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LLNL-TR-830903

Coaxial Cable Assembly Procedure

K. L. Rosier

January 18, 2022

Disclaimer

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

RG217 V2-V2 Coaxial Cable Assembly Procedure

1010466565

Lawrence Livermore National Laboratory

December 2021

Lawrence Livermore National Laboratory

REVISION LOG

Rev No.	Date	Description	Affected Pages
AA	11/29/2021	Initial issue for CD-1 approval	All
AB	12/14/2021	Removing outdated references	All

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1.0 SUMMARY

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 AND SCOPE

This document covers the assembly 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 assembly procedure describes the process used to install cable connectors properly onto the cable.

3.0 LOCATION, ENTRY, AND COORDINATION REQUIREMENTS (IWD PART 2)

FOD	**TA**	**Bldg.**	**Room**	**Other Location**
WFO	Enter TA	Enter Building(s)	Room(s)	- Click here to enter text.
FOD Designated Facility POC	**Name**	**Phone**	**Pager**	**Email**
	POC Name	FOD Phone	Pager	- Click here to enter text.

☐No Entry/Coordination Requirements
☐Work must be Scheduled
☒Facility POTD/POTW
☐Organization POTD/POTW
☐Co-located Hazards\Concerns:
Click here to enter text.
☐Security Clearance Requirements: Select a value
☐Other Security Requirements:
Click here to enter text.
☐Other Bounding Conditions:
Click here to enter text.

☐Escort Required
☐Check In\Out Requirements
☐With FOD at Start\End of Work
☐With FOD Daily

Additional Facility/Work-Area Information

Not applicable.

4.0 VALIDATION AND WORK RELEASE (IWD PART 3)

By signing below, I verify this activity is compatible with current facility configuration and operating conditions.
FOD designated Operations Manager or other facility point-of-contact for work area
Signature/Z#/Date (If required by FOD):

_____

By signing below, I have verified the following:

I have verified authorization by ensuring approval signatures of the RLM and FOD.

I have jointly conducted a validation walkdown with workers to confirm the IWD can be performed as written, and that required initial conditions and other prerequisites are in place.

The assigned workers are authorized and are competent to perform the work in a safe, secure, and environmentally responsible manner.

I have conducted the pre-job briefing, and all workers (including support workers) have been briefed.

I have ensured coordination with any required FOD work-area representatives (e.g., area work coordinators).

PIC (Signature/Z#/Date) Required:

_____

Alternate PIC Signatures acknowledges PIC authority is assumed for the first time. *(Note: Alternate PICs are required to sign only once, but formal handoff includes conferring with previous PIC to obtain all required information associated with the handoff.)*
Alternate PIC (Signature/Z#/Date) Required:

_____

Alternate PIC (Signature/Z#/Date) Required:

_____

Pre-Job Brief Content

What are the critical steps* or phases of this activity?
How can we make a mistake at that point?
What is the worst thing that can go wrong?
What controls, preventive measures, and bounding conditions are needed?
What work permits are required and how will we meet their requirements?
What are the handoffs and coordination requirements among workers and multiple PICs?
Are there hold-points including those that require sign-offs?
What are the pause/stop work responsibilities and expectations (e.g., for unanticipated conditions or hazards)?
How would we respond to alarms and emergencies?
Are there lessons learned from previous similar work?

Is other information needed to perform this activity in a safe, secure, and environmentally responsible manner?

Does everyone agree to the work tasks/steps, hazards, and controls and commit to follow them?

* "Critical steps occur anytime human performance involves a substantial transfer of energy, or movement of solids, liquids, and gases, or the transmission of data and information that , if not performed under control, could cause serious harm to one or more important assets." (Performance Improvement, vol. 53, no. 9, October 2014)

HUMAN PERFORMANCE INDICATORS ERROR PRECURSORS

Task Demands	Individual Capabilities
Time pressure (in a hurry)	Unfamiliarity w/ task / First time
High Workload (memory requirements)	Lack of knowledge (mental model)
Simultaneous, multiple tasks	New technique not used before
Repetitive actions, monotonous	Imprecise communication habits
Irrecoverable acts	Lack of proficiency / Inexperience
Interpretation requirements	Indistinct problem-solving skills
Unclear goals, roles, & responsibilities	"Hazardous" attitude for critical task
Lack of or unclear standards	Illness / Fatigue
Work Environment	**Human Nature**
Distractions / Interruptions	Stress (limits attention)
Changes / Departures from routine	Habit patterns
Confusing displays or controls	Assumptions (inaccurate mental picture)
Workarounds / OOS instruments	Complacency / Overconfidence
Hidden system response	Mindset ("tuned" to see)
Unexpected equipment conditions	Inaccurate risk perception (Pollyanna)
Lack of alternative indication	Mental shortcuts (biases)
Personality conflicts	Limited short-term memory

Pre-Job Brief Attendance Roster

By signing below as required, I agree to the following:

I agree to follow the work steps and implement the controls as written as applicable to my work assignments.

I agree to pause/stop work when conditions or hazards change or when I encounter unexpected conditions during the execution of work, or when work cannot be performed as written, or instructions become unclear during execution.

I confirm that I am authorized, trained/qualified, and fit to perform the work.

Worker (Signature/Z#/Date)	**Worker** (Signature/Z#/Date)
Worker (Signature/Z#/Date)	**Worker** (Signature/Z#/Date)
Worker (Signature/Z#/Date)	**Worker** (Signature/Z#/Date)
Worker (Signature/Z#/Date)	**Worker** (Signature/Z#/Date)

Worker (Signature/Z#/Date)	**Worker** (Signature/Z#/Date)
Worker (Signature/Z#/Date)	**Worker** (Signature/Z#/Date)
Worker (Signature/Z#/Date)	**Worker** (Signature/Z#/Date)

5.0 REQUIRED TRAINING

This procedure requires assigned workers to be properly trained. Table 1 lists the trainings required to complete the following assembly procedure.

Table 1. LLNL Required Trainings

UTrain Item or Curriculum ID	Title
HS4261-W	Lead Awareness
HS5303-W	Ergonomic Risk Factors
EP1006-W	Waste Management Overview
HS0018-W	General Hazards Training
HS4245-W	Chemical Hazard Communications
HS4686-W	Personal Protective Equipment (PPE)
IS0030-W	Work Planning & Control for the General Worker

6.0 PERFORMANCE DOCUMENTS

The following documents are referenced throughout the assembly procedure and are required to complete the procedure correctly.

Table 2. Referenced Drawings

Drawing Number	Revision	Title	Pre-Job Check
1010290657	AA	LLNL V2-V2 Pulser Cable	☐

Table 3. Referenced Specifications, Requirements, and Test Plans

Document Number	Title	Pre-Job Check
ASME Y14.5M-1994	Dimensioning and Tolerancing	☐
ASME B46.1-2002	Surface Texture	☐
ASME Y14.36M-1996	Surface Texture Symbols	☐
ASME Y14.38-2007	Abbreviations and Acronyms	☐
IPC/WHMA-A-620	Requirements and Acceptance for Cable and Wire Harness Assemblies	☐

Table 4. Referenced Procedures

Document Number	Title	Pre-Job Check
1010466421	RG217 V2-V2 Coaxial Cable Soldering Procedure	☐

7.0 REQUIRED PERSONAL PROTECTIVE EQUIPMENT (PPE)

The following equipment is necessary for implementing this procedure safely. PPE must be worn whenever applicable.

Table 5. Required Personal Protective Equipment

Description	Pre-Job Check
Eye Protection	☐
Mask	☐
Latex Gloves	☐
Closed Toe Shoes	☐

8.0 INSTRUMENTS, COMPONENTS AND SUPPLIES

8.1 TOOLS AND FIXTURES

In addition to the tools and fixtures listed in Table 6, additional required tools and fixtures can be found in RG217 V2-V2 Coaxial Cable Assembly Soldering Procedure, referenced in Table 4.

Table 6. Required Tools and Fixtures

Part Number	Description	Pre-Job Check
1010591060	Custom Crimp Tool	☐
N/A	Wire Cutters	☐
W66	Kingsing Model W66 Heavy-Duty Rotary Cable Stripper	☐
CT-100	Mohr CT-100 Time-Domain Reflectometer	☐
N/A	Insulation Cover metal tube, 0.402” ID, 0.5” OD, 4” long	☐

8.2 COMPONENTS

In addition to the components listed in Table 7, additional required components can be found in RG217 V2-V2 Coaxial Cable Assembly Soldering Procedure, referenced in Table 4.

Table 7. Required Components

Part Number	Qty	Title	Pre-Job Check
1004127258	4	7 mm Nom ID, Bal-Seal, CC Spring, Series 104, Gld-Pltd	☐
1005891090	2	Bal-Seal 17.33 mm ID CC Spring	☐
1001527929	2	RG217 Coaxial Ring Connector	☐
1001527929	2	Rtng Ring, Ext, 14 mm Shaft x 1.1 Thk	☐
1009768279	2	RG217 Coaxial Doughnut	☐
1009192464	2	RG217 Coaxial Shield Connector	☐
1009192455	2	RG217 Retaining Nut M36	☐
1009213599	2	Frl, Crmp, 14 mm Shaft	☐
1010290659	AR	RG 217 Coaxial Cable	☐

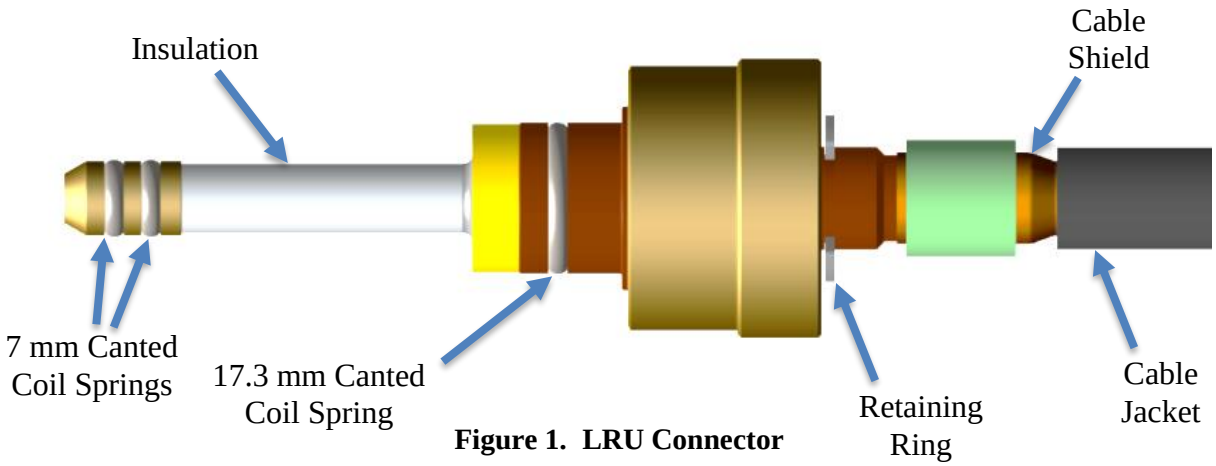


Figure 1. LRU Connector

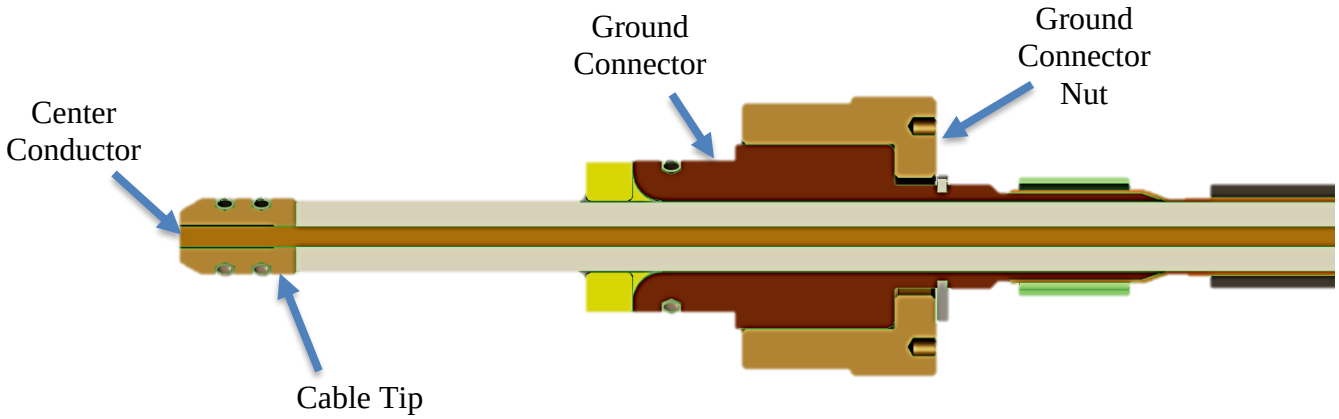


Figure 2. LRU Connector Section View

8.3 SUPPLIES

In addition to the supplies listed in Table 8, additional required supplies can be found in RG217 V2-V2 Coaxial Cable Assembly Soldering Procedure, referenced in Table 4.

Table 8. Required Supplies

Part Number	Description	Quantity	Pre-Job Check
1009107143	Acrylic Adhesive Epoxy (RG217)	AR	☐
	>99% Isopropyl Alcohol (IPA)	AR	☐

9.0 PRECAUTIONS, GENERAL HAZARDS, AND CONTROLS

Table 9. Hazards and Controls

Hazards	Controls	HA Reference
Chemicals	Workers must wear PPE to protect hands, feet, and face from contact with chemicals or chemical fumes. Works must also exercise care when handling chemicals to prevent spills.	
Crushing	Workers must exercise care when using crimping tool. Workers should ensure no body parts are inside the crimping area at any time.	
Sharp and/or Abrasive Tools	Workers must exercise care when handling tools that have sharp edges or abrasive surfaces.	

10.0 EMERGENCY ACTIONS

In case of Injury

Leave the area immediately if at risk.
Call 911
Notify group management, the Duty Officer (Phone Number), and Access Control.

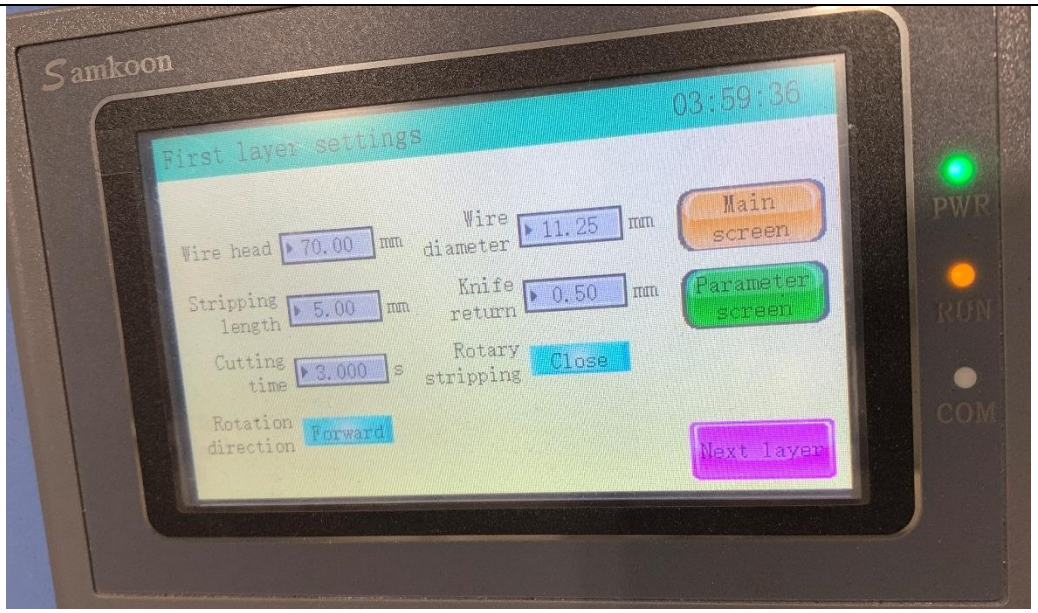
In Case of Fire

Leave the area immediately if at risk. Pull a nearby fire alarm if alarm is not sounding.
Call 911 to give additional information on the location and nature of the fire.
Notify group management, the Duty Officer (Phone Number), and Access Control.

11.0 OPERATIONAL STEPS

See Figure 1. , Figure 2. , and Table 2 drawings for reference in assembly.

Step	Action
1	Trim exposed end of Cable to provide clean, undamaged surface.
2	Using IPA, thoroughly clean Cable Tip, Ground Connector, Crimp, Ground Connector Nut, and Donut. Let all parts dry completely before continuing to Step 3.
3	Straighten any bends in last 12 inches of Cable.
4	Set up dimensions for Cable Jacket and Insulation in cable stripper according to dimensions from drawing.

	 **Figure 3. Cable Stripper Settings Page 1** ***Note:*** *Numbers shown in Figure 3. are for reference only and may not reflect correct dimensions.*
5	Ensure Cable is centered in cable stripper before continuing to Step 6. **NOTE:** If Cable is not centered properly, Insulation or Cable Shield can be damaged or improperly cut.

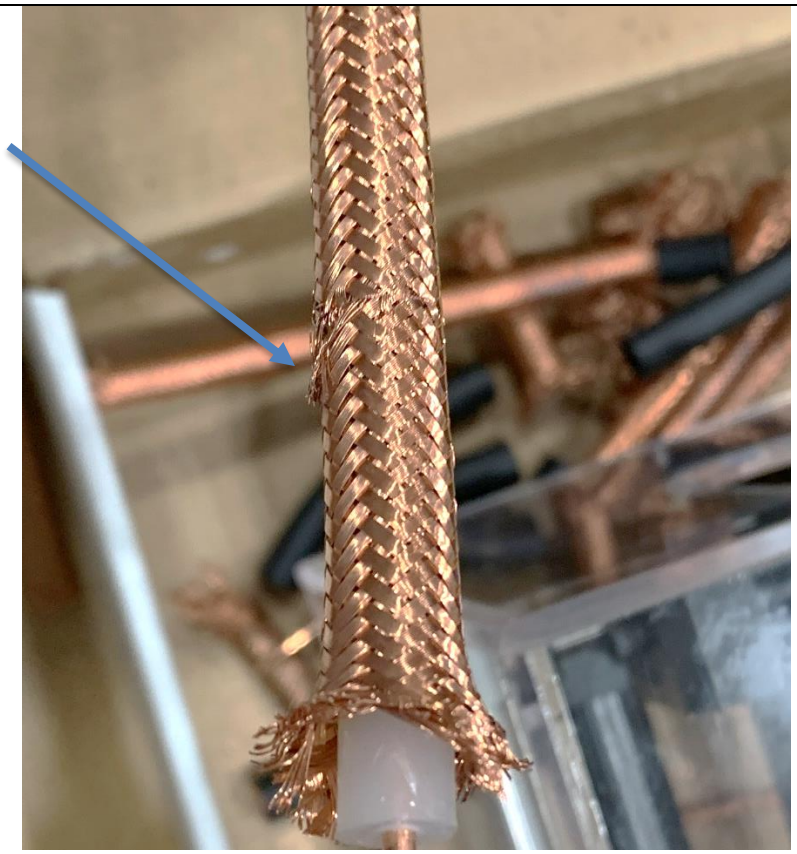


Figure 4. Cable with Damaged Cable Shield

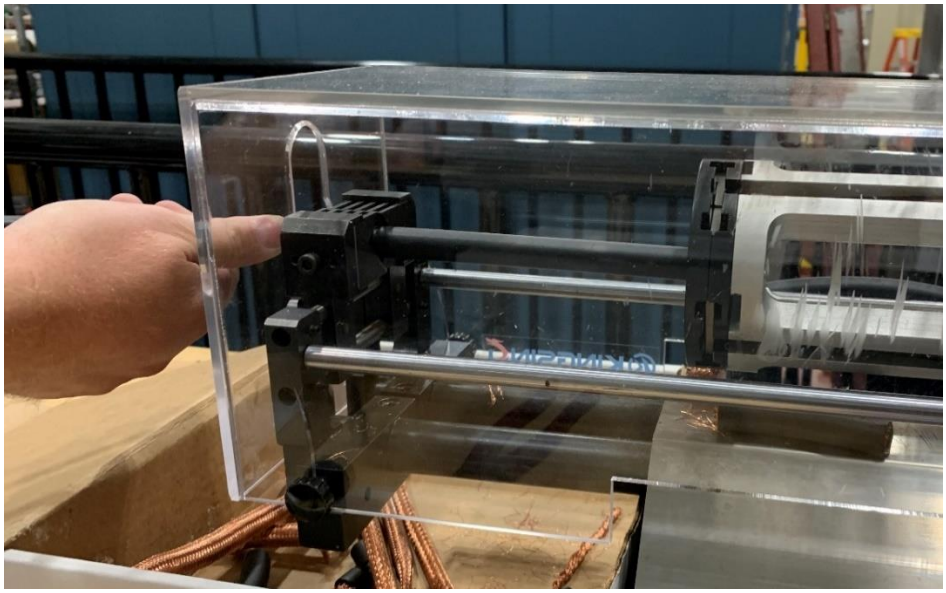
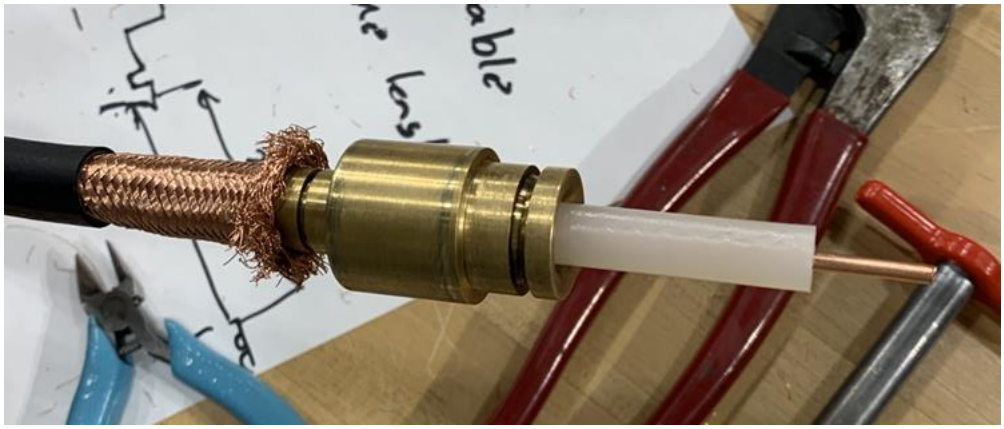


Figure 5. Cable in Cable Stripper

6	Use cable stripper to cut Insulation and Cable Jacket according to dimensions from drawing.
7	**Verify** Insulation is not damaged. If Insulation is damaged, discard Cable and return to Step 1 with new Cable.
8	Slide Crimp onto Cable until it is on the Cable Jacket. Ensure Cable Shield is not damaged.  **Figure 6. Crimp Slid onto Cable**
9	Slide Ground Connector Nut onto Cable until it is on the Cable Jacket. Ensure Cable Shield is not damaged.
10	Slide insulation cover onto Cable underneath Cable Shield until insulation cover is approximately 1” from the Cable Jacket. Smooth Cable Shield down over insulation cover. Ensure Cable Shield and Insulation are not damaged.
11	Repeat Steps 3-7 with dimensions for cutting Cable Shield to correct length.
12	Remove insulation cover from Cable.
13	**Verify** Insulation is not damaged. If Insulation is damaged, discard Cable and return to Step 1 with new Cable.

14	Peel outer edges of Cable Shield back carefully. Ensure Insulation is not damaged.  **Figure 7. Cable Shield Peeled Back**
15	Install Ground Connector onto Cable. a. Slide Ground Connector onto Insulation. b. Push Ground Connector under peeled-back section of Cable Shield. c. **Verify** Ground Connector is correct distance from end of Insulation according to dimensions from drawing.  **Figure 8. Cable with Ground Connector Installed**
16	Slide Ground Connector Nut onto Ground Connector.
17	Smooth peeled-back section of Cable Shield down over Ground Connector.
18	Slide Crimp along Cable until it reaches section where Cable Shield and Ground Connector overlap.

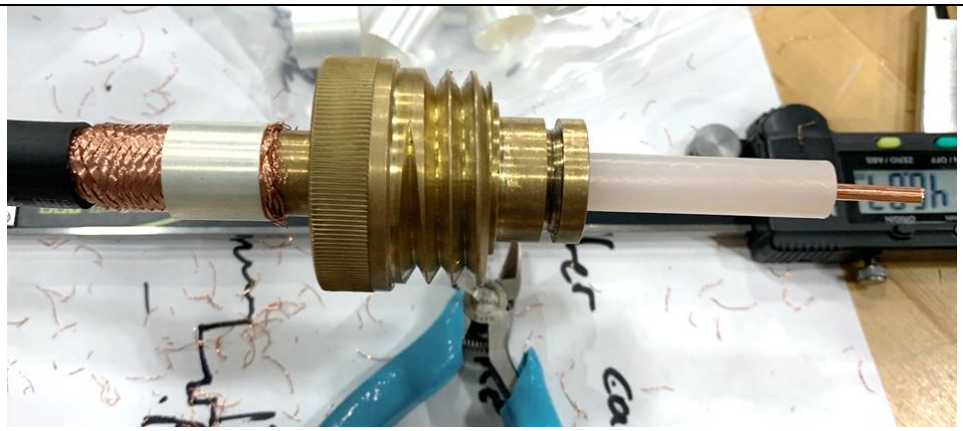


Figure 9. Cable with Ground Connector Nut Installed and Crimp in Correct Position

19	**Verify** Crimp is correct distance from chamfer on Ground Connector according to dimensions from drawing.
20	Use crimping tool to apply 2 tons of force and fully compress Crimp onto Cable Shield.
21	**Verify** Crimp is not deforming chamfer of Ground Connector. If Ground Connector chamfer is deformed, discard Cable and return to Step 1 with new Cable.

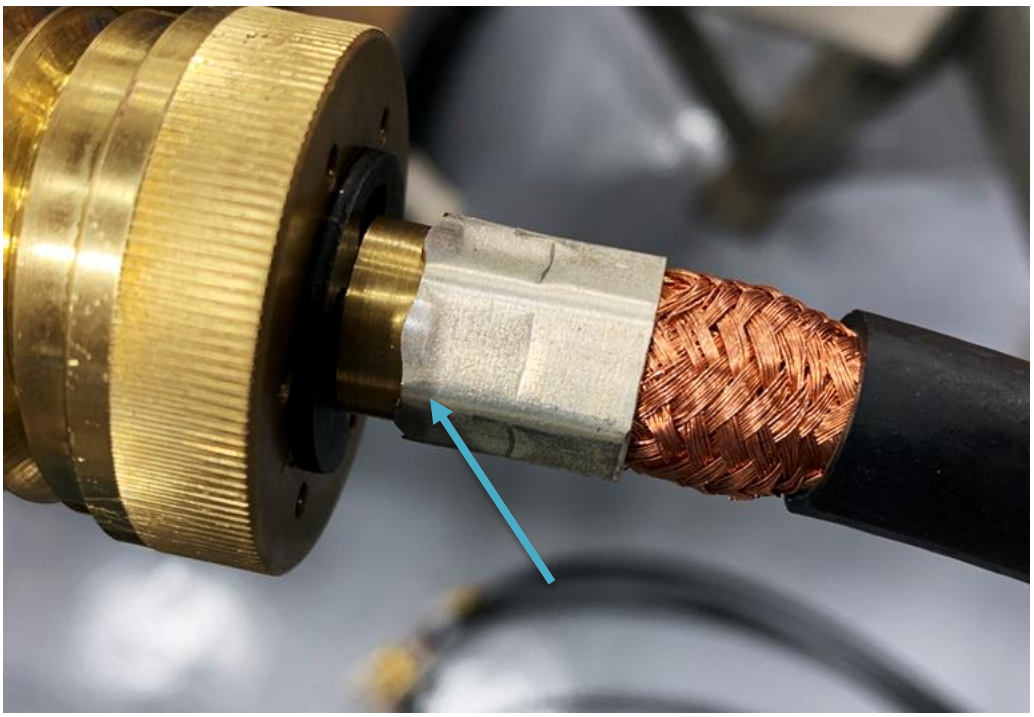
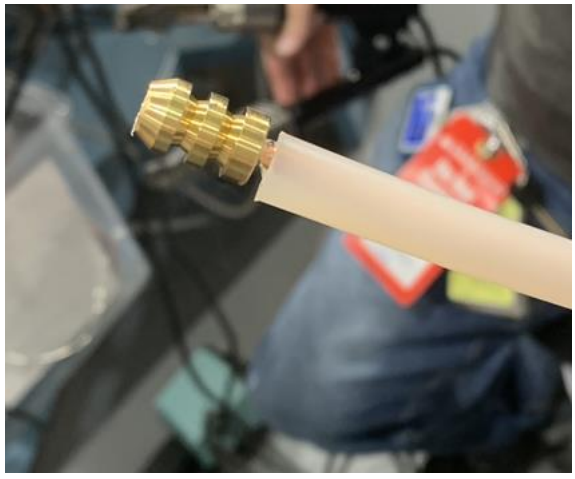


Figure 10. Improperly Installed Crimp

22	Use wire cutters to remove any stray Cable Shield braiding sticking out of Crimp.
23	Solder Cable Tip onto Center Conductor according to referenced Cable Soldering Procedure.  **Figure 11. Cable Tip Soldered onto Cable**
24	**Verify** no visible gap between Insulation and Center Conductor. If gap is visible, discard Cable and return to Step 1 with new Cable.  **Figure 12. Improperly Soldered Cable Tip with Gap at Insulation**
25	**Verify** Insulation is not damaged. If Insulation is damaged, discard Cable and return to Step 1 with new Cable.

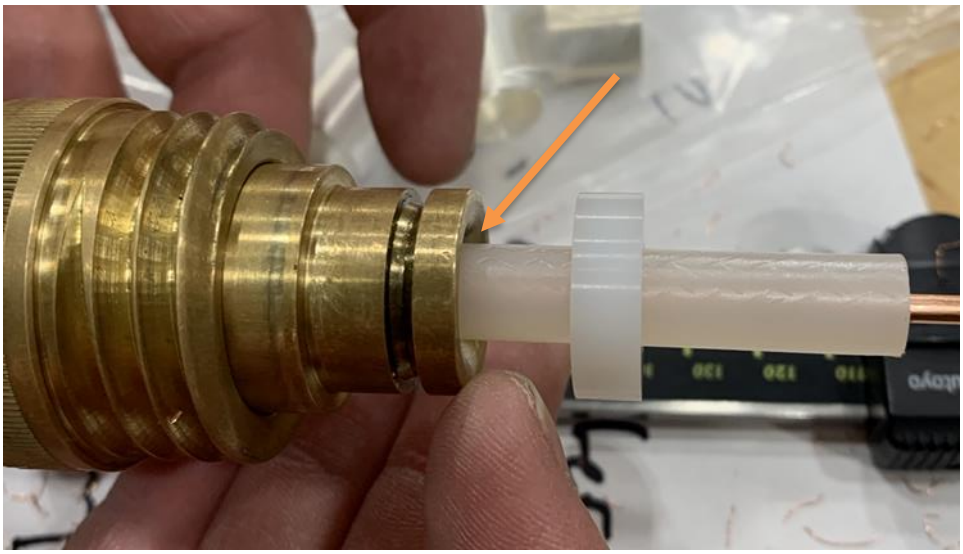
26	Verify epoxy has not expired. Prepare epoxy according to manufacturer's instructions.
27	Apply epoxy to joint where Insulation and Ground Connector meet according to referenced drawing. Ensure epoxy is evenly distributed around the circumference of the joint.  **Figure 13. Joint Where Insulation and Ground Connector Meet**
28	Slide Donut onto Insulation until it reaches the Ground Connector.
29	Press Donut firmly onto Ground Connector. While still applying pressure, rotate Donut 180 degrees around Insulation. Verify small amount of epoxy squeezes out of the seam.
30	Press Donut against Ground Connector for 1 minute.
31	Use IPA to clean any visible epoxy on outside surfaces of Ground Connector and Donut.

	 **Figure 14. Cable with Donut Installed**
32	Let epoxy harden for a minimum of 10 minutes.
33	Install two 7 mm Canted Coil Springs according to drawing. Canted Coil Springs should be installed so they are canted in the same direction.
34	Install one 17.33 mm Canted Coil Spring.
35	Install one Retaining Clip according to drawing.
36	**Verify** all parts are present according to drawing.
37	**Verify** all dimensions are correct according to drawing.
38	**Verify** insulation is not deformed or damaged in any way. If insulation is deformed or damaged, discard Cable and return to Step 1 with new Cable.
39	Using standard Time-Domain Reflectometer (TDR) measurement methods, cut Cable to correct overall length according to dimensions from drawing.
40	Repeat Steps 2-38 on other side of Cable.

12.0 APPENDICES

APPENDIX A: HAZARD ANALYSIS DOCUMENTATION

Hazard Analysis Team Membership

Review Role	Name	Z#	Organization
- PIC	-	-	-
- Worker Representative	-	-	-
- Independent Member	-	-	-
- ESH SME	-	-	-
- HE SME	-	-	-
- Technical SME	-	-	-
- Co-located Worker	-	-	-
- RLM	-	-	-
- FOD Representative	-	-	-

Identified Hazards and Selected Controls

Hazards	Controls
Chemicals	Workers must wear PPE to protect hands, feet, and face from contact with chemicals or chemical fumes. Works must also exercise care when handling chemicals to prevent spills.
Crushing	Workers must exercise care when using crimping tool. Workers should ensure no body parts are inside the crimping area at any time.
Sharp and/or Abrasive Tools	Workers must exercise care when handling tools that have sharp edges or abrasive surfaces.

APPENDIX B: FEEDBACK / POST JOB REVIEWS (IWD PART 4)

Feedback of ongoing activities/post job review with the workers and Person in Charge (PIC) should include the following:

- identify inefficiencies, problems during the activity, coordination issues, unanticipated conditions, near misses; and
- develop recommendations for improvement.

A post-job review with the workers and PIC should include the following:

- verify that the activity is complete and make notifications in accordance with Facility Operations Director (FOD) requirements; and
- ensure that follow-through actions (e.g., clean-up, recycle, waste disposal, equipment removal, and secure storage) are completed.

- Safety, security, quality, and environmental issues; coordination issues; and unexpected conditions.
-
-
-
-

- Suggested improvements that should be considered for Laboratory-wide application. - - - -
- Other recommendations for improvements to performing this activity. - - - -
- State the positive attributes of this activity. - - - - -
Completion Statement

- Name (print) of PIC/Z #: - -	- Signature -	- Date -