RG217 Coaxial Cable Assembly.</p>

**8.4 CENTER CONDUCTOR CONDUCTIVITY**

See Figure 1, Figure 2, and Figure 3 for reference in testing.

Step	Action
	<p><b>PAUSE:</b> If any verification step in the procedure below fails, or if there are any observed signs of arcing, equipment abnormalities, damage, or erroneous waveforms, <b>PAUSE WORK</b> and <b>DO NOT PROCEED</b>. Follow Off-Normal Procedure listed below:</p> <ol style="list-style-type: none"> <li>Turn off ALL equipment.</li> <li>Safe test stand according to procedure in Section 9.1.</li> <li>Review Sections 8.1 and 8.2 to ensure proper cable assembly and test stand set up.</li> <li>Rectify any issues with equipment.</li> <li>Return to Step 1 of Section 8.4 Center Conductor Conductivity Test.</li> </ol>
1	<p><b>SAFETY:</b> Ensure test stand is set up correctly according to Section 8.2, including safety barriers.</p>
2	<p>Connect test leads to Micro-ohmmeter.</p> <ol style="list-style-type: none"> <li>Connect Micro-ohmmeter <b>red</b> cable clips to the Micro-ohmmeter <b>C1</b> and <b>P1</b> input terminals.</li> <li>Connect Micro-ohmmeter <b>black</b> cable clips to the Micro-ohmmeter <b>C2</b> and <b>P2</b> input terminals.</li> </ol>  <p style="text-align: center;"><b>Figure 7. Micro-ohmmeter Terminal Connections for Center Conductor Test</b></p>
3	<p>Connect test leads to RG217 Coaxial Cable Assembly.</p> <ol style="list-style-type: none"> <li>Connect other end of <b>red</b> cable clip to RG217 on <b>Center Conductor Adapter ring lug</b> on one end of RG217 Coaxial Cable Assembly.</li> <li>Connect other end of <b>black</b> cable clip to RG217 on <b>Center Conductor Adapter ring lug</b> on other end of RG217 Coaxial Cable Assembly.</li> </ol>

<p>4</p>	<p>Set up Micro-ohmmeter settings.</p> <ol style="list-style-type: none"> <li>a. Turn dial to “10 A 250 mΩ”.</li> <li>b. Verify meter reads “AUTO”.</li> <li>c. Press Start/Stop button.</li> <li>d. Verify meter reads “OPER”.</li> </ol> <div data-bbox="609 485 1214 1003" data-label="Image"> </div> <p style="text-align: center;"><b>Figure 8. Micro-ohmmeter Settings for Center Conductor Test</b></p>
<p>5</p>	<p>Read resistance value of Center Conductor.</p> <ol style="list-style-type: none"> <li>a. Verify resistance is 1 mΩ – 50 mΩ.</li> <li>b. <b>Record</b> resistance value in test record in Section 10.0.</li> </ol>
<p>6</p>	<p>Turn Micro-ohmmeter off.</p> <ol style="list-style-type: none"> <li>a. Press Start/Stop button.</li> <li>b. Verify meter reads “OPER”.</li> <li>c. Turn dial to “OFF”.</li> </ol>
<p>7</p>	<p><b>SAFETY:</b> Safe test stand according to procedure in Section 9.1.</p>
<p>8</p>	<p>Disconnect Micro-ohmmeter test leads from RG217 Coaxial Cable Assembly.</p>

**8.5 CABLE ASSEMBLY HI-POT TEST**

See Figure 1, Figure 2, and Figure 3 for reference in testing.	
Step	Action
<p><b>PAUSE:</b> If any verification step in the procedure below fails, or if there are any observed signs of arcing, equipment abnormalities, damage, or erroneous waveforms, <b>PAUSE WORK</b> and <b>DO NOT PROCEED</b>. Follow Off-Normal Procedure listed below:</p> <ol style="list-style-type: none"> <li>Turn off ALL equipment.</li> <li>Safe test stand according to procedure in Section 9.1.</li> <li>Review Sections 8.1 and 8.2 to ensure proper cable assembly and test stand set up.</li> <li>Rectify any issues with equipment.</li> <li>Return to Step 1 of Section 8.5 Cable Assembly Hi-POT Test.</li> </ol>	
1	<b>SAFETY:</b> Ensure test stand is set up correctly according to Section 8.2, including safety barriers.
2	<p>Connect Hi-POT Tester test leads to one end of RG217 Coaxial Cable Assembly.</p> <ol style="list-style-type: none"> <li>Connect Hi-POT Tester <b>black</b> alligator clip to <b>Center Conductor Adapter ring lug</b>.</li> <li>Connect Hi-POT Tester <b>red</b> alligator clip to <b>Cable Shield Adapter ring lug</b>.</li> <li>Connect Hi-POT Tester <b>green</b> alligator clip to <b>earth ground</b>.</li> </ol>
3	<b>SAFETY:</b> Ensure RG217 Coaxial Cable Assembly is fully inside Mesh Testing Cage and close Mesh Testing Cage lid.

- 4 Set up Hi-POT Tester.
- Switch Main Power toggle to ON.
  - Press Main Power ON button.
  - Verify “EXT.LINK” is installed.
  - Set Voltage Range to 100 kV.
  - Set Current Range to 200  $\mu$ A.
  - Set Current Trip to 5.
  - Press High Voltage ON button.

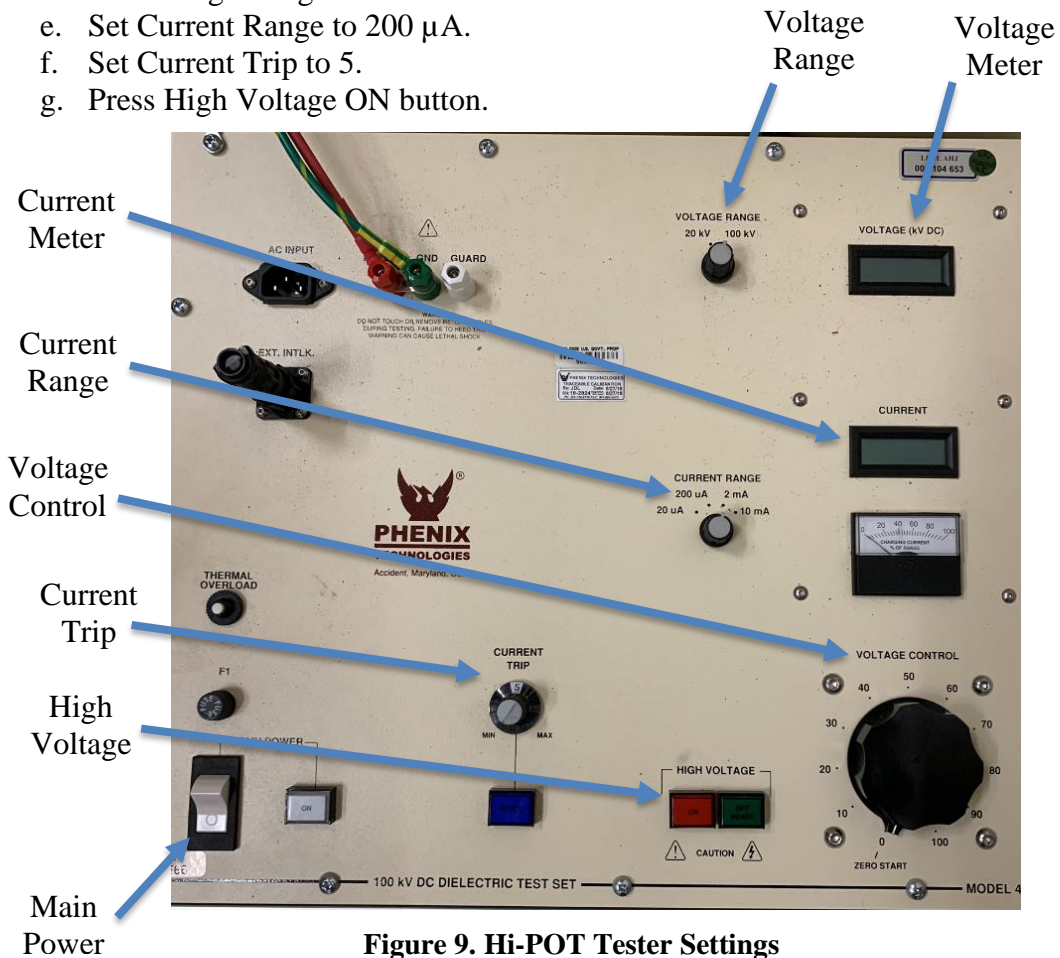


Figure 9. Hi-POT Tester Settings

In Steps 5-14, the RESET button lighting up while the Voltage Meter reads below 40 kV means the tester has tripped.

If this is the first time the tester has tripped,

- Record** value displayed on Voltage Meter in test record in Section 10.0.
- Record** value displayed on Current Meter in test record in Section 10.0.
- Record** where RG217 Coaxial Cable Assembly failed in test record in Section 10.0.
- Turn off Hi-POT tester using procedure from Step 16.
- SAFETY:** Ensure RG217 Coaxial Cable Assembly is fully inside Mesh Testing Cage and open Mesh Testing Cage lid.

<p>f. <b>SAFETY:</b> Safe test stand according to procedure in Section 9.1.</p> <p>g. Repeat Steps 5-14.</p> <p>If this is the second time the tester has tripped, the RG217 Coaxial Cable Assembly has failed the Cable Assembly Hi-POT Test.</p> <p>a. <b>Record</b> value displayed on Voltage Meter in test record in Section 10.0.</p> <p>b. <b>Record</b> value displayed on Current Meter in test record in Section 10.0.</p> <p>c. <b>Record</b> where RG217 Coaxial Cable Assembly failed in test record in Section 10.0.</p> <p>d. Skip to Step 16.</p>	
5	Start with Voltage Control knob at 0 kV. Turn Voltage Control knob at a maximum ramp rate of 10 kV/min to increase tester's output voltage to 5 kV, using value displayed on Voltage Meter.
6	Verify value displayed on Current Meter is less than 1000 $\mu$ A. <b>Record</b> value displayed on Current Meter in test record in Section 10.0
7	Turn Voltage Control knob at a maximum ramp rate of 10 kV/min to increase tester's output voltage by 5 kV, using value displayed on Voltage Meter.
8	Wait 30 seconds.
9	Repeat Steps 7-8 until Voltage Meter display reads 35 kV.
10	Wait 1 minute.
11	Turn Voltage Control knob at a maximum ramp rate of 2 kV/min to increase tester's output voltage by 1 kV, using value displayed on Voltage Meter.
12	Wait 30 seconds.
13	Repeat Steps 11-12 until Voltage Meter display reads 40 kV.
14	Wait 1 minute.
15	<p>Read Hi-POT test values.</p> <p>a. Verify value displayed on Voltage Meter is 40 kV.</p> <p>b. Verify value displayed on Current Meter is less than 1000 <math>\mu</math>A.</p> <p>c. <b>Record</b> value displayed on Voltage Meter in test record in Section 10.0.</p> <p>d. <b>Record</b> value displayed on Current Meter in test record in Section 10.0.</p>
16	<p>Turn Hi-POT Tester off.</p> <p>a. Turn Voltage Control knob to decrease tester's output voltage to 0 kV.</p> <p>b. Press High Voltage OFF READY button.</p> <p>c. Press Main Power ON button.</p> <p>d. Switch Main Power toggle to OFF.</p>

17	<b>SAFETY:</b> Ensure RG217 Coaxial Cable Assembly is fully inside Mesh Testing Cage and open Mesh Testing Cage lid.
18	<b>SAFETY:</b> Safe test stand according to procedure in Section 9.1.
19	Disconnect Hi-POT Tester test leads from RG217 Coaxial Cable Assembly.
20	<b>SAFETY:</b> Take down safety barriers around high-voltage area.

## 9.0 SAFETY PROTOCOLS INCLUDING COVID-19

This document is intended to provide necessary safety-related procedures required to mitigate the many hazards associated with RG217 Coaxial Cable Assembly testing. Stored energy is less than 1 J. This and other stored electrical energy associated with high voltage power supplies and high voltage components are all potential hazards, which must be mitigated prior and during the testing process.

Vendor should have training program in place for any workers completing this test procedure. Required training topics for this test procedure shall include a minimum of CPR/AED, personal protective equipment, and high voltage training.

Two qualified energy workers must be present whenever testing is above 250 V or 10 J. Qualified energy workers are individuals who are current with their training. Prior to accessing any High Voltage area, connection, or component, each worker is required to have required Personnel Protective Equipment. Safety glasses will be needed for protection from debris, in the event of an arc occurring during high voltage testing. Jewelry, especially watches, rings and badges shall be removed before beginning any procedures involving high voltage.

During the RG217 Coaxial Cable Assembly testing, safety barriers and signs must be placed around the perimeter to prevent other personnel from entering the area. A mesh metal testing cage must be placed around the test stand to prevent access to high voltage components during high voltage testing. After any testing, the cable must be placed in a safe condition by bleeding stored energy in the cable and performing a zero-energy check. An insulated grounding stick will be utilized to expedite the discharge of any stored energy in the cable.

### 9.1 SAFING THE TEST STAND

Step	Action
1	<b>SAFETY:</b> Ensure test stand is set up correctly according to Section 8.2, including safety barriers.
2	Turn off all test equipment connected to the RG217 Coaxial Cable Assembly.
3	<b>SAFETY:</b> Ensure RG217 Coaxial Cable Assembly is fully inside Mesh Testing Cage and open Mesh Testing Cage lid.
4	Using Insulated Grounding Stick, contact the <b>Center Conductor Adapter</b> on both sides of the RG217 Coaxial Cable Assembly.
5	Using Insulated Grounding Stick, contact the <b>Cable Shield Adapter</b> on both sides of the RG217 Coaxial Cable Assembly.
6	Using Insulated Grounding Stick, contact the <b>Cable Jacket</b> on both sides of the RG217 Coaxial Cable Assembly.
7	Repeat Steps 4-6 until there are no audible crackling sounds.

## **10.0 REPORTING**

The test report for the RG217 Coaxial Cable Assembly includes verification of visual inspection of both the cable connectors and the cable itself. In addition, it includes the measured results of the conductivity and holdoff voltage tests described in the procedure.

All measured values from the procedures Section 8.0 should be noted in the test record provided below.

# RG217 Cable Assembly ATP



<b>Part Number:</b>	<b>Revision:</b>	<b>Test Date:</b>
<b>Serial Number:</b>		<b>Tested By:</b>

## RG217 Coaxial Cable Assembly Acceptance Test

Test Description	Limits Low	Limits High	Units	Results	Pass/Fail	Comments
Visual Inspection	Components installed correctly					Verify no damage to cable
Conductivity Test: Center Conductor	1	50	mΩ			
Conductivity Test: Cable Shield	1	50	mΩ			
DC Hi-POT Insulation Test - Current	0	1000	μA			
DC Hi-POT Isolation Test - Voltage	35	40	KV			
DC Hi-POT Isolation Test - Current	0	1000	μA			

End of Test

**11.0 REFERENCES****Table 3. LLNL Drawings**

Part Number	Description
1010290657	LLNL V2-V2 Pulser Cable
1010601299	Universal Cable Test Fixture