General Harness Repair Manual

Presented by TE Connectivity
Raychem Products
Engineered Polymer Solutions

Menlo Park, California

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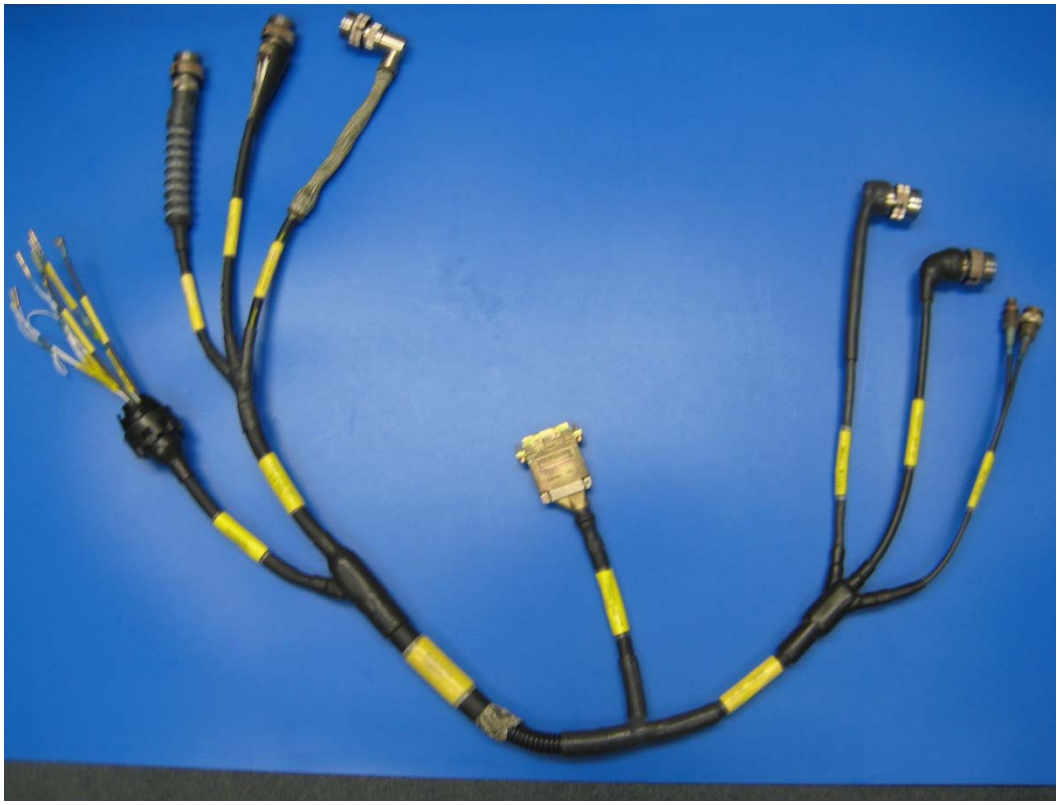
1.0 Scope

The General Harness Repair Manual covers procedures for repairing wiring harnesses manufactured with TE Connectivity's (TE) Raychem harness system components.
All replacing components are chosen to meet the adhesive peel strength, mechanical strength, environmental protection, and fluid resistance requirements of the wire harness systems as defined by customer specifications and TE technical specifications.



2.0 Connector & Contact Rework

Index to this section:

2.1 Connector Re-entry

2.1.1 Re-entry to Connectors Having Spin-Coupling Adapters

Uni-boots and bulbous boots can usually be reused in reassembly. Low profile boots may not provide enough access to the rear of the connector and may have to be cut off and replaced (See Glossary for descriptions of Uni-boots, bulbous boots, and low profile boots).

Step 1
De-mate the connector.

Step 2
Unscrew the adapter from the connector (Figure 2-1).

- Warm up the adapter to soften the sealants using a hot air heater with a proper reflector.

- Use connector pliers with plastic jaws or torque strap wrench to turn the coupling ring counterclockwise.

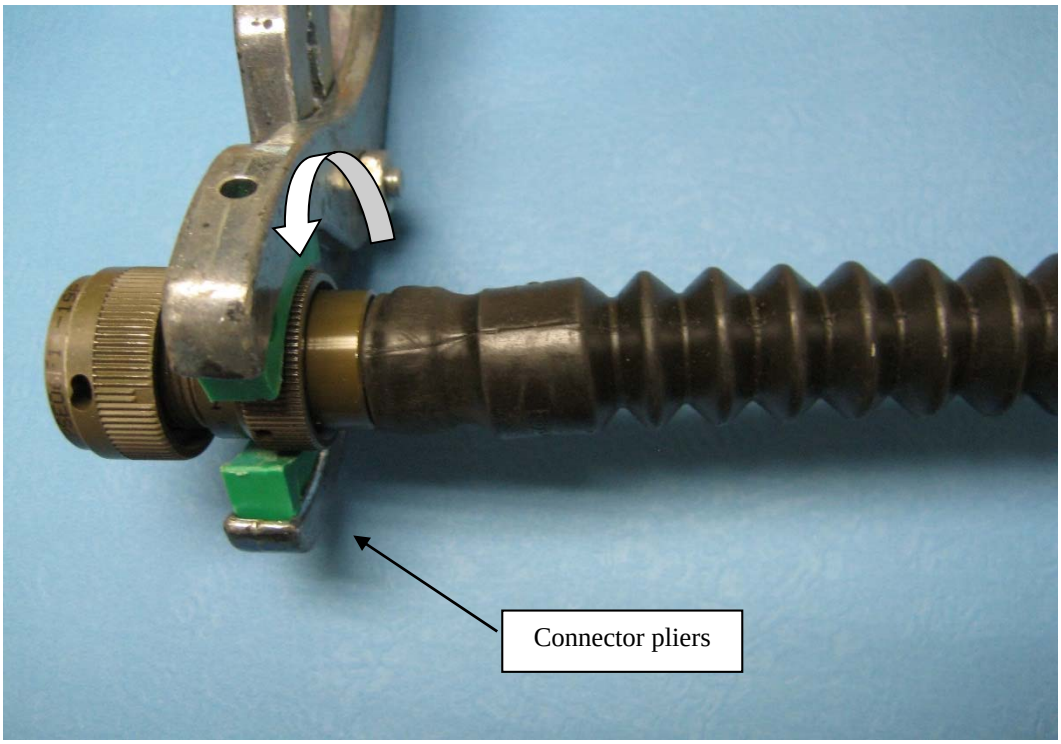


Figure 2-1

Step 3

Heat the boot until it is warm to touch and becomes flexible (Figure 2-2).

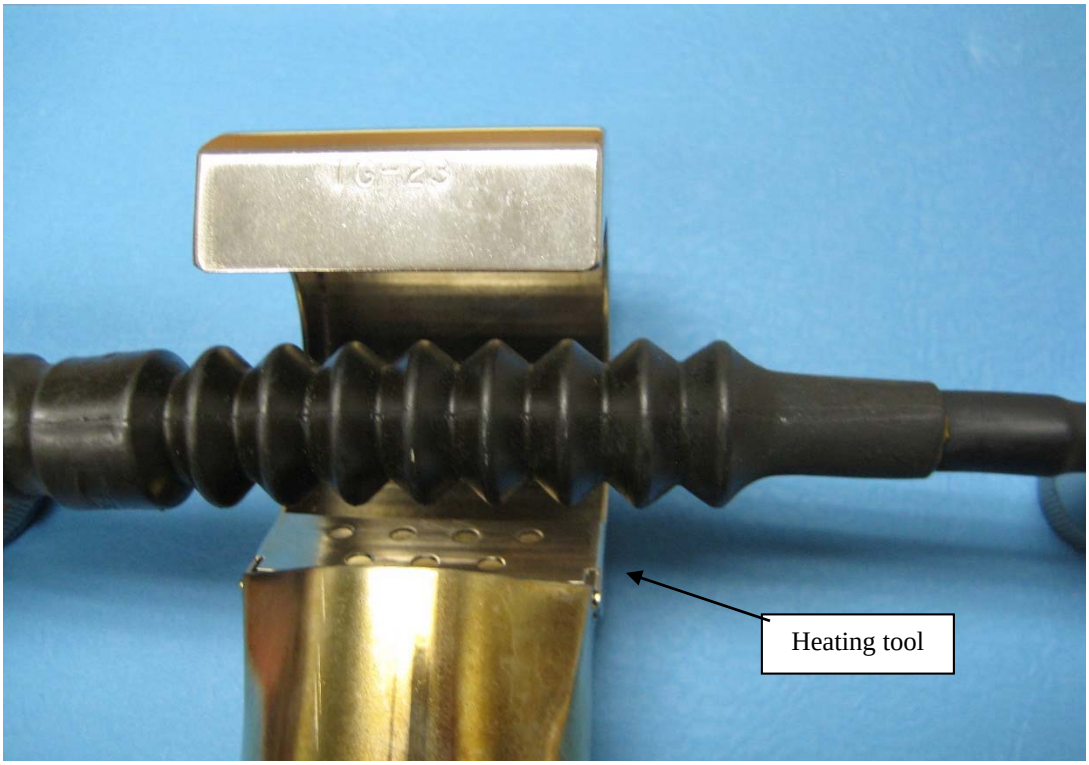


Figure 2-2

- Use a ThermoGun hot air heater with a reflector to encircle the boot (See Tool Appendix).

- Do not direct hot air at the ends of the boot where the adhesive joints are located.

Step 4
Push the adapter and boot back from the connector, exposing the wires, and hold the boot back until it cools about 2 to 3 minutes.

- When cool, the boot will remain in pushed back position (Figure 2-3).

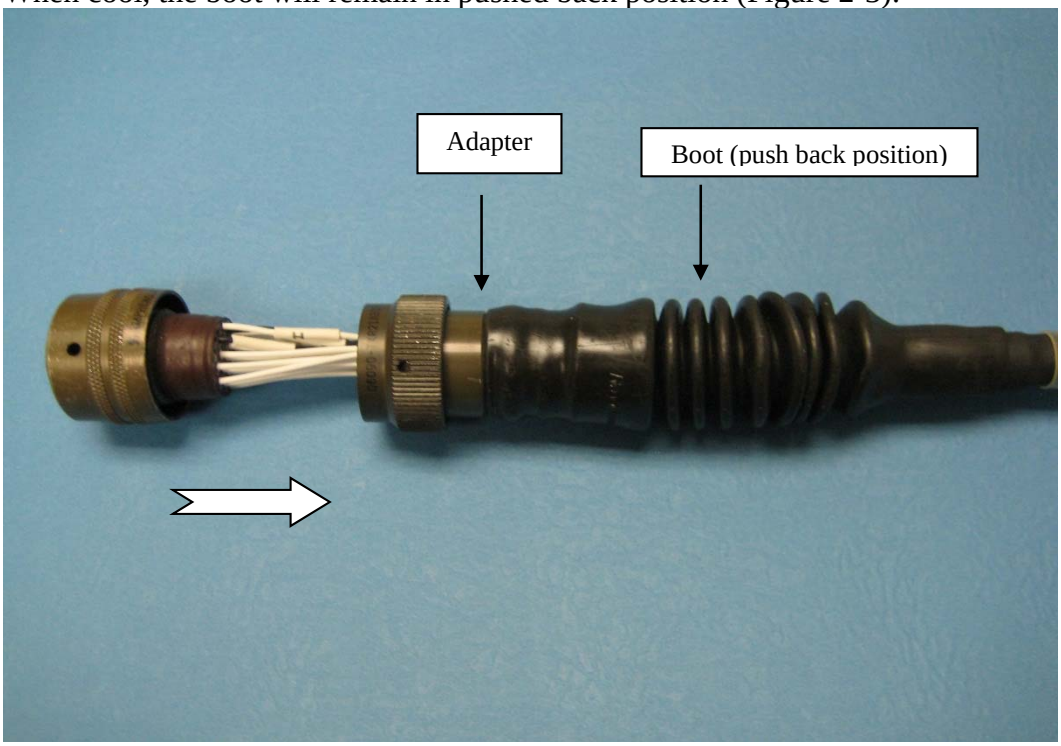


Figure 2-3

- Certain low-profile boots may be difficult to push back. Remove them and install a new boot per section 3, if necessary.

2.1.2 Re-entry to Connectors Not Having Spin-Coupling Adapters

Use this procedure to gain access to the rear of connector having solid adapter or no adapter. This procedure results in damage to the boot, which cannot be reused. A new boot must be installed to complete the re-assembly.

Step 1
De-mate the connector.

Step 2
Remove the boot (Paragraph 3.1).

2.2 Contact Removal and Insertion

Follow this procedure to remove contacts from the connector and to install contacts in the connector.

Step 1
Re-enter the connector (Paragraph 2.1 or 2.2).

Step 2
Identify and mark conductors as required to permit proper contact reinstallation.

Step 3
Remove and insert contacts as required (Figure 2-4).

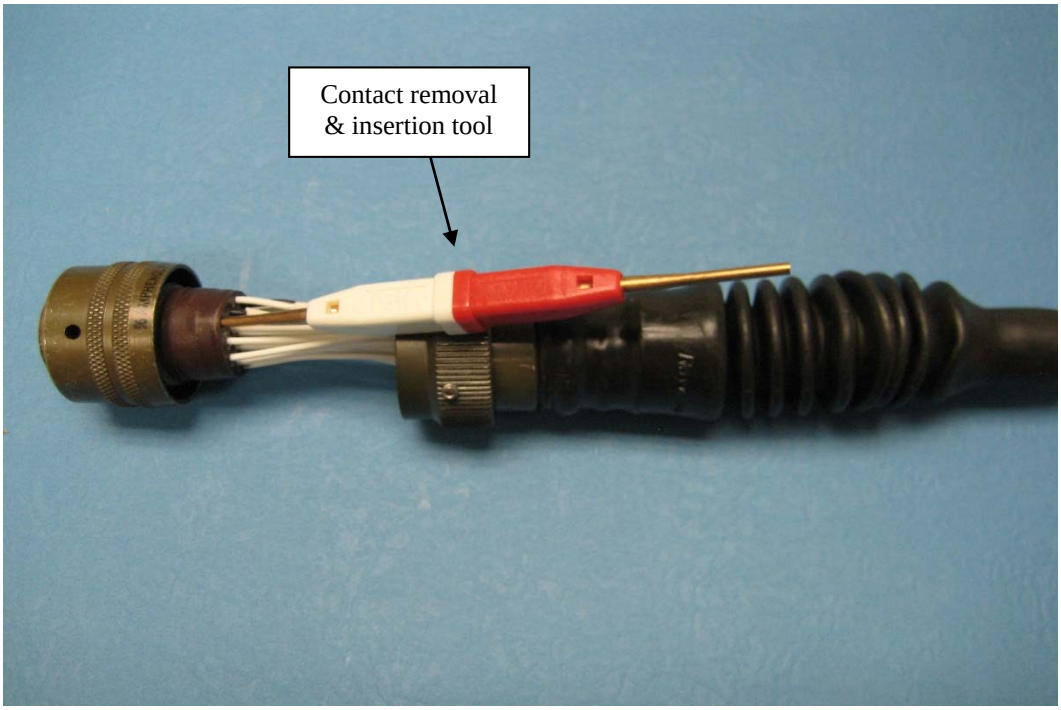


Figure 2-4

- If any contacts require replacement (Paragraph 2.4).
- Use the tools and procedures specified by the connector manufacturer.

Step 4
Insert contacts and sealing plugs into any unused contact cavities.

Step 5
Reclose the connector (Paragraph 2.5).

Step 6
Test per the following procedures:
- Circuit continuity per applicable revision of harness drawing.
- Electrical performance per manufacturing specification and/or harness drawing.

2.3 Damaged Contact Replacement

Follow this procedure to remove damaged contacts from the end of a wire or cable and to install a replacement contact on a wire or cable.

Step 1
Re-enter the connector (Paragraph 2.1 or 2.2).

Step 2
Remove damaged contacts from connector (Paragraph 2.3).

Step 3
Remove damaged contacts from the wires

- SolderTacts™ contacts can be removed without shortening the wires. Use a hot air or infrared heating tool with a SolderSleeve™ reflector to heat the SolderTacts™ contact until the solder melts (See Tool Appendix). Pull the contact off before the solder solidifies (Figure 2-5).

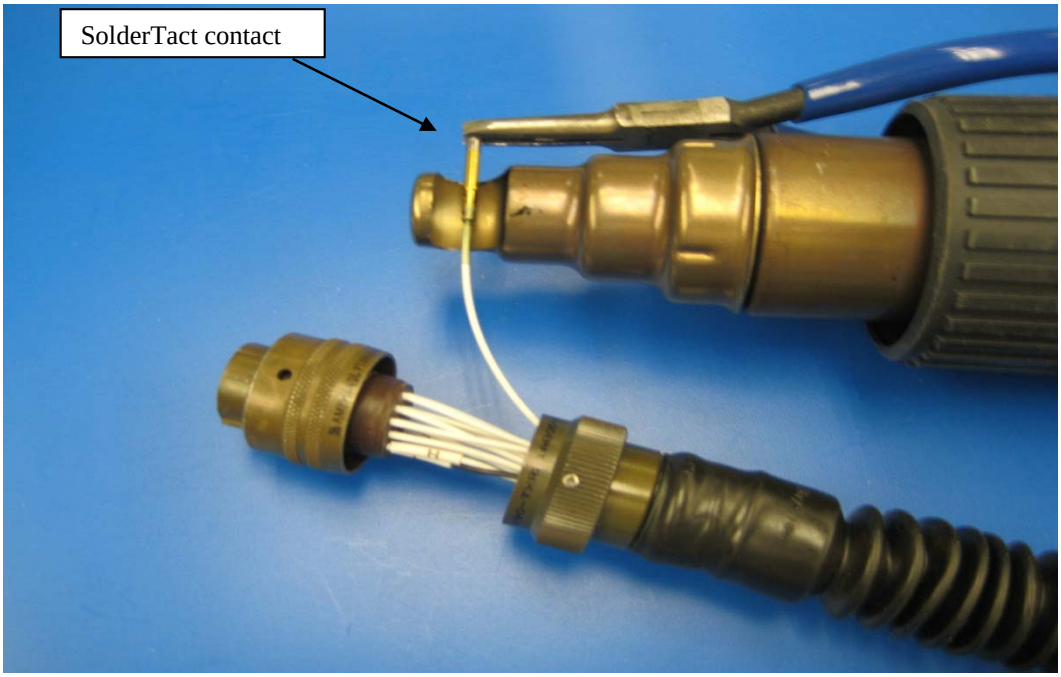


Figure 2-5

- Crimp contacts must be cut off, shortening the wires. Cut the wire as close to the contact as possible (Figure 2-6).

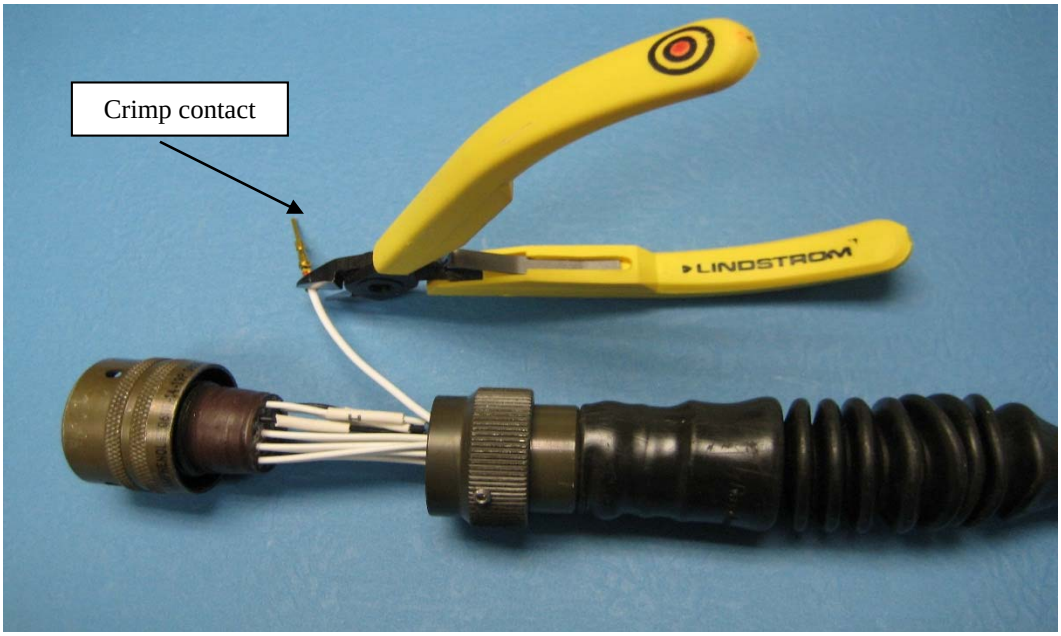


Figure 2-6

Step 4

Prepare the wires for contact installation (Figure 2-7).

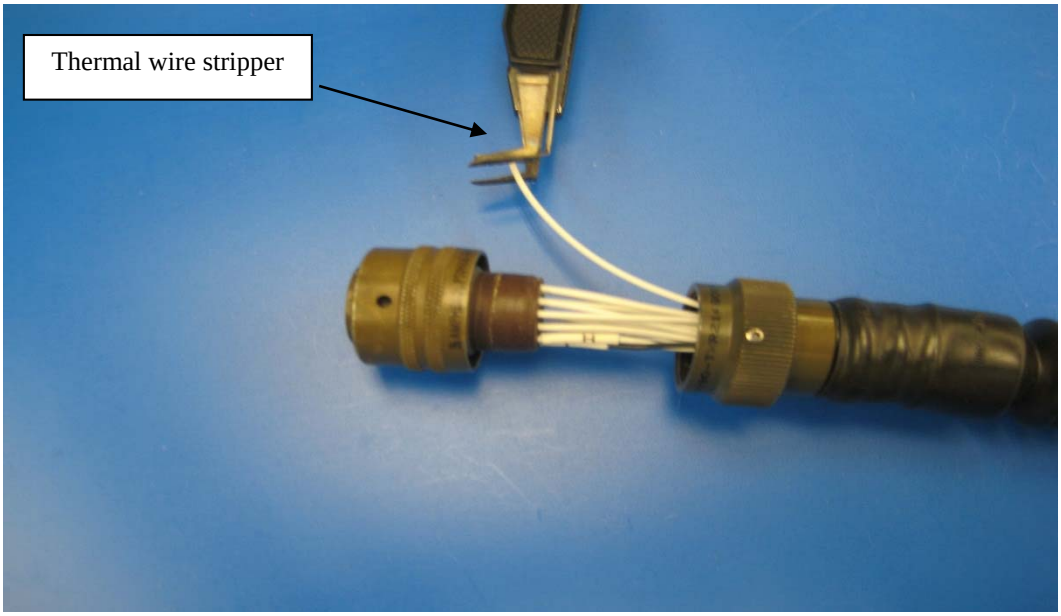


Figure 2-7

- For SolderTacts™ contacts, prepare wire as directed in the contact installation procedure.
- For crimp contacts, prepare wire as specified by contact manufacturer.

Step 5
Install new contacts onto wires as directed by contact/connector manufacturer (Figures 2-8 and 2-9).

Figure 2-8

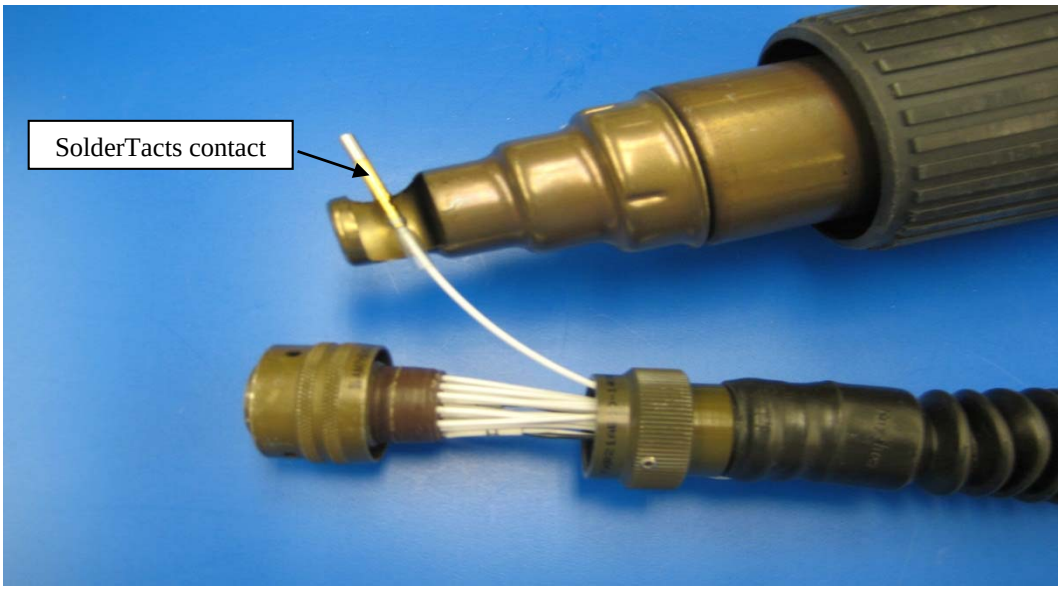


Figure 2-9

Step 6
Insert contacts into connector (Paragraph 2.2).

Step 7
Reclose the connector (Paragraph 2.5).

Step 8
Test per the following procedures:

- Circuit continuity per applicable revision of harness drawing.
- Electrical performance per manufacturing specification and/or harness drawing.

2.4 Connector Reclosing With Spin-Coupling Adapters

Follow this procedure to reattach a spin-coupling adapter with boot to the rear of a connector where the boot was pushed back and not cut off. If boot was cut off, refer to paragraph 3.2.

Step 1
Heat the boot until it is warm to touch and becomes flexible (Figure 2-10).

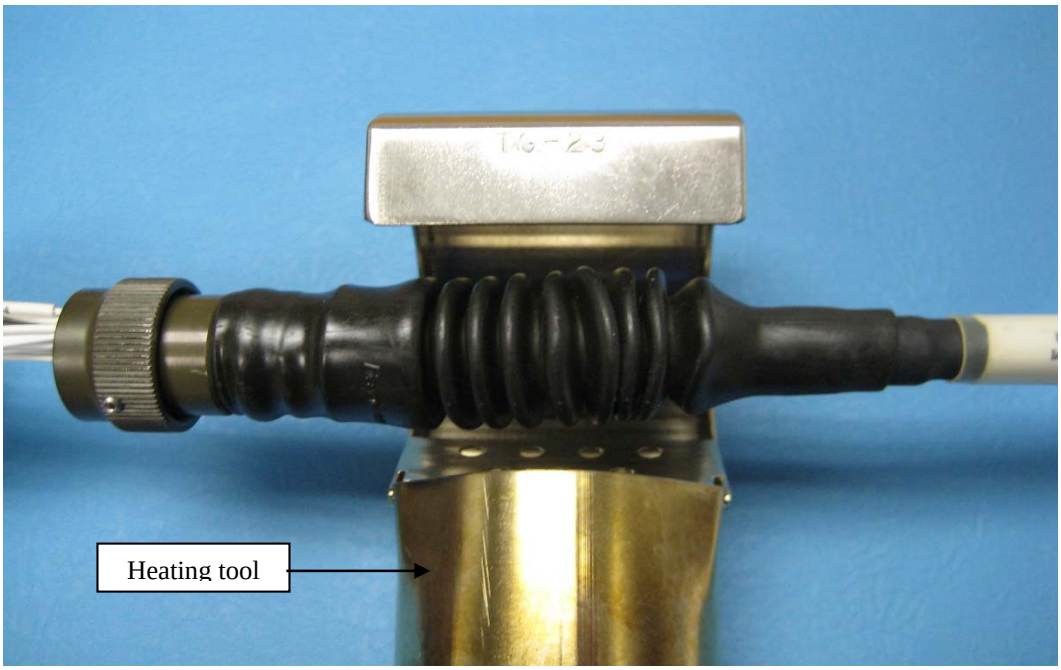


Figure 2-10

- Use a ThermoGun hot air heater with a reflector to encircle the boot (See Tool Appendix).
- Do not direct hot air at the ends of the boot where the adhesive joints are located.

Step 2
Pull the adapter toward the connector while the boot is warm and flexible.

Step 3
Orient the connector and adapter so that the connector will mate without twisting the harness.

Step 4
Apply thread coating compound onto connector threads if specified on harness drawing.

Step 5
Screw the adapter coupling ring onto the connector (Figure 2-11).

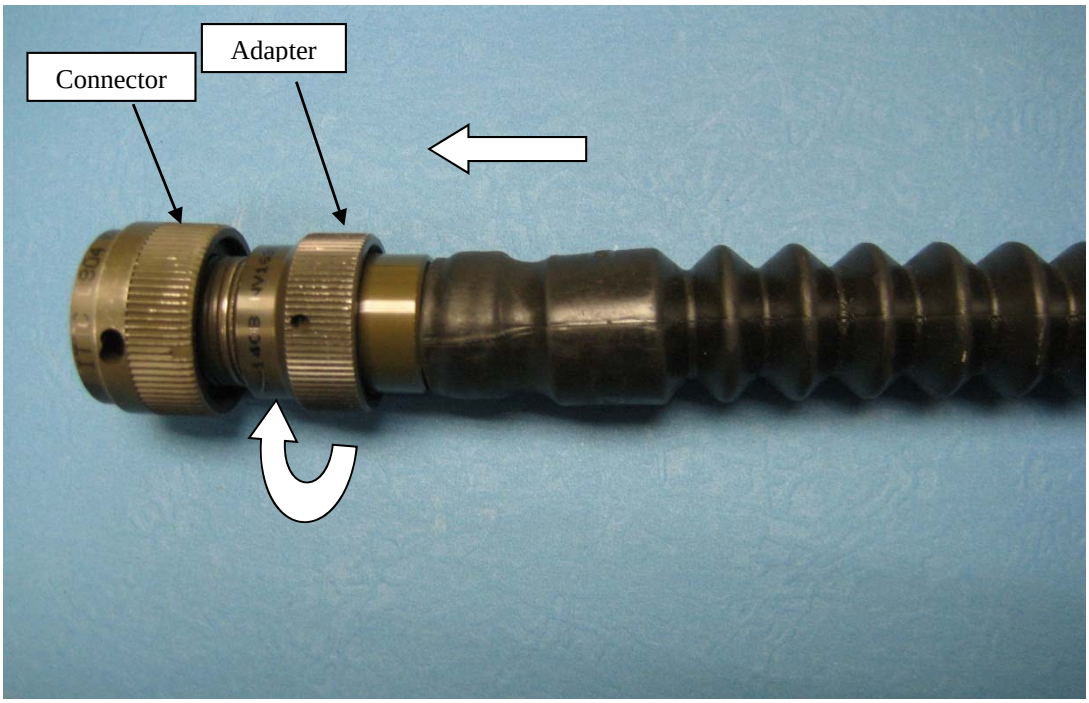


Figure 2-11

Step 6
Tighten the coupling ring to the torque specified in Table 2-1 or appropriate engineering drawing.

Table 2-1
Adapter Coupling Ring Torque

Connector Shell Size	**Coupling Ring Torque** (Inch-Lbs)
8	35-40
10	40-45
12	50-55
14	65-75
16	65-75
18	80-85
20	90-95
22	100-110
24	120-130
28	130-140
32	150-160
36	175-185
40	190-200

2.5 Connector Re-Orientation

If the connector is attached to a spin-coupling adapter such that the cable is twisted or bent in the wrong direction, re-align the connector and adapter as follows.

Step 1
Loosen the adapter coupling ring (Figure 2-12).

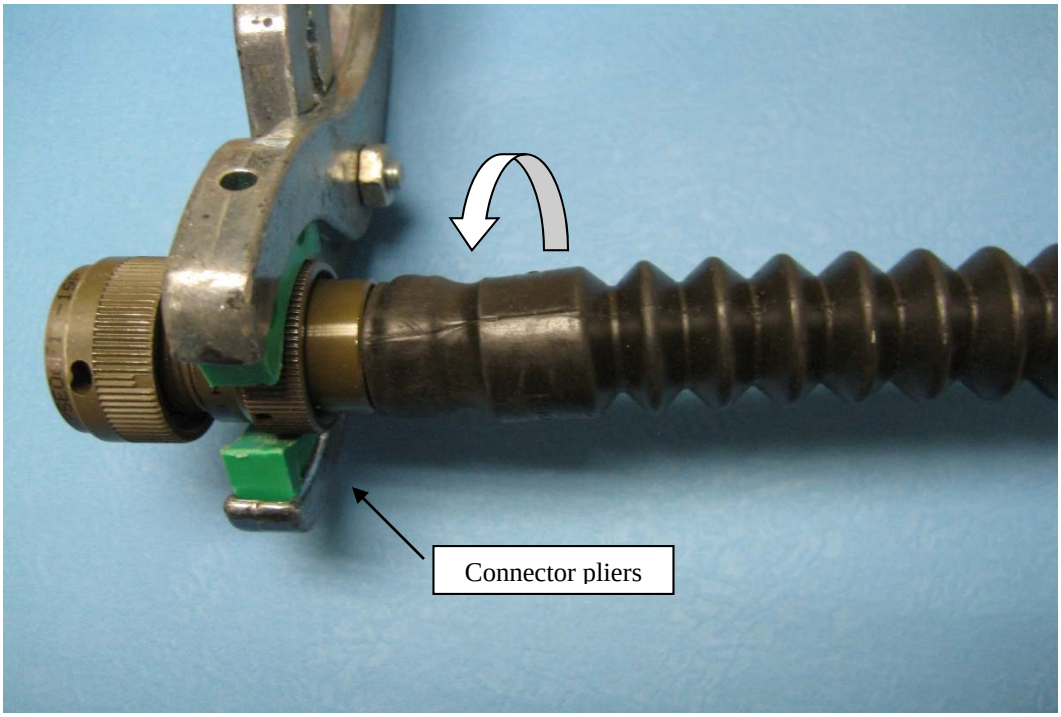


Figure 2-12

- Use connector pliers with plastic jaws or a torque strap wrench to turn the coupling ring counterclockwise.

Step 2
Rotate the connector to the proper position.

Step 3
Tighten the coupling ring to the torque specified in Table 2-1 or appropriate engineering drawing.

3.0 Boot Replacement

These procedures are for replacing damaged boots and for gaining access to the rear of a connector which has a non-reenter able boot and/or adapter.

Index to this section:

3.1 Boot Removal

Step 1

Score the boot lengthwise with a thermal knife (Figure 3-1). See Tool Appendix.

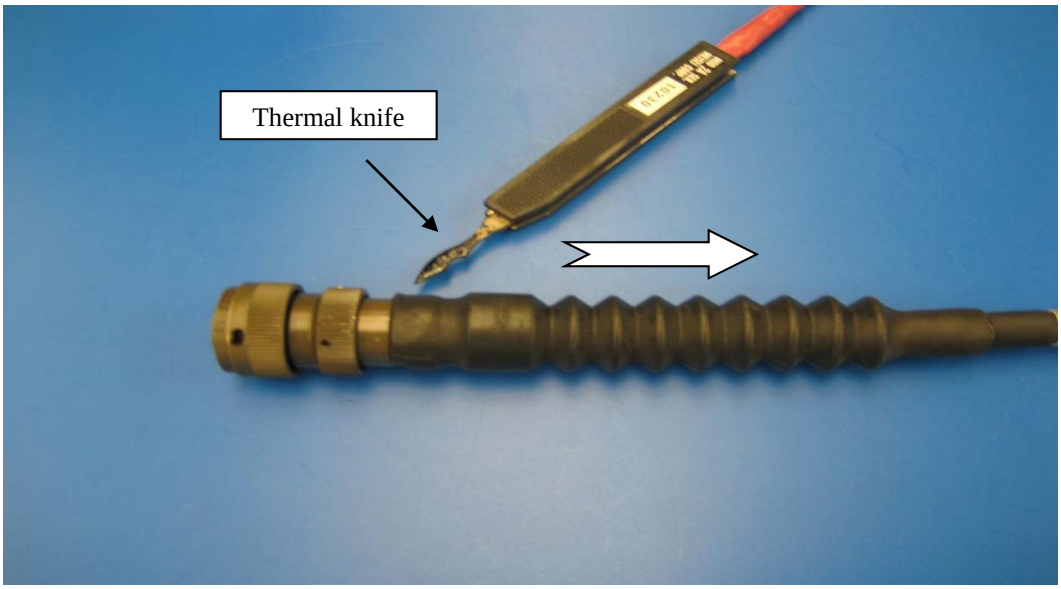


Figure 3-1

- Take care not to cut through the boot and into the cable jacket.

Step 2

Heat the boot until it is warm to touch and becomes flexible (Figure 3-2).

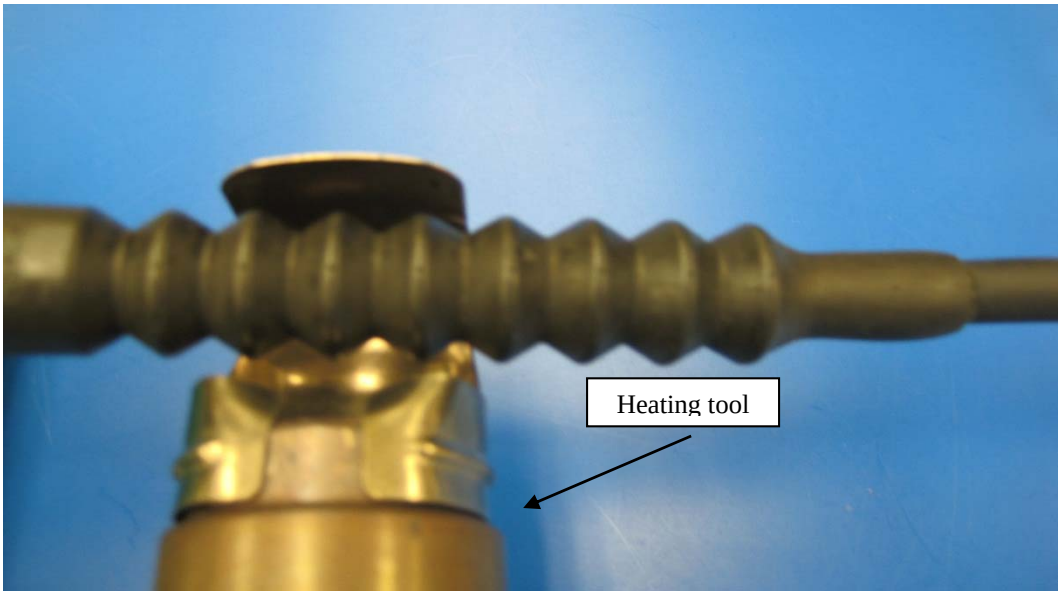


Figure 3-2

- Use a ThermoGun hot air heater with a reflector to encircle the boot. See Tool Appendix.

- Heat the entire boot, including the adhesive bond areas at both ends.

Step 3

Use pliers to peel the warm boot off the connector or adapter and cable jacket (Figure 3-3).

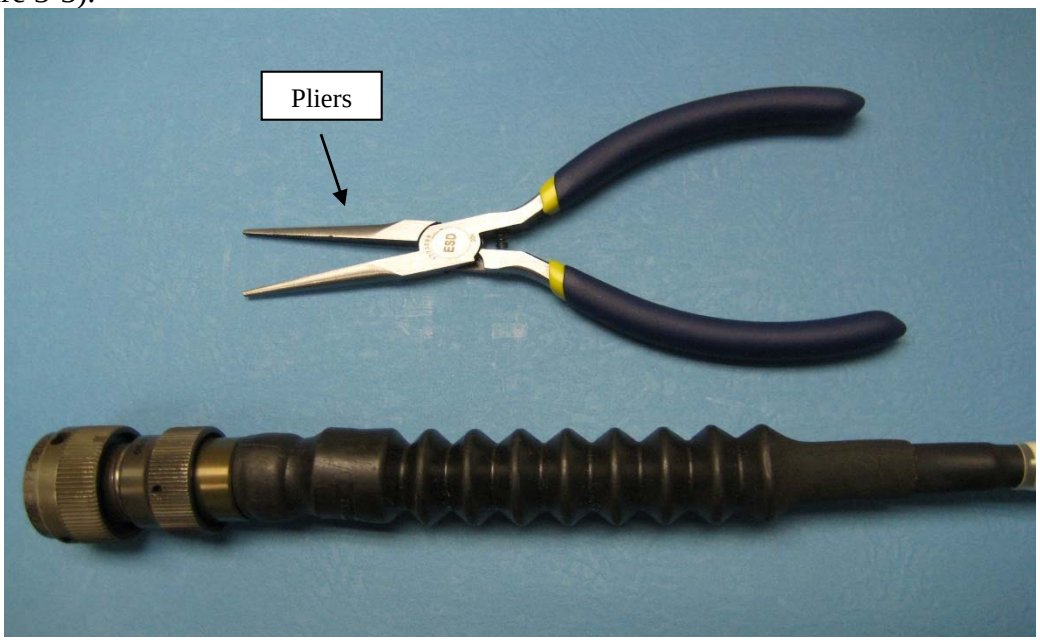


Figure3-3

Step 4
Remove excess adhesive from connector or adapter.

- Apply heat to soften hot melt adhesive.
- Thermosetting (epoxy) adhesives can usually be peeled off.

After boot is removed, make any repairs or modifications required to connector, contacts or shield terminations.

3.2 Boot Installation

Step 1
Determine the material, size, and configuration of the boot to be installed.

- Refer to harness drawing/material lists or to the repair boot selection tables 3-1 and 3-2.

Table 3-1
Repair Boot Size Selection

Connector or Adapter Dia.@ Boot Interface	Jacket Dia. (Min)	Non-Adapter Boot	Adapter Boots		
			Bulbous	Low Profile	Uni-Boot
0.35 - 0.40	0.20	202A111	202D121	202D211	202C611
0.40 - 0.50	0.25	202A121	202D121	202D211	202C611
0.50 - 0.60	0.30	202A132	202D121	202D211	202C621
0.60 - 0.70	0.30	202A132	202D132	202D221	202C621
0.70 - 0.80	0.30	202A142	202D142	202D221	202C621*
0.80 - 0.90	0.35	202A142	202D142	202D232	202C632*
0.90 - 1.00	0.40	202A153	202D153	202D242	202C632*
1.00 - 1.20	0.45	202A153	202D153	202D242	202C642*
1.20 - 1.40	0.55	202A163	202D163	202D253	202C653*
1.40 - 1.60	0.65	202A174	202D174	202D263	202C653*
1.60 - 1.80	0.65	202A174	202D174	202D263	202C653*
1.80 - 2.00	0.80	202A185	202D185	202D274	202C653
2.00 - 2.20	0.80	202A185	202D185	202D285	202C663
2.20 - 2.40	0.80	202A185	202D185	202D285	202C663
2.40 - 2.60	1.10	202A196	202D196	202D296	202C663

Note: * Shim cable outside diameter is required.

Table 3-2 Material Selection

Harness System Nomenclature	Harness Jacket Material	Molded Part Material	Adhesive
System 10	Versafit™ Polyolefin	Flexible Polyolefin -4, -71	S-1017 S-1030
System 15	NT-FR™ Neoprene polychloroprene	Semi-rigid Polyolefin -3	S-1009 S1017
System 20	NT-FR™ Neoprene polychloroprene	EPB -51	S-1009 S-1124
System 25	DR-25	-25 Elastomer	S-1125 S-1048
System 30	VPB	VPB-50	S-1255-04
System 100	Zerohal ZHTM	-100	S-1030
System 200	RW-200	-12 fluoroelastomer	S-1255-04
System 300	RT-555	-55	S-1255-04
System Silicone	SFR	SFR-6	G.E. RTV-108 D.C. 3145 RTV Gray

Step 2

Determine whether the boot as supplied will fit over the connector and/or adapter for installation onto the harness.

- If the **as supplied** inside diameter of the boot is too small, either the connector must be de-pinned or a different boot must be selected. Contact TE Connectivity representative for assistance in boot selection.

Step 3
Abrade surfaces to be bonded (jacket and molded part) using #320 emery cloth* (Figure 3-4).

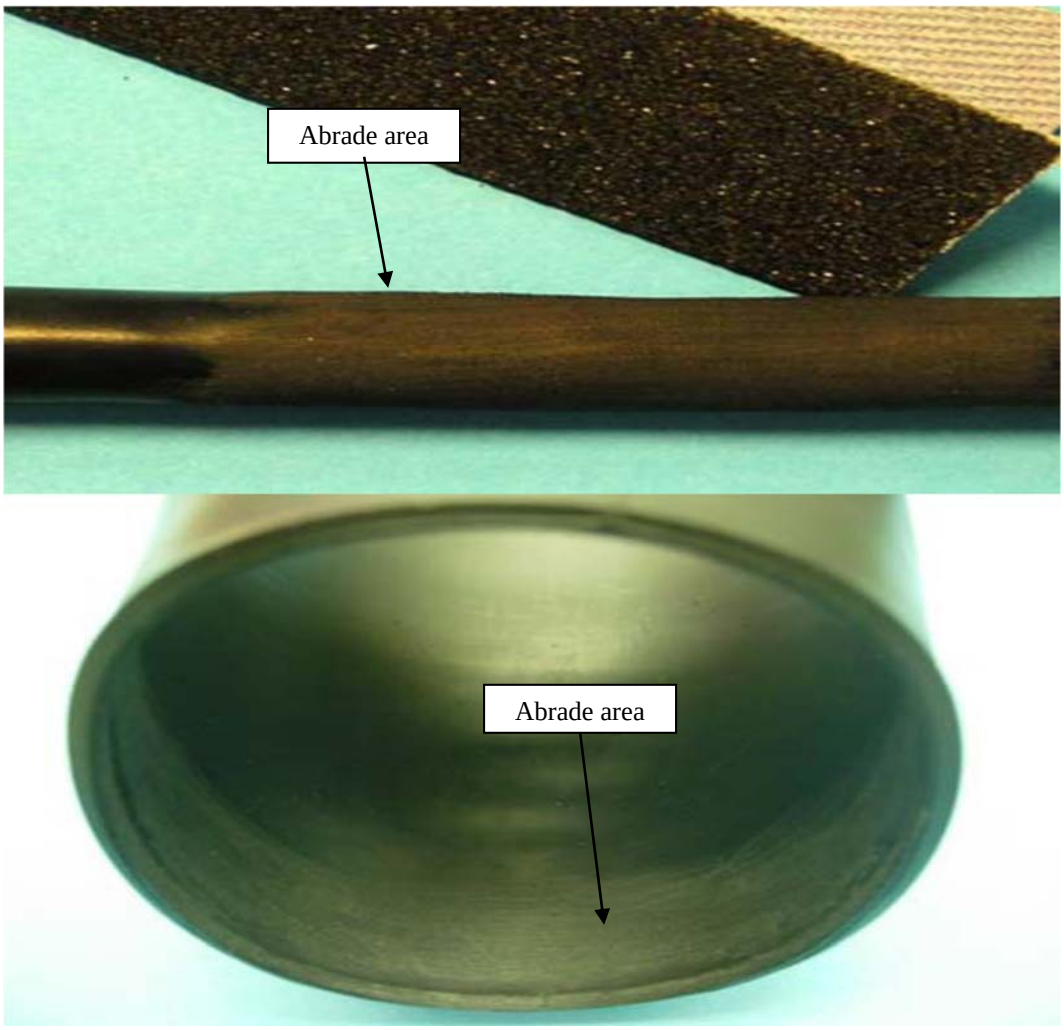


Figure 3-4

- Do not abrade metal surfaces of connector/adapter or pre-coated molded parts.

Step 4
Wipe loose particles from abraded surfaces with clean cloth or tissue.

Step 5
Degrease boot attachment surface of adapter or connector using disposable wipers wet with Isopropyl Alcohol (IPA) (Figure 3-4).

Step 6
Apply adhesive to bonding areas of cable jacket and connector or adapter (Figure 3-4).

- Refer to **Table 3-2** for adhesive selection.

Step 7
Slide the new boot over the harness and position it over the connector or adapter (Figure 3-5).

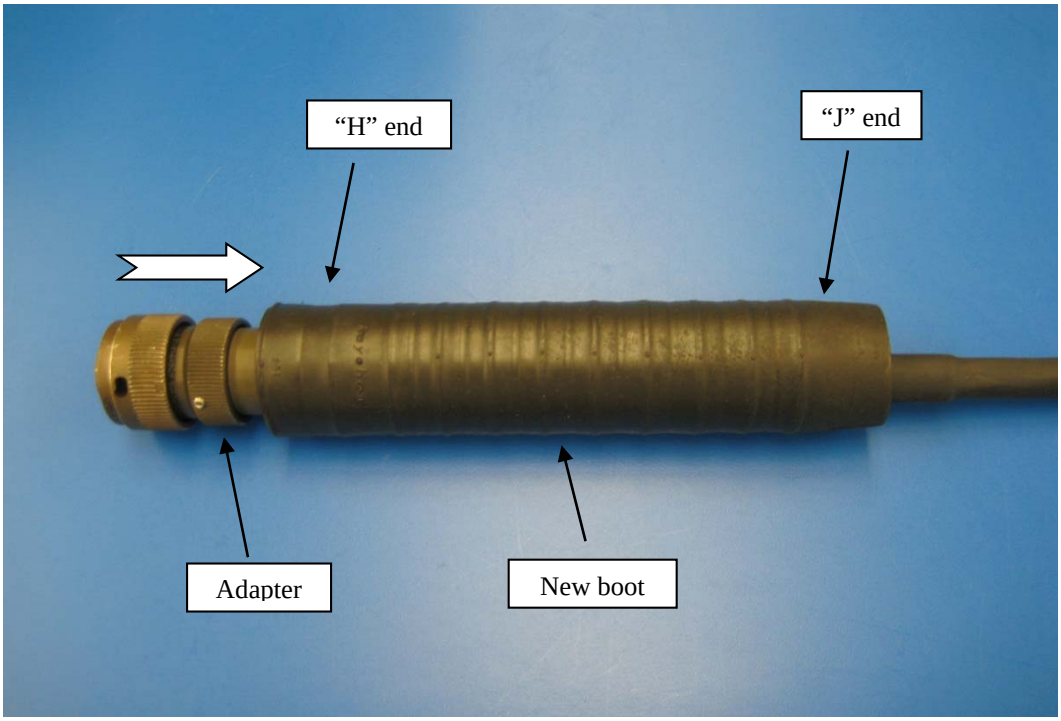


Figure 3-5

- Make sure that the end of the boot marked "H" goes toward the connector or adapter and the end marked "J" goes toward the cable jacket.

Step 8
Shrink the boot into place using a ThermoGun heating tool with a reflector to encircle the boot (See Tool Appendix).

- Shrink the H end of the boot first to secure it onto the backshell adapter (Figure 3-6).

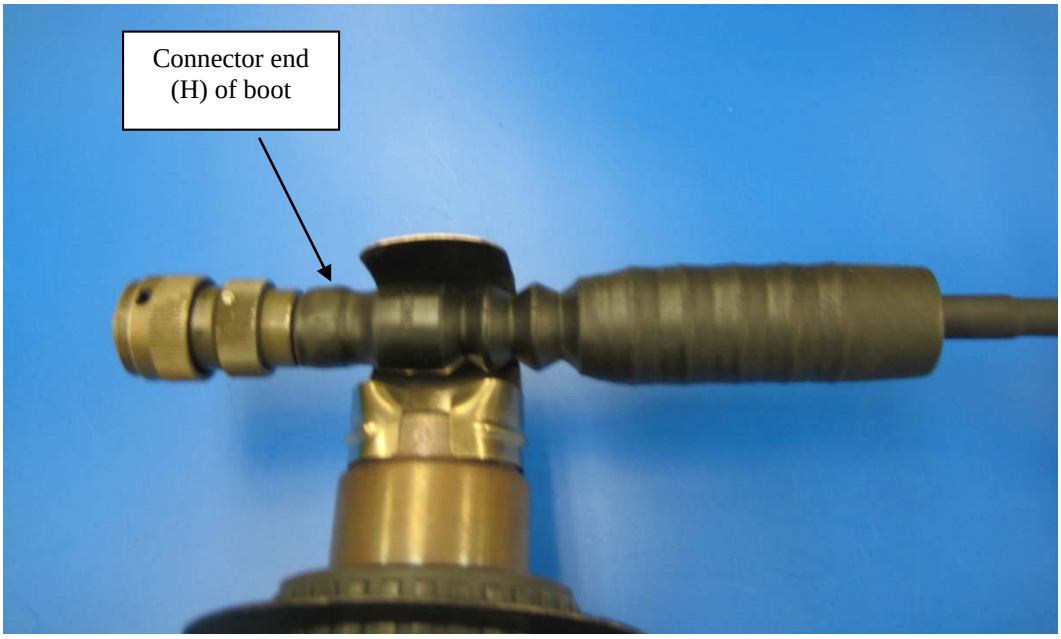


Figure 3-6

- Work toward the J end as the boot shrinks (Figure 3-7).

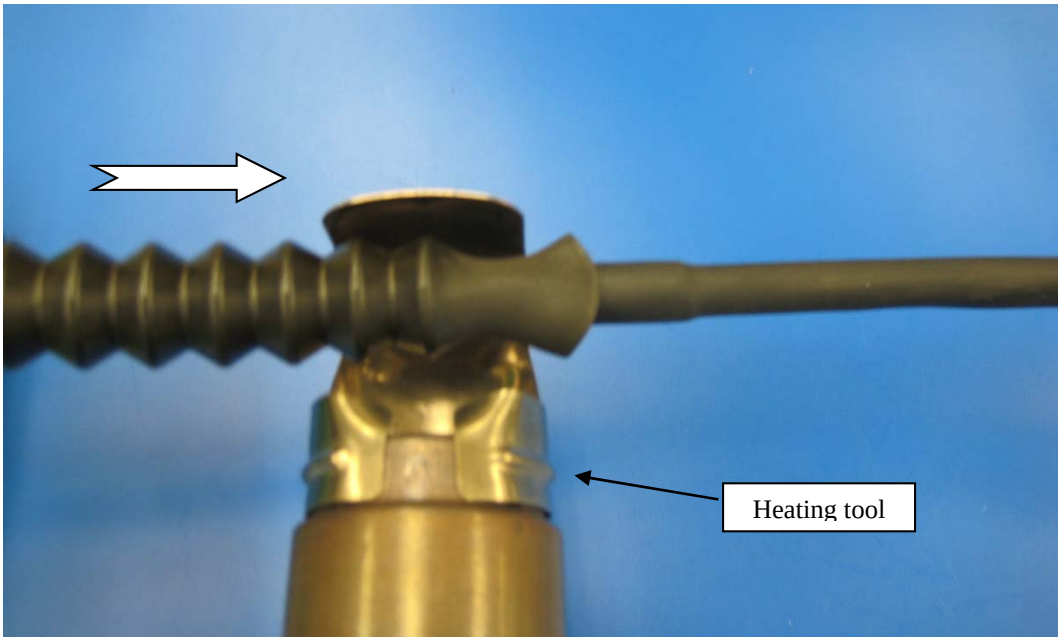


Figure 3-7

Step 9
Clean excess adhesive from each end of the boot.
- For hot melt adhesive use an orange stick or equivalent.
- For thermosetting (epoxy) adhesive use cloth or tissue.

Step 10
Cure the adhesive according to the instructions for the adhesive used.
- The bond line must not be moved or stressed during the cure time.

4.0 Adapter Replacement

This procedure is for replacing solid, spin-coupling, and shielded adapters. If an adapter is replaced, the attached boot must also be replaced.

Step 1
De-mate the connector.

Step 2
Score the boot lengthwise with a thermal knife (Figure 4-1). See Tool Appendix.
- Take care not to cut into the cable jacket.

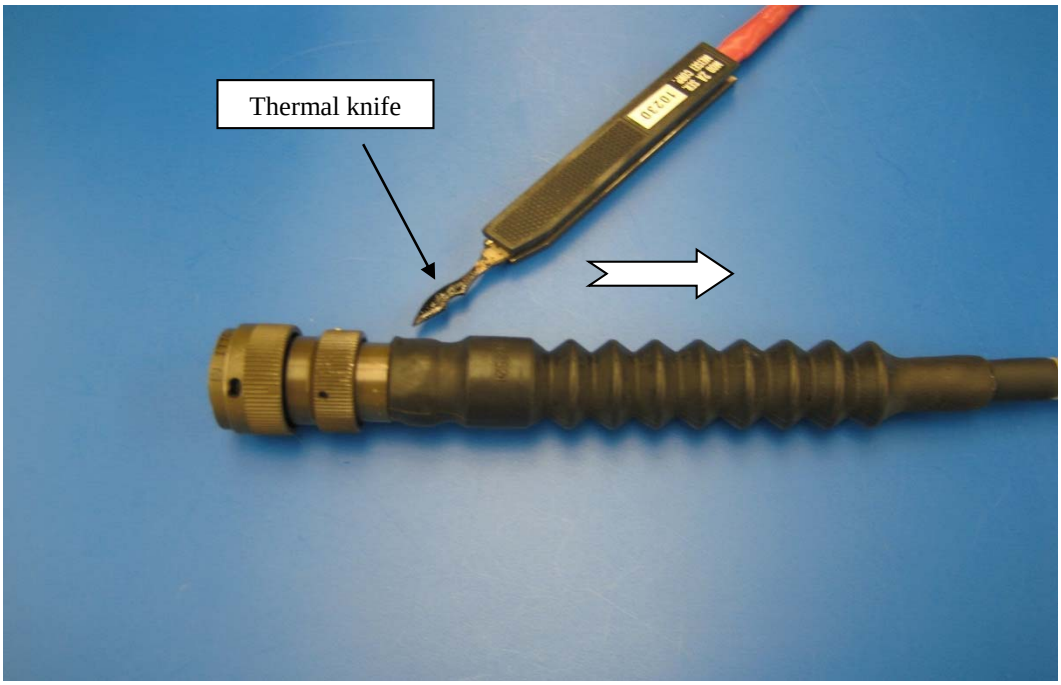


Figure 4-1

Step 3
Heat the boot until it is warm to touch and becomes flexible (Figure 4-2).

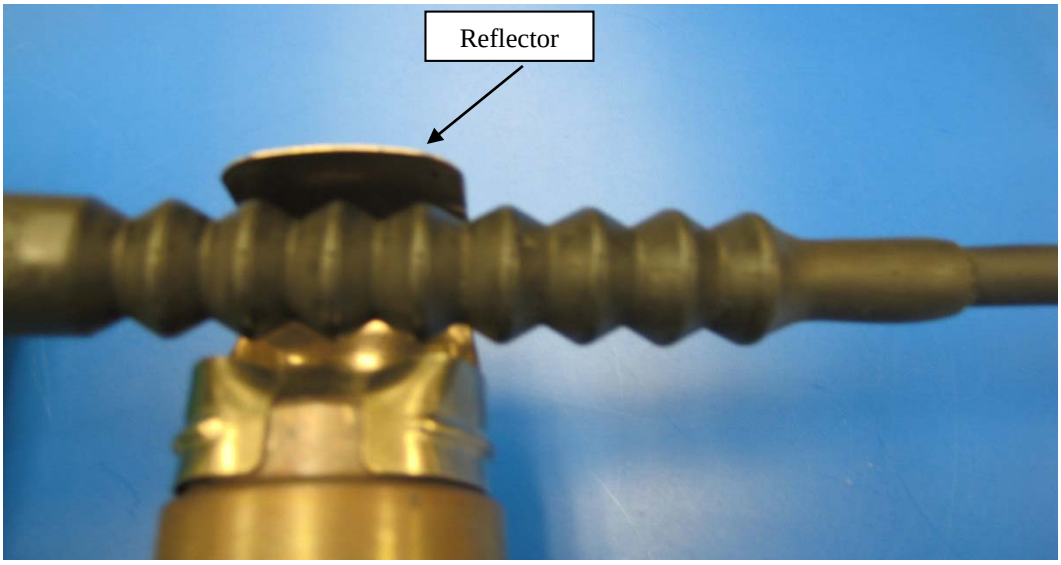


Figure 4-2

- Use a ThermoGun hot air heater with a reflector to encircle the boot (See Tool Appendix).
- Heat the entire boot, including the adhesive bond areas at both ends.

Step 4

Use pliers to peel the warm boot off the adapter and cable jacket (Figure 4-3).

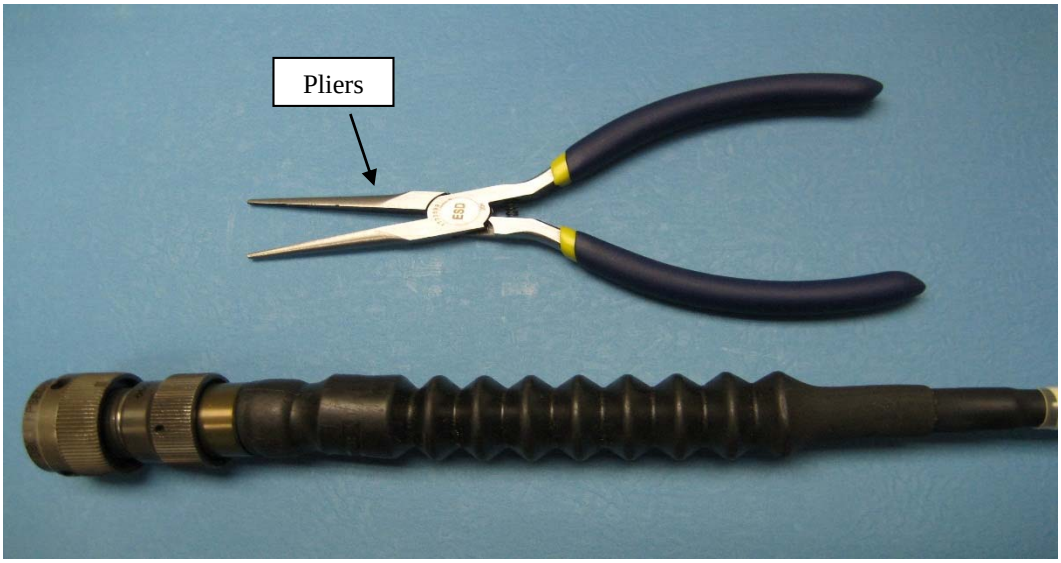


Figure 4-3

Step 5
Unscrew the adapter from the connector (Figure 4-4).

- Use connector pliers with plastic jaws or a torque strap wrench to turn the adapter or coupling ring counterclockwise.

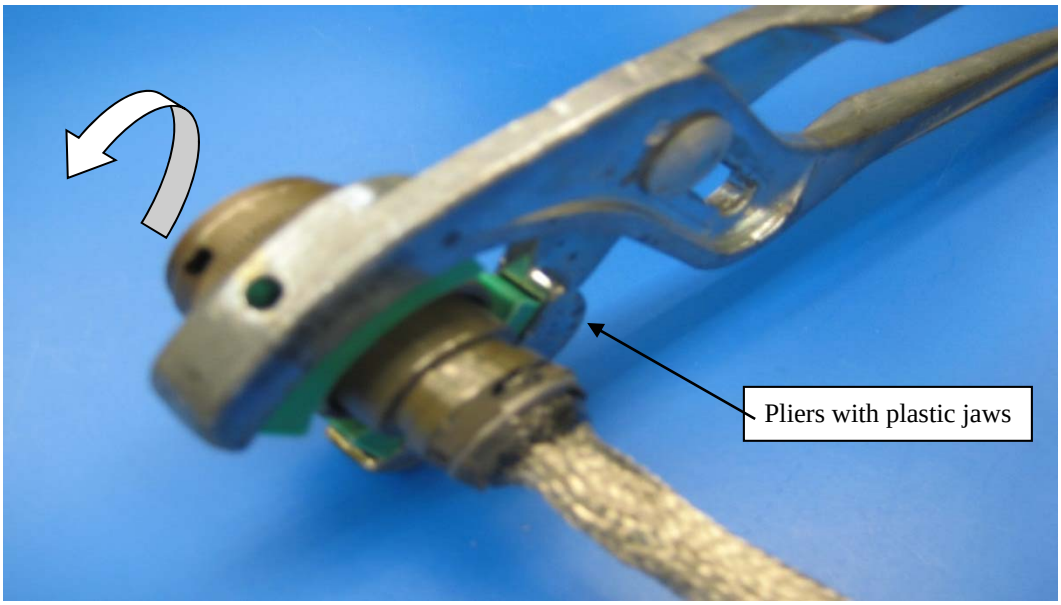


Figure 4-4

Step 6
Identify and mark conductors as required to permit proper contact re-installation.

Step 7
Remove contacts from connector or unsolder wires from the rear of connector.

- Use the tools and procedures specified by the contact manufacturer.

Step 8A (Adapters without attached shields)
Remove the adapter from the cable.

Step 8B (Shielded adapters)
Separate the adapter shield from the cable shield and remove the adapter from the cable (Figure 4-5).

a. If shields are tied together with lacing cord, cut the cord carefully and pull adapter from cable.
b. If shields are tied together with wire whipping, de-solder and unwrap wire.
c. If shields are soldered together, use infrared or hot air heating tool to melt solder while carefully pulling adapter.

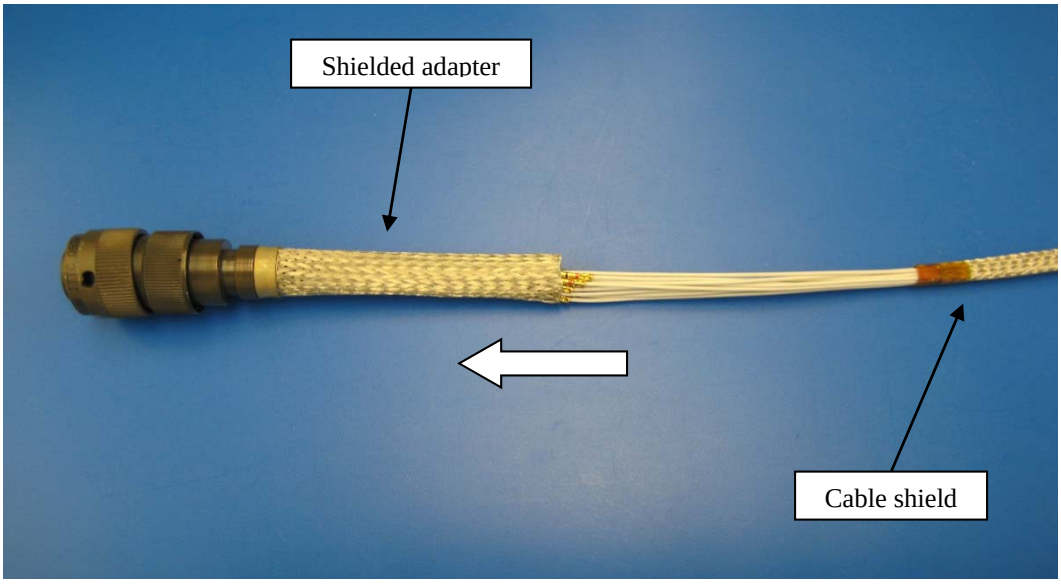


Figure 4-5

Warning:
Wear eye protection when de-soldering.

To de-solder the braid splice terminators or high temperature solder, infrared heat must be used.

To de-solder the Solder Shield braid splices, first score and remove the plastic sleeve.

Step 9
If cable has shield braid, make sure that the braid is straightened out and smoothed. Remove excess solder from braid.

Step 10
Slide a new heat-shrinkable boot back over the cable (Figure 4-6).

- Refer to the harness drawing/material list to select the proper boot material, size, and configuration.

- Make sure that the end marked “J” goes on first. The end marked “H” will go toward the adapter backshell.

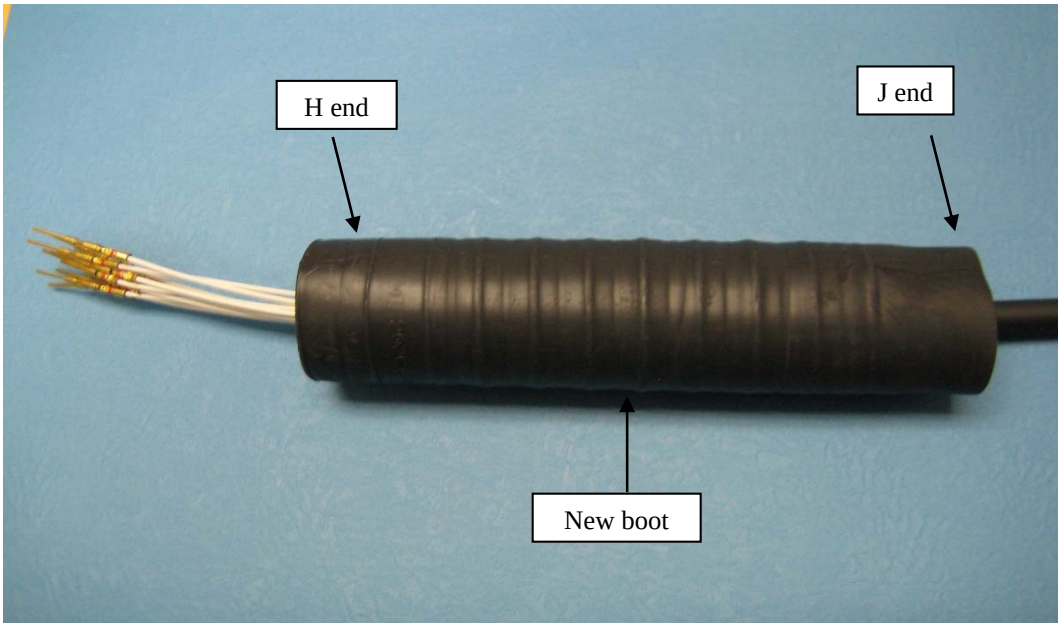


Figure 4-6

Step 11
If a braid splicing device is to be used, slide it onto the cable (Figure 4-7).

Step 12
Slide a SolderShield™ and a new shielded adapter over the cable (Figure 4-7).

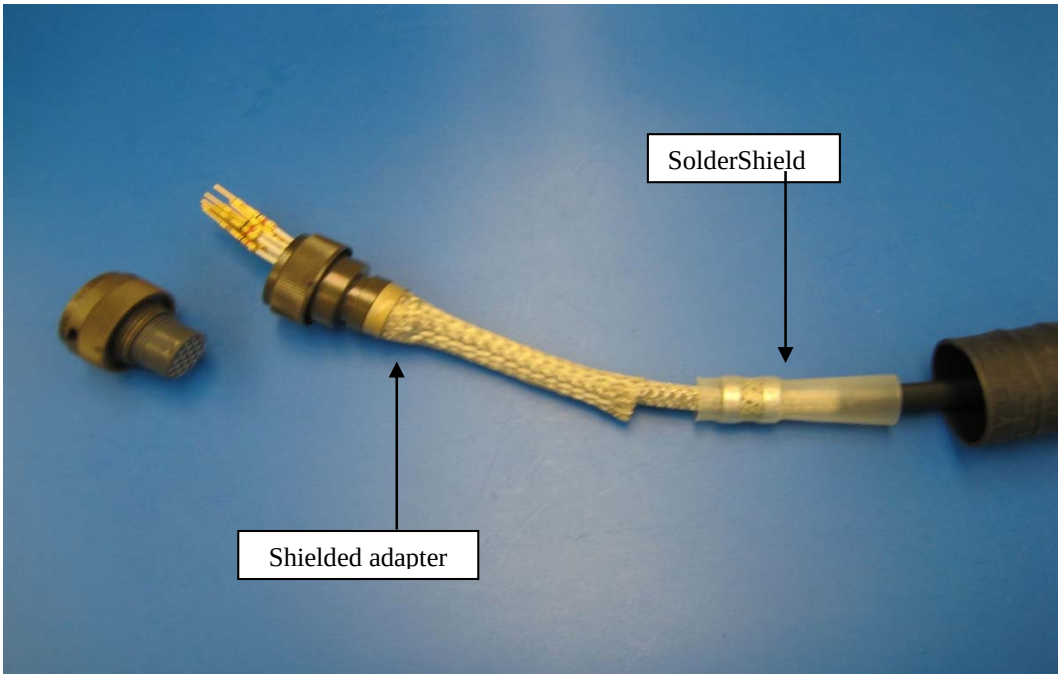


Figure 4-7

Step 13
Insert contacts into the proper cavities in the connector, or re-solder wires to connector terminals.

- Use the tools and procedures specified by the connector manufacturer.
- Make sure that all unused cavities have contacts and sealing plugs.

Step 14
Apply thread coating compound on connector threads as specified on harness drawing.

Step 15
Screw the adapter to the connector (Figure 4-8).

- If possible, orient the adapter on the connector so that the connector will mate without twisting the harness.

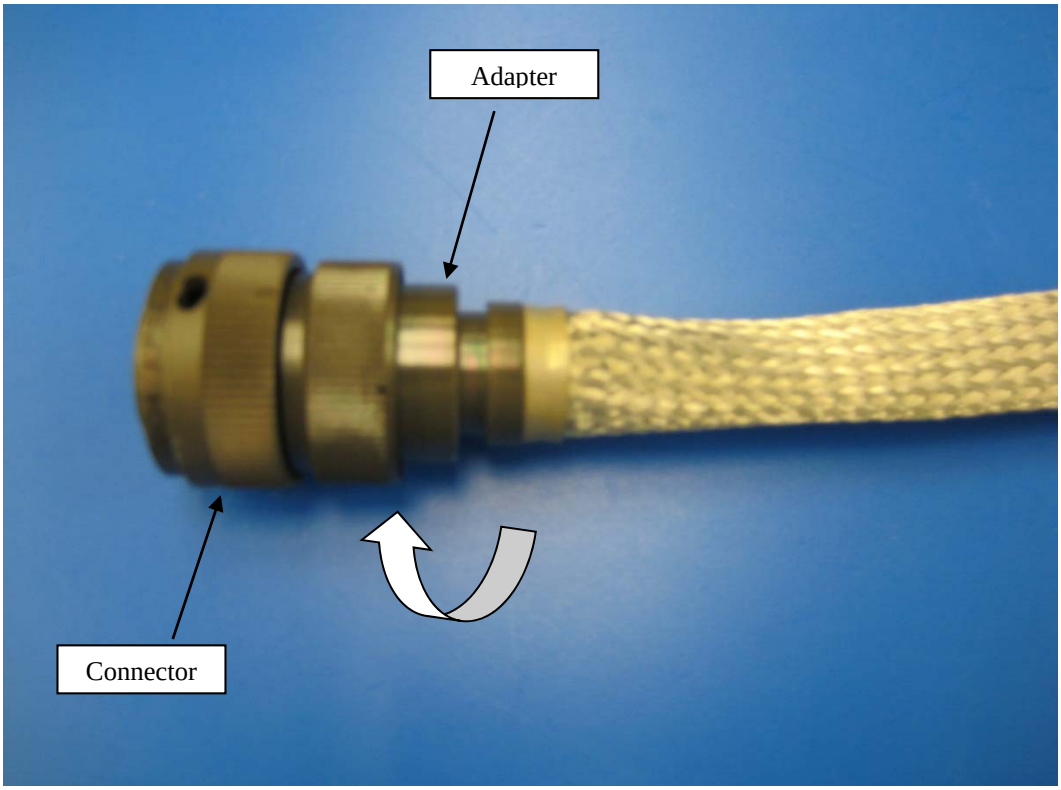


Figure 4-8

Step 16
Tighten the adapter or the coupling ring to the torque value specified in **Table 2-1** or appropriate engineering drawing.

Step 17
If the shielded adapter is used, trim the adapter braid so that it does not overlap the cable jacket (Figure 4-9).

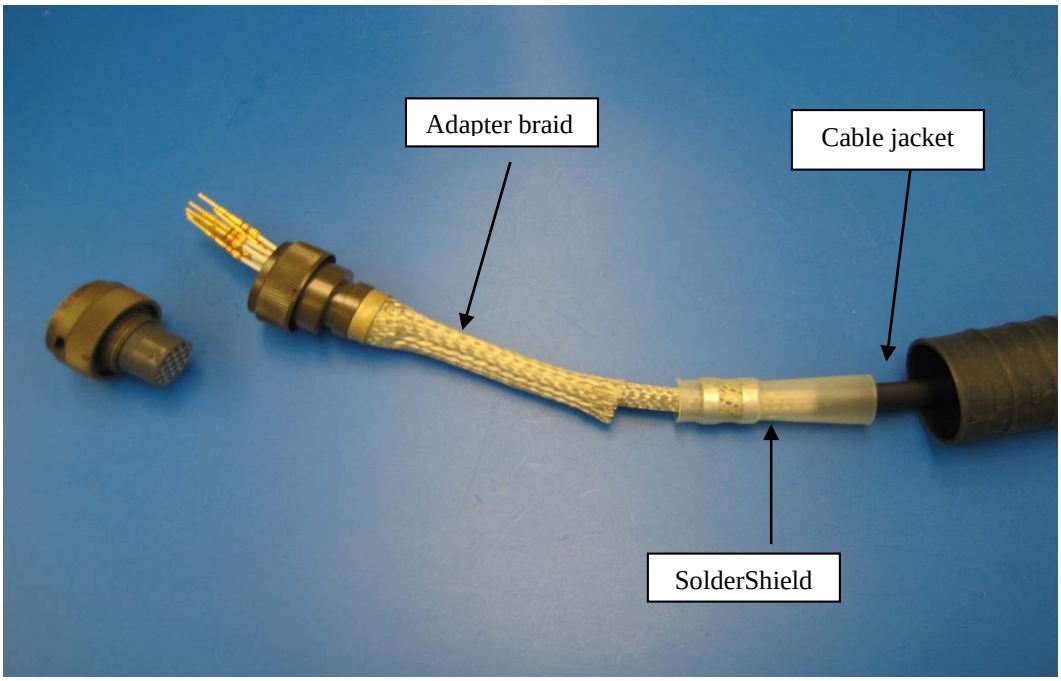


Figure 4-9

Step 18
If the adapter has a shield braid, splice the adapter braid onto the cable braid, using the method specified for the harness being repaired. Recommended methods include:

- Soldering
- Lacing cord
- Wire whipping
- **SolderShield** braid splice
- **SolderSleeve** braid splice terminator

Step 19
Install the heat-shrinkable boot as directed in section 3-2.
Note: The boot may already be slid back over the cable (step 10 above).

Step 20
Test per the following procedures:
a. Circuit continuity per applicable revision of harness drawing.
b. Electrical performance per manufacturing specification and/or harness drawing.

5.0 Jacket Repair

This procedure is for using heat-shrinkable repair tubing to make moisture-tight repairs to damaged harness jacketing. Repairs are made without removing connectors.

Step 1

Inspect for shield and component wire damage and perform following electrical tests:

a. Circuit continuity per applicable revision of harness drawing.
b. Insulation resistance (IR) of component wires.
c. Shield-to-wire insulation resistance (500 Mega-Ohm, min.).
d. Shell-to-shell DC resistance.

Step 2

Repair any shield damage per section 6.0.
Repair any wire damage per section 7.0.

Step 3

Wipe off any oil, dirt or grease in the repair area.

- The repair area will depend on the length of the damaged area. The repair area will be 7 inches if the damaged area less than 1 inch long and 13 inches if the damaged area 1 inch to 6 inches long (Figure 5-1).

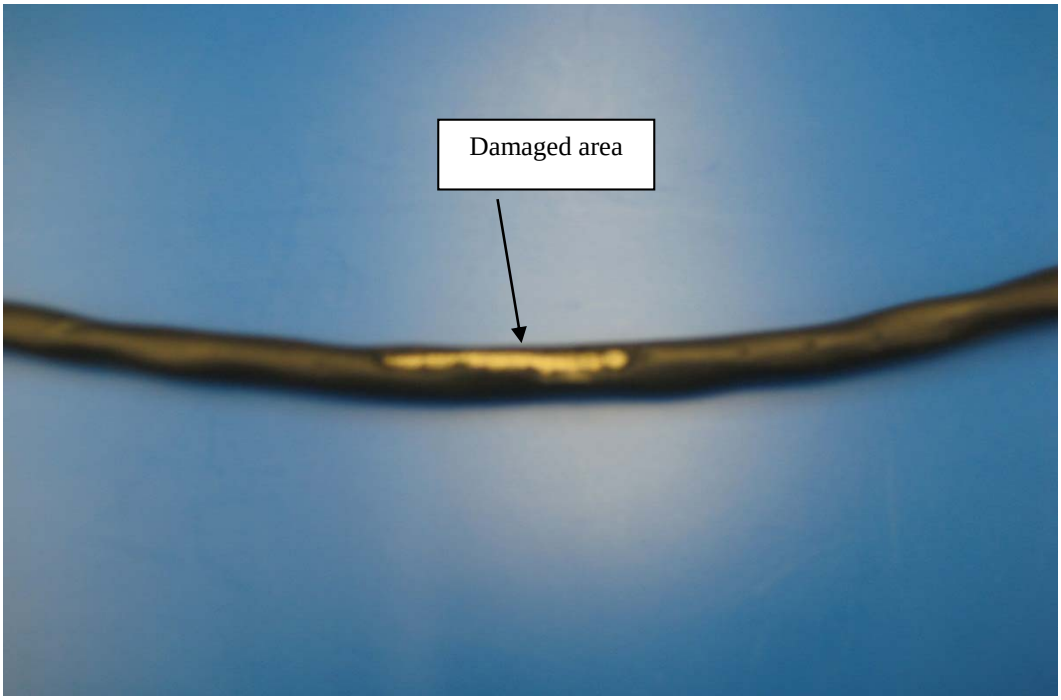


Figure 5-1

Step 4
Abrade the cable jacket with #320 emery cloth in the repair area.

Step 5
Wipe loose particles from abraded surfaces with clean cloth or tissue.

Step 6
If the abraded surfaces have any oil or grease on them, wipe clean with disposable wipers wet with Isopropyl Alcohol (IPA) and allow drying for 5–10 minutes.

Step 7
Use lacing cord (MIL-T-43435, Type V, Finish F, Size 3) to spiral wrap the damaged area of jacket. Tie at both ends and in the middle (Figure 5-2).

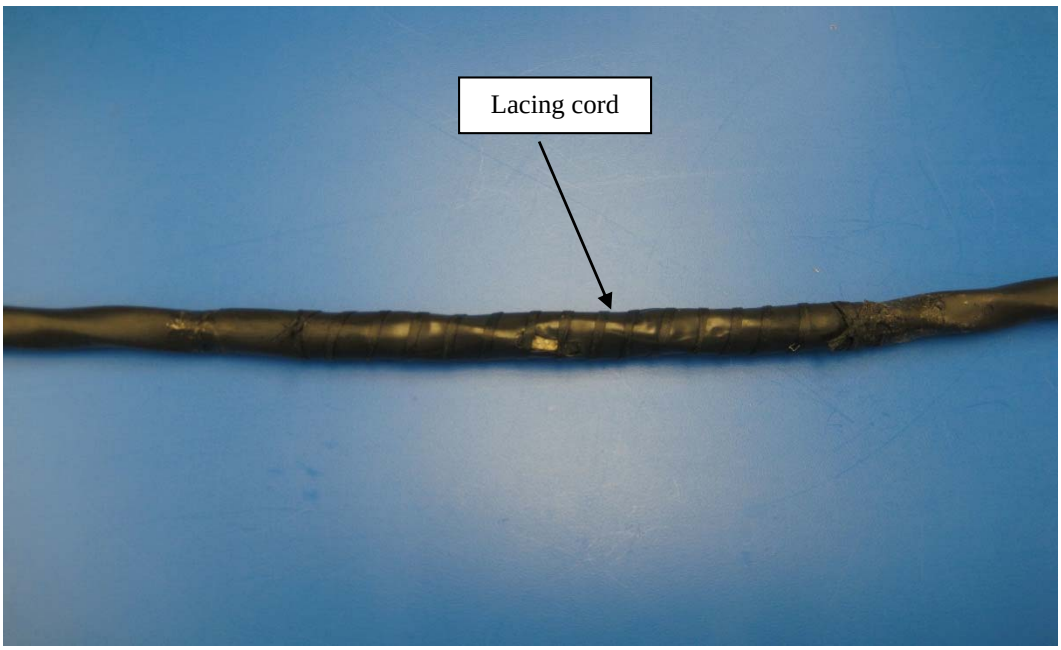


Figure 5-2

Step 8
Select repair tubing or tape material and adhesive from Table 5-1.

Table 5-1
Repair Tubing or Tape Material Selection

Harness System Nomenclature	Harness Jacket Material	Repair Tubing/Tape Material	Adhesive
System 10	Versafit polyolefin	RP-4800 / S1081 Tape	S-1017
-	RNF-100 polyolefin	RP-4800 / S1081 Tape	S-1030
-	Polyurethane	S1081 Tape	S-1017 S-1009
System 15, 20	NT-FR Neoprene polychloroprene	RP-4800 S1081 Tape	S-1009 S-1124
System 25	DR-25 Elastomer	T-DR-25 Tape	S-1125 S-1048
System 30	VPB	VPB-RT-X T-DR-25 Tape	S-1255-04 S-1125
System 100	Zerohal ZHTM	S1081 Tape	S-1030
System 200	RW-200	RT-555 HT adhesive tape	NA
System 300	RT-555	RT-555 HT adhesive tape	NA
System Silicone	SFR	Silicone Tape ST1B215	G.E. RTV-108 D.C.3145 RTV Gray

Step 9
Select a diameter of repair tubing according to Table 5-2 or 5-3.

- The tubing must fit the cable diameter and be large enough **as supplied** to fit over the connector.

Table 5-2
VPB-RT Repair Tubing Diameter Selection

Cable Jacket Diameter Range (Inch)	**Maximum Connector Diameter** (inch)	**VPB-RT Repair Tubing Part Number**
0.25-0.35	0.7 inch	VPB-RT-3/4-*
0.35-0.50	0.9 inch	VPB-RT-1-*
0.50-0.70	1.4 inch	VPB-RT-1 1/2-*
0.70-1.00	1.9 inch	VPB-RT-2-*
1.00-1.75	2.8 inch	VPB-RT-3-*

*Length callout: -6 = 6 inch; -12 = 12 inch. See step 10

Table 5-3
RP-4800 Repair Tubing Diameter Selection

Cable Jacket Diameter Range (Inch)	**Maximum Connector Diameter** (inch)	**RP-4800 Repair Tubing Part Number**
0.30-0.60	1.0	RP-4800-1
0.60-0.80	2.0	RP-4800-2
0.80-1.10	3.0	RP-4800-3
1.10-1.60	4.0	RP-4800-4

Step 10
Select the repair tubing **installed** length.

- Six inch if damaged area less than one inch long.
- Twelve inch if damaged area one to six inches long.
- VPB tubing increases slightly in length as it shrinks in diameter.
- Length callout of VPB-RT is on Table 5-2.
- RP-4800 tubing shrinks considerably in length as it shrinks in diameter.
- **Installed** length of RP-4800 is marked on tubing in 6-inch (installed) increments.

Step 11

Apply adhesive to the repair area (Figure 5-3).

- Mix and/or apply adhesives as directed on adhesive instruction sheet.

Figure 5-3

Step 12

Slide the repair tubing over the cable and center it over the repair area (Fig. 5-4).

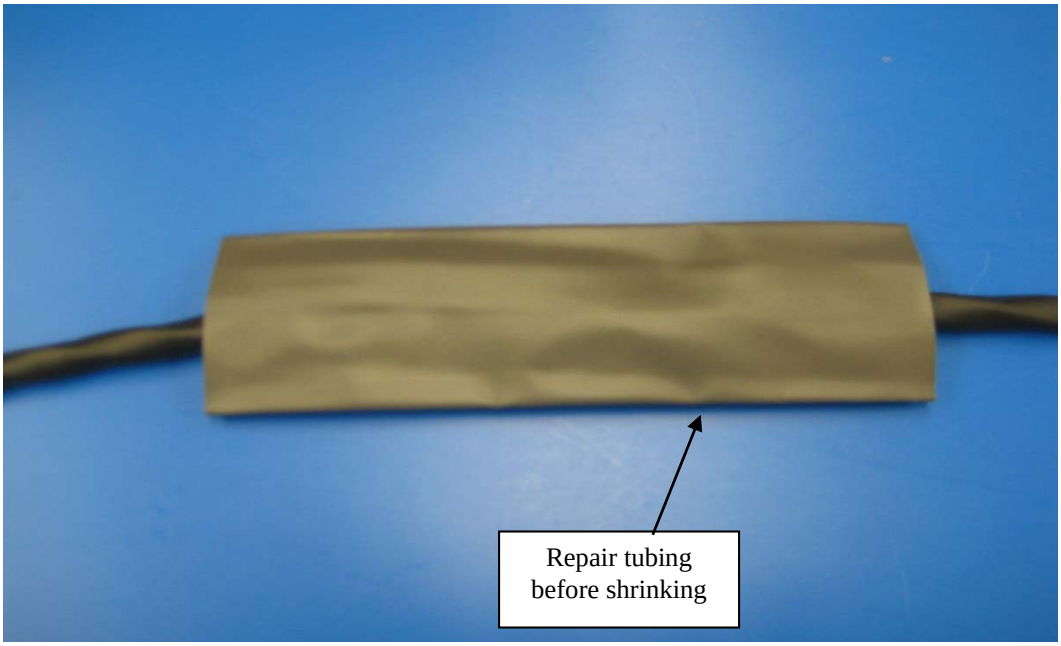


Figure 5-4

Step 13

Heat the repair tubing to shrink it onto the cable (Figure 5-5).

- Use a Thermo Gun hot air heater with a reflector to encircle the tubing (See Tool Appendix).
- Start at the middle of the repair tubing and work slowly outward. Fully shrink each section to the ends one at a time.

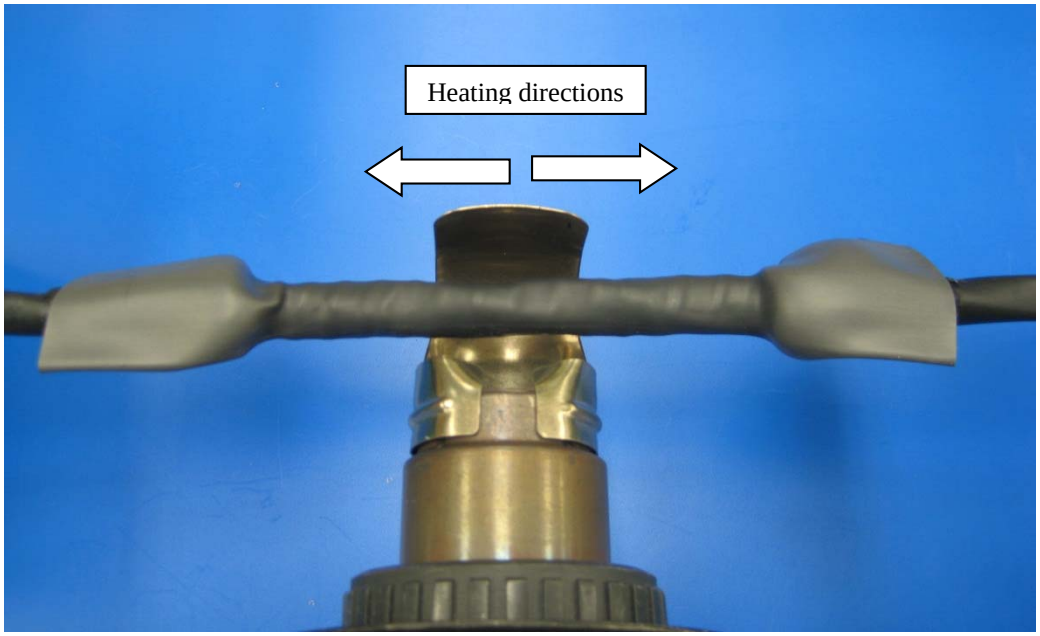


Figure 5-5

Step 14

Clean excess adhesive from each end of the repair tubing (Figure 5-6).

- For hot melt adhesive use a wooden paddle or equivalent.
- For thermosetting (epoxy) adhesive use cloth or tissue.

Figure 5-6

Step 15
Cure the adhesive according to the instructions for the adhesive used.

- The bond line must not be moved or stressed during the cure time.

Step 16
Test per the following procedures:

a. Circuit continuity per applicable revision of harness drawing.
b. Electrical performance per manufacturing specification and/or harness drawing.

6.0 Shield Repair

Follow this procedure to repair localized damage to a small area of shield braid.

Step 1
Remove the cable jacket from the damaged area and for one or two inches in both directions (Figure 6-1).

- Use only a thermal knife. Do not use razor blade or knife blade because of possibility of damaging the shield braid or wires (See Tool Appendix).

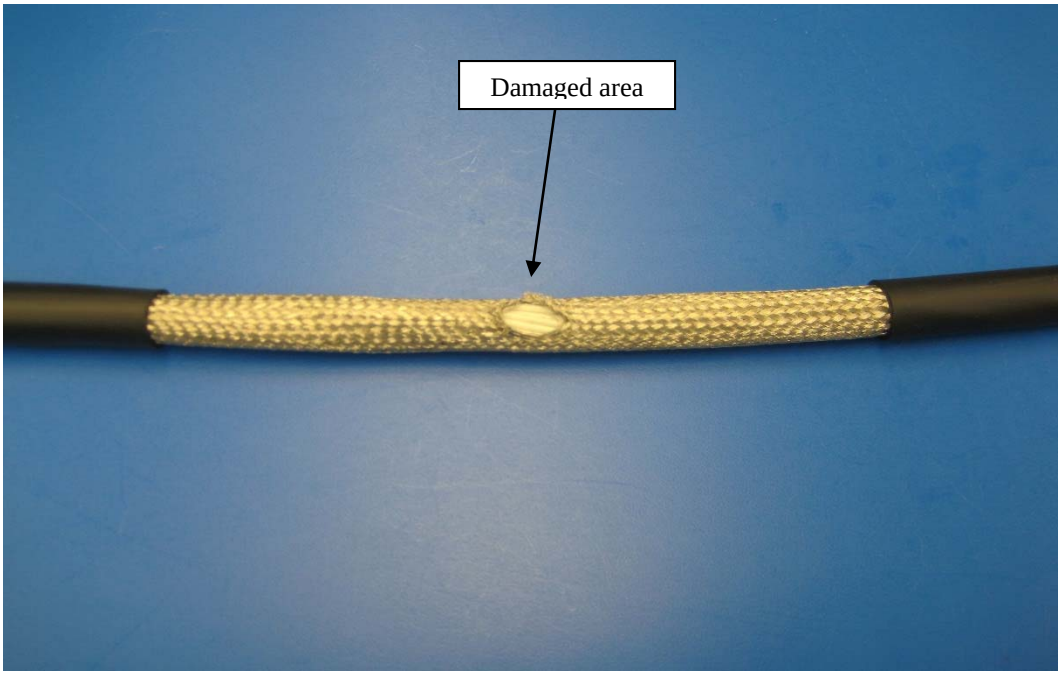


Figure 6-1

Step 2
Inspect for component wire damage and perform following electrical tests:

a. Circuit continuity per applicable revision of harness drawing.
b. Insulation resistance (IR) of component wires.
c. Shield-to-wire insulation resistance (500 Mega-Ohm min.).

Step 3
Repair any wire damage per section 7.0.

Step 4
Wrap the damaged area with shield tape (TE part description 000W280) [Figure 6-2].

- Overlap each wrap at least 50%.

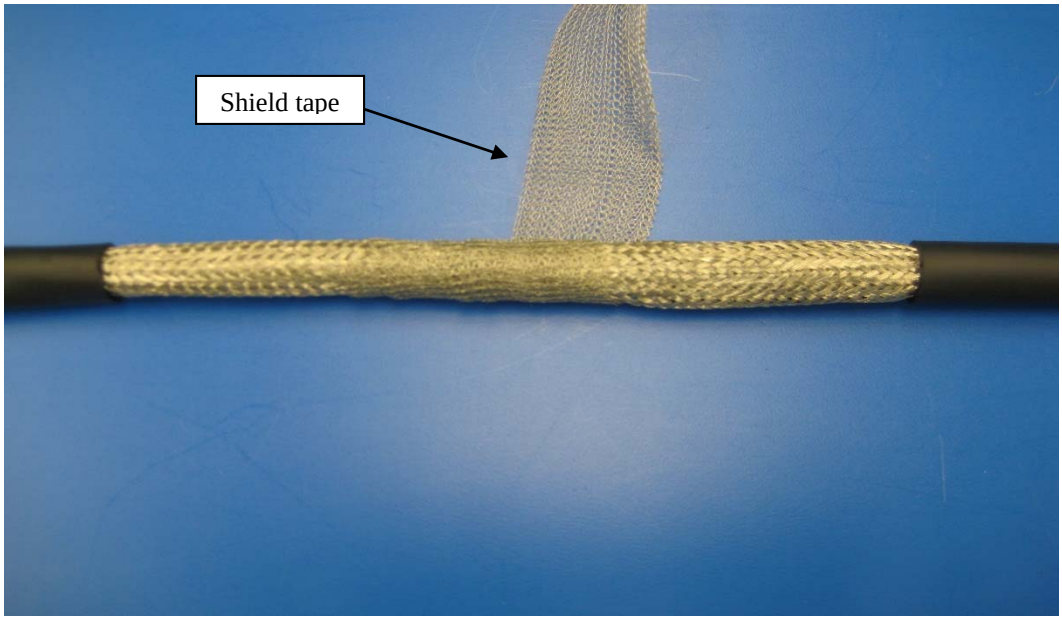


Figure 6-2

Step 5
Use lacing cord (MIL-T-43435, Type V, Finish B, Size 3) to attach the shield tape in place. Tie at least two knots at each end of the shield tape (Figure 6-3).

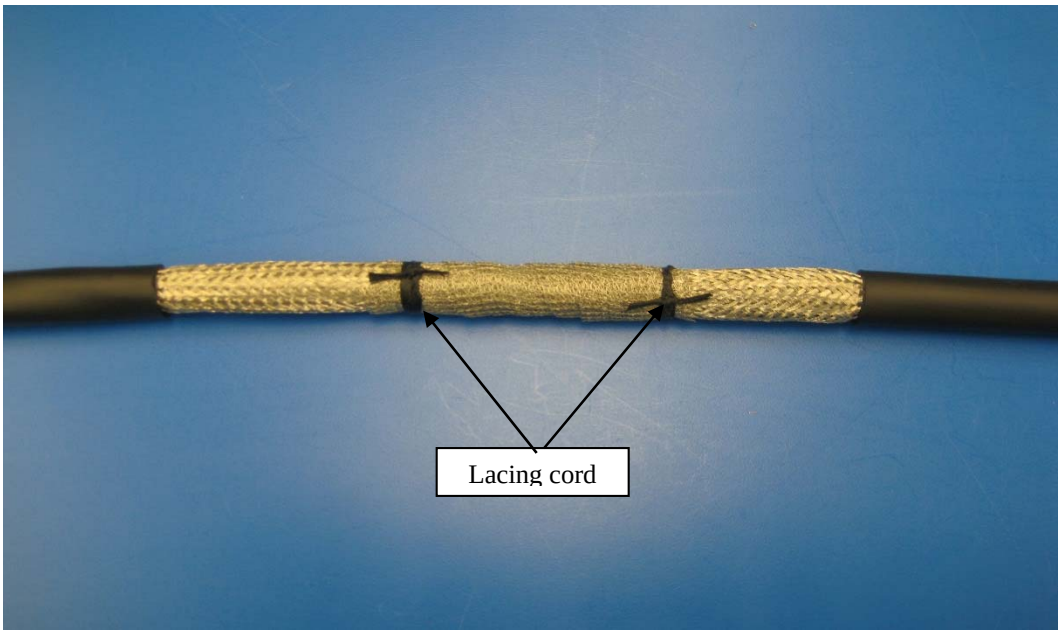


Figure 6-3

Step 6
Install repair tubing over the repaired shield as directed in 5.0.

7.0 Component Wire Repair

Damaged component wires can be repaired by cutting out the damaged section and splicing in a length of new wire (Paragraph 7.1). If the damaged wire can be pulled out, a new wire can be attached to the end and pulled into the harness (Paragraph 7.2).

Index to this section:

7.1 Wire Repair

Step 1

Remove the cable jacket from the damaged area and for approximately two inches in both directions (Figure 7-1).

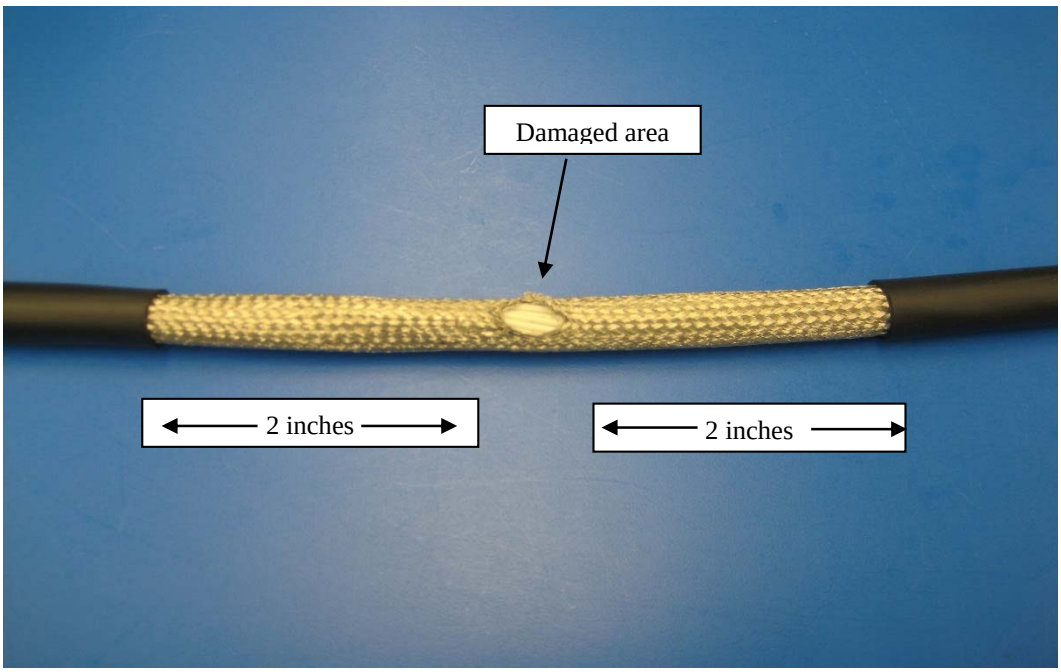


Figure 7-1

- If the harness has a braided shield, a thermal knife can be used to remove jacket (See Tool Appendix). Do not use a sharp blade because of possibility of damaging the shield.

- If the harness has no braid shield, small scissors are recommended for cutting the jacket without damaging the component wire insulation.

Step 2
If the harness has a shield, cut the shield carefully around the harness in the middle of the exposed area.

- Small scissors are recommended for cutting the shield without damaging the component wire insulation.

Step 3
If the harness has a shield, fold the shield back over the jacket in both directions so as to expose the component wires (Figure 7-2).

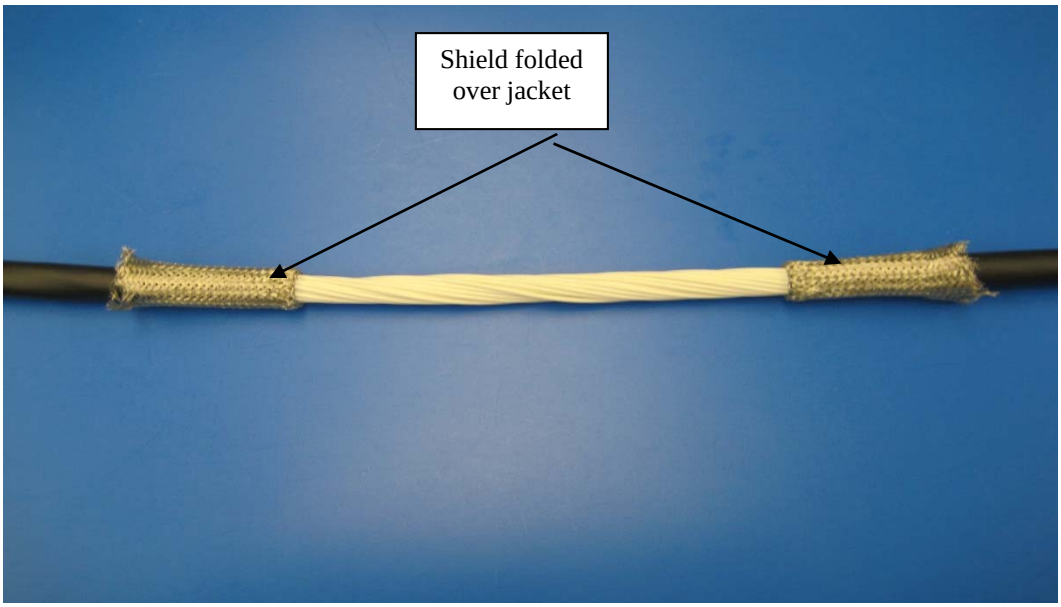


Figure 7-2

Step 4
Cut out the damaged wire, leaving at least one inch of wire at each end to which a repair wire can be spliced (Figure 7-3).

- If several wires are damaged, stagger the positions of the repair wires to avoid a bulky repair area.

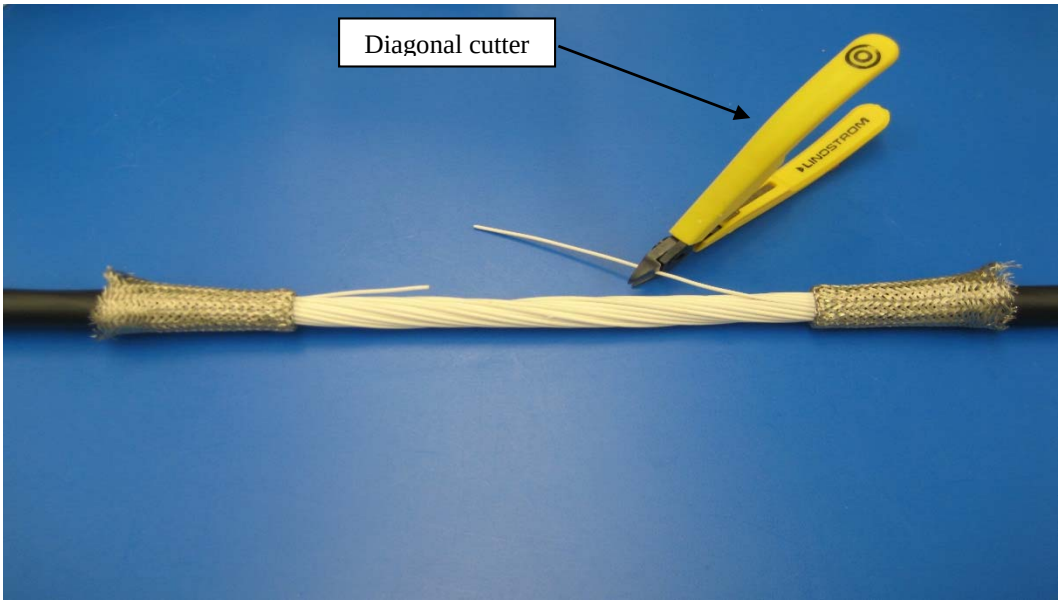


Figure 7-3

Step 5

Prepare a length of wire to replace the damaged wire (Figure 7-4).

- Refer to harness drawing for wire type and size.
- The repair wire should be the same length as the wire which was removed.

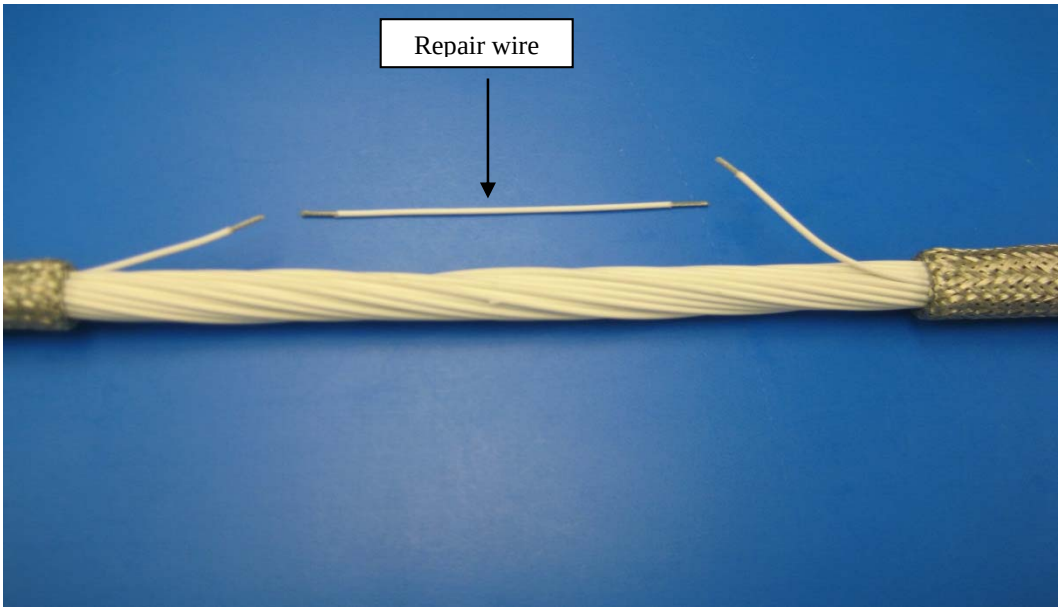


Figure 7-4

Step 6

Strip the wire end 1/4 ± 1/16 inch (Figure 7-4).

Step 7
Use Table 7-1 to select a Mini-Seal splice for each wire connection to be made.

Table 7-1
Mini-Seal Splice Selection

Conductor Size Range	Insulation Diameter (Maximum)	Color Code	Raychem Part Number	MIL Number
Tin or Silver Conductor Coating				
AWG 26-20	0.085 inch	Red	D-436-36	M81824/1-1
AWG 20-16	0.110 inch	Blue	D-436-37	M81824/1-2
AWG 16-12	0.170 inch	Yellow	D-436-38	M81824/1-3
Nickel Conductor Coating				
AWG 26-20	0.085 inch	Red	D-436-82	-
AWG 20-16	0.110 inch	Blue	D-436-83	-
AWG 16-12	0.170 inch	Yellow	D-436-84	-

Step 8
Splice the repair wire to the harness wires (Figure 7-5 and 7-6).

- Be sure to slide the splice sleeves onto the wires before both crimps are installed.

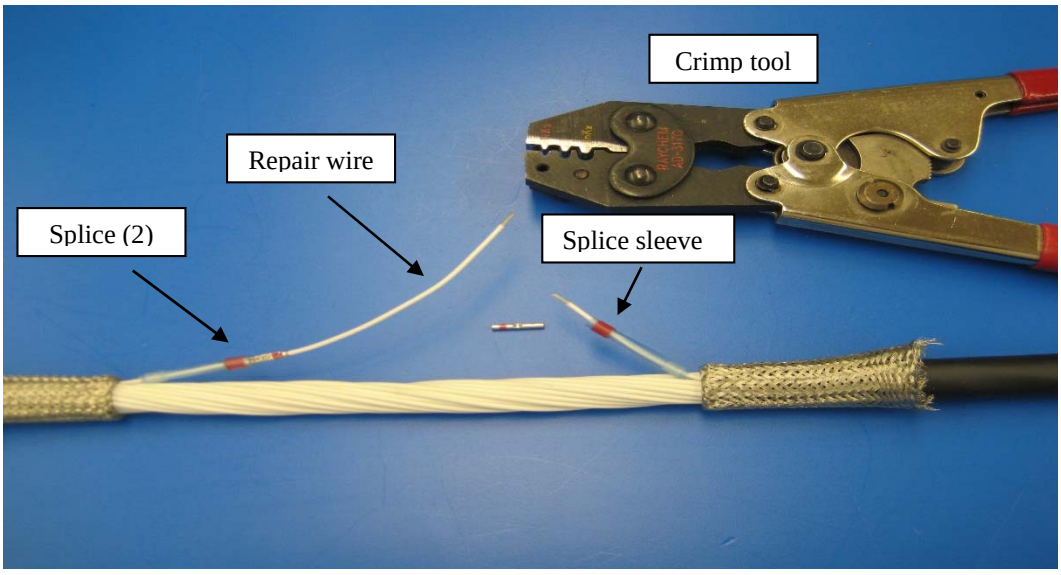


Figure 7-5

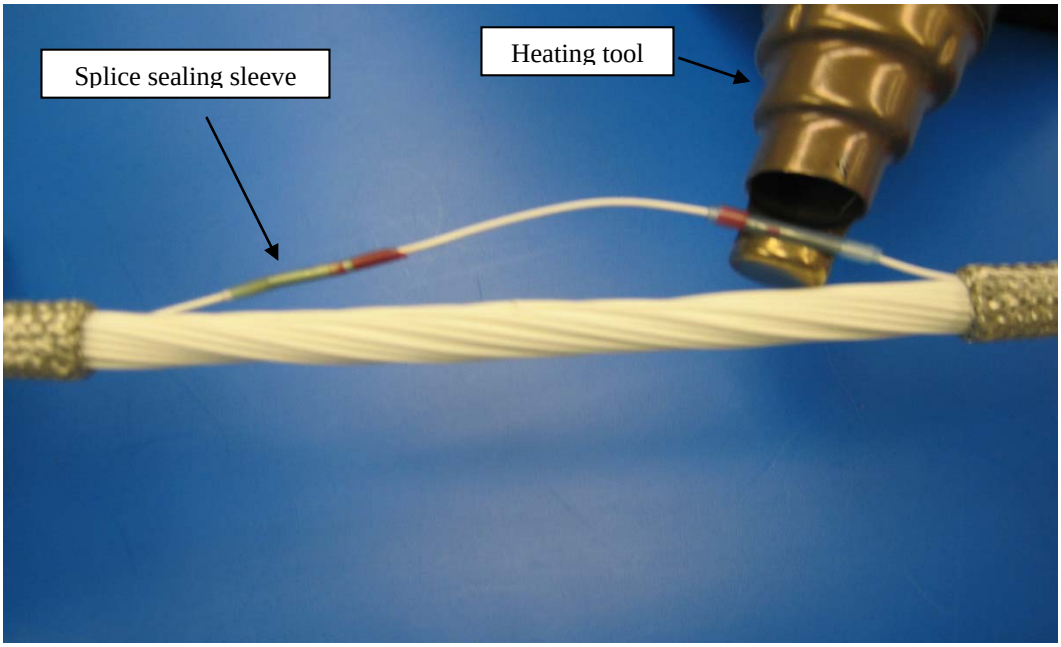


Figure 7-6

- If more than one wire in the harness is being repaired, be careful to splice each wire to the correct wire.

Step 9

Test per the following procedures:

a. Circuit continuity per applicable revision of harness drawing.
b. Insulation resistance (IR) of component wires.

Step 10

If the harness is shielded, fold the shield back over the repair area (Figure 7-7).

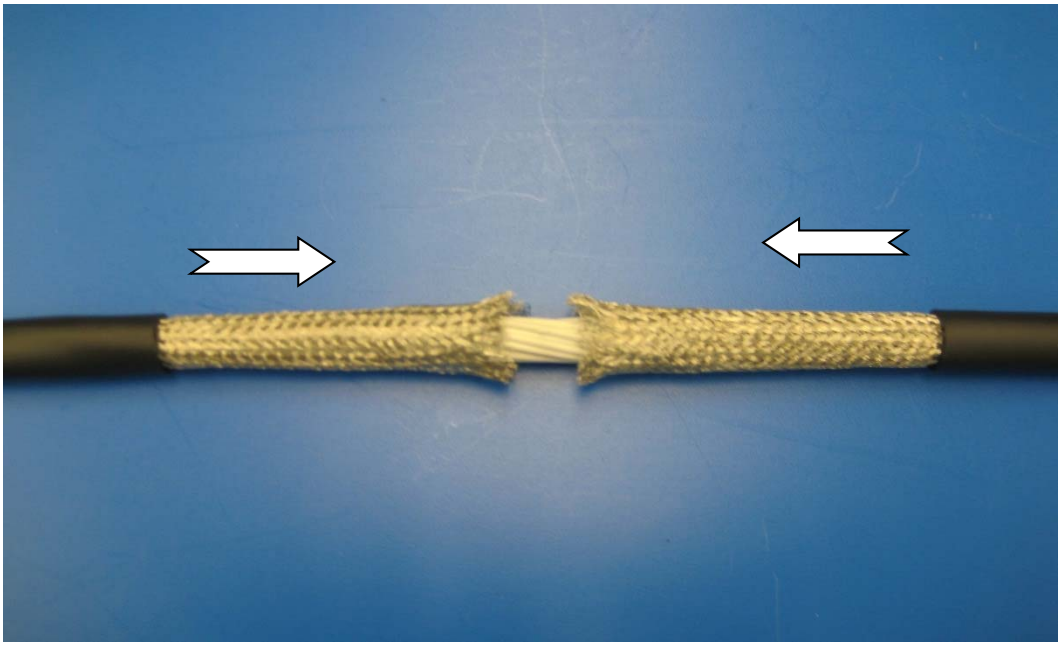


Figure 7-7

Step 11
If the harness is shielded, repair the shield per section 6.0.

Step 12
Test per the following procedures:
a. Shield-to-wire insulation resistance (IR) (500 Mega-Ohm, min.).
b. Shell-to-shell DC resistance.

Step 13
Repair the jacket per section 5.0.

7.2 Replacing a Wire

If the jacket is not too tight and if any bends in the wire are not too sharp, it may be possible to attach a new wire to a damaged wire and pull the new wire into place while pulling the damaged wire out.

Step 1
Locate both ends of the damaged wire and remove contact or unsolder from connectors.

Step 2
Strip the damaged and new wires approximately one inch.
- The new wire should be several inches longer than the wire being replaced.

Step 3
Solder the damaged and new wires together without twisting (Figure 7-10).

- SolderSleeve shield terminators or splices (NAS 1744 or 1745) can be used to solder wires together.

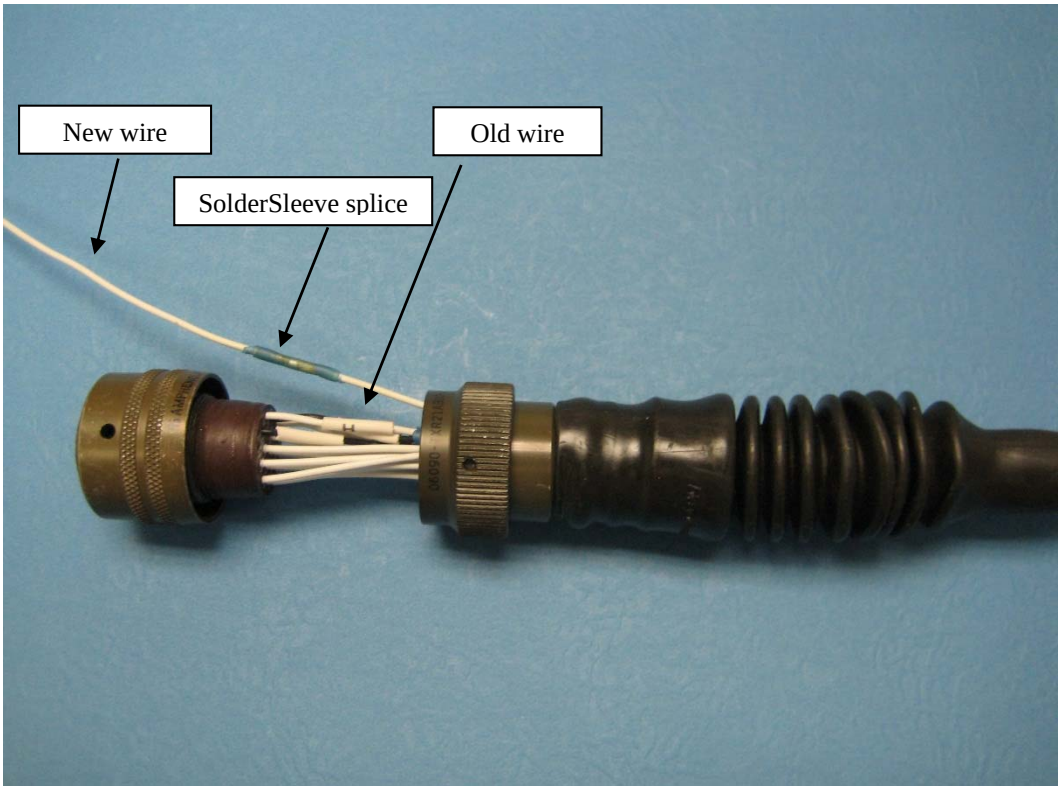


Figure 7-10

- Keep solder build-up to a minimum if a soldering iron or gun is used.

Step 4
Carefully pull the damaged wire out while feeding the new wire in.

- Keep the harness straight along the path of the wire being changed.

Step 5
Cut off the soldered area.

Step 6
Cut the replacement wire to the length required, and attach to contacts or connector terminals.

Step 7
Test per the following procedures:
a. Circuit continuity per applicable revision of harness drawing.
b. Insulation resistance (IR) of component wires.
c. Shield-to-wire insulation resistance (500 Mega-Ohms, min.).

8.0 Transition Rework

Transitions with minor damage, such as a cut or hole, can be repaired (Paragraph 8.1). Transition with major damage, such as splitting, must be replaced (Paragraph 8.2).

Index to this section:

8.1 Transition Repair

8.1.1 Repair Using Tubing

A transition can be repaired by covering the damaged area with heat-shrinkable repair tubing, if the damage is located so that the repair tubing will extend at least one inch each way from the damaged area. Follow the procedure in paragraph 5.0 (Figure 8-1).

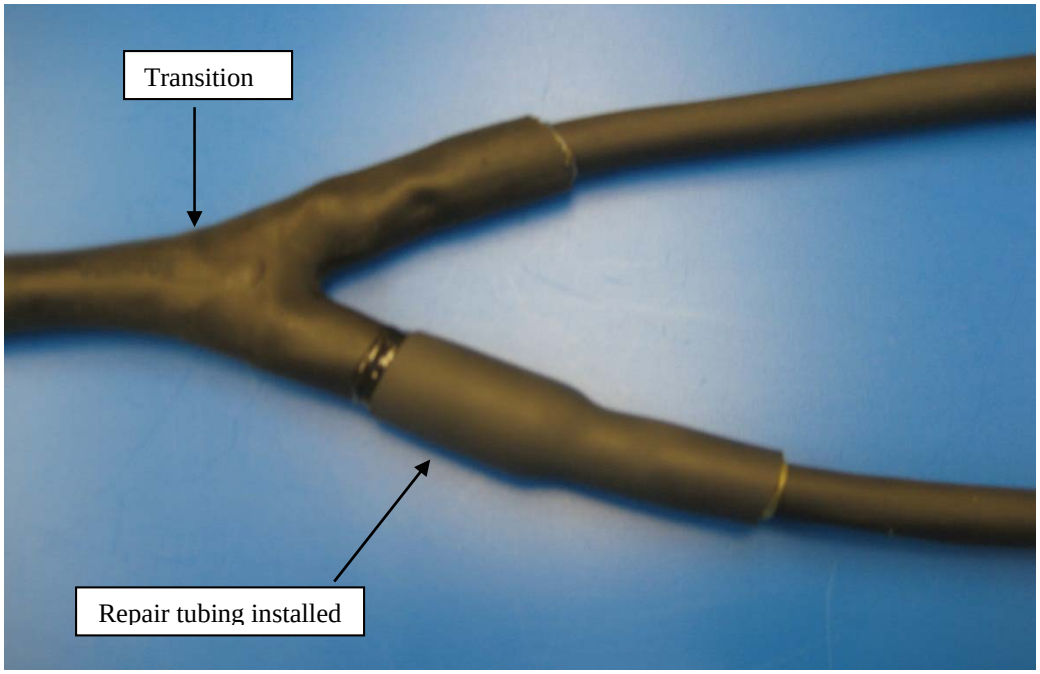


Figure 8-1

8.1.2 Repair Using Transition

A damaged transition can be covered with a new transition of the same size and material. Follow the procedure in paragraph 8.2, steps 8 through 15.

8.2 Transition Replacement

Step 1

Score the transition lengthwise along each leg with a thermal knife (Figure 8-2) (See Tool Appendix).

- Take care not to cut through the transition and into the cable jacket.

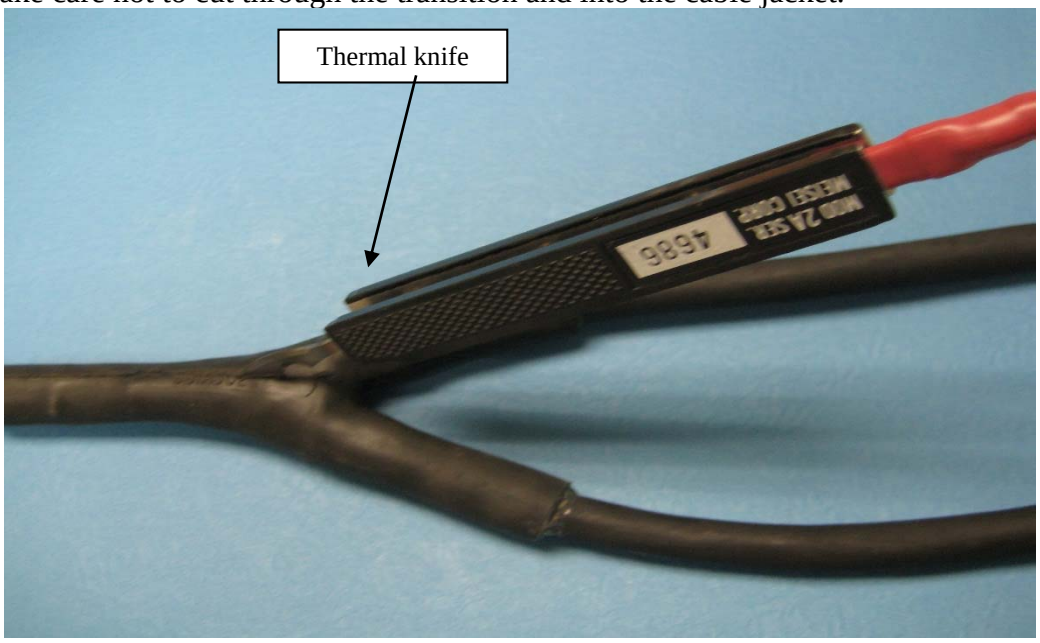


Figure 8-2

Step 2

Heat the transition until it is warm to touch and becomes flexible (Figure 8-3).

- Use a ThermoGun hot air heater with a reflector to encircle the transition (See Tool Appendix).

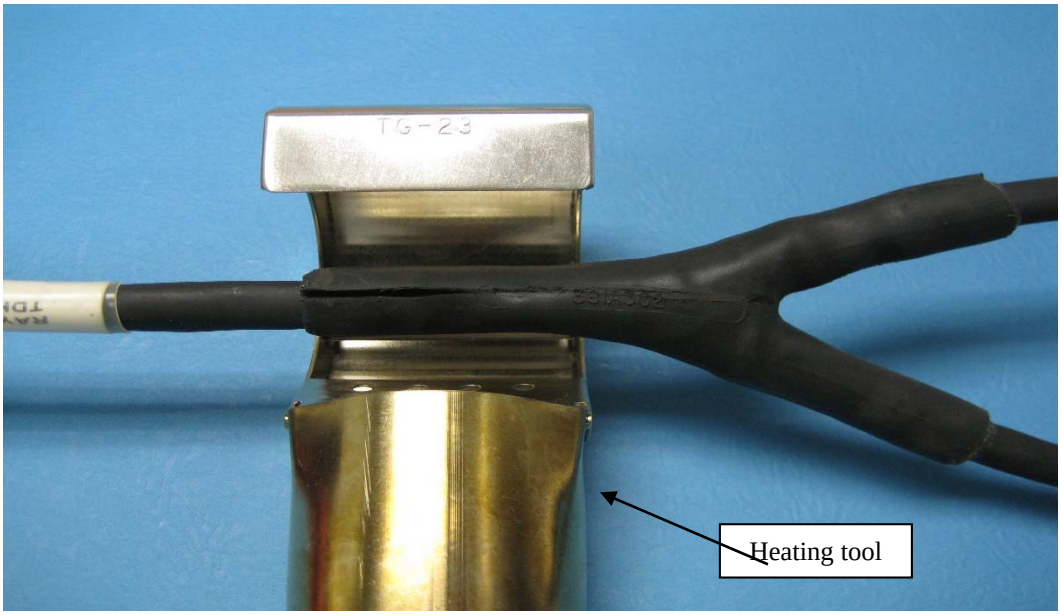


Figure 8-3

Step 3

Use pliers to peel the warm transition off the cable (Figure 8-4).

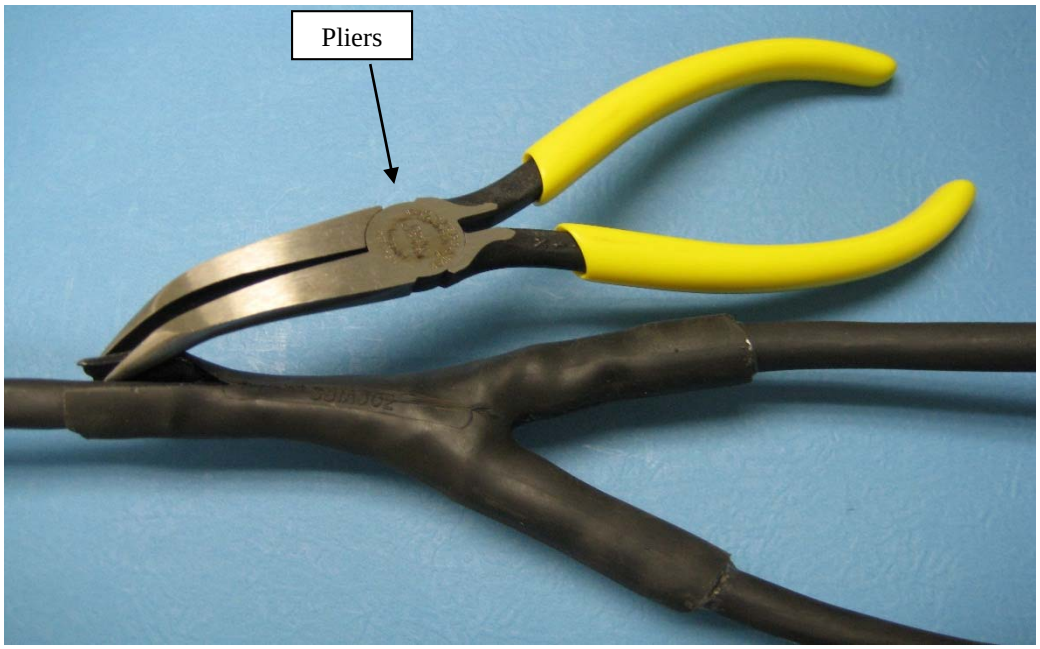


Figure 8-4

Step 4
Inspect for shield and component wire damage and perform following electrical tests:
a. Circuit continuity per applicable revision of harness drawing.
b. Insulation resistance (IR) of component wires.
c. Shield-to-wire insulation resistance.
d. Shell-to-shell DC resistance.

Step 5
Repair any shield damage per section 6.0.

Repair any wire damage per section 7.0.

Step 6
Abrade the surfaces to be bonded (jacket and transition) using #320 emery cloth.

Step 7
Wipe loose particles from the abraded surfaces with clean cloth or tissue.

Step 8
Degrease the abraded surfaces of transition and jacket using disposable wipers wet with Isopropyl Alcohol (IPA).

Step 9
If the harness is shielded, make sure that the shield in the transition area is smooth and uniform with no frayed ends which could cause the new transition to split (Figure 8-5).

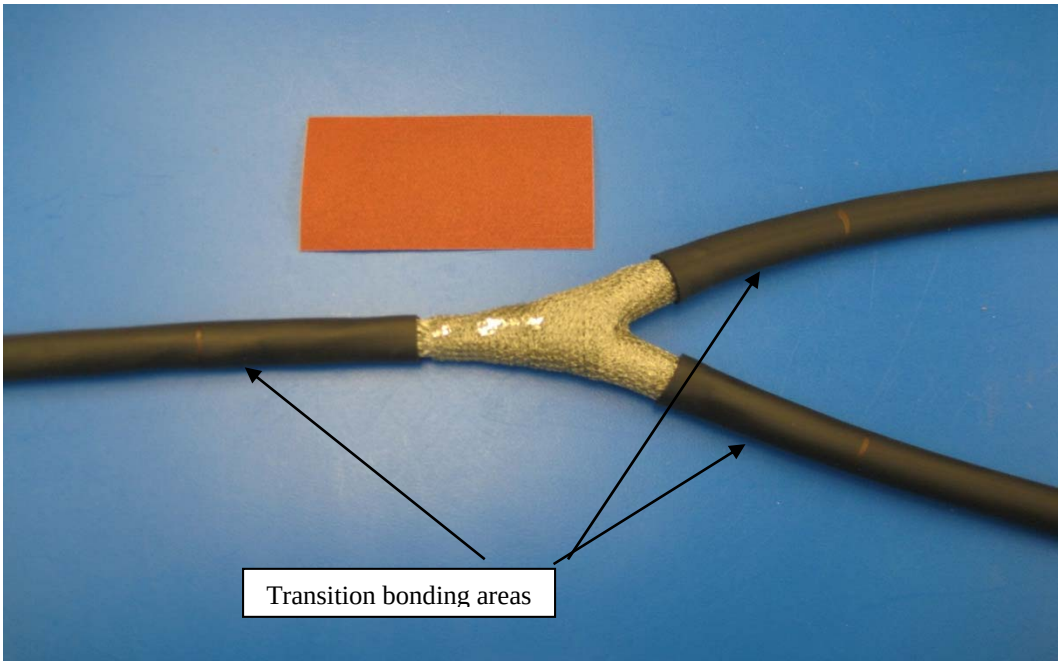


Figure 8-5

Step 10
Slide the new transition onto the harness so that the breakout occurs within the transition (Figure 8-6).

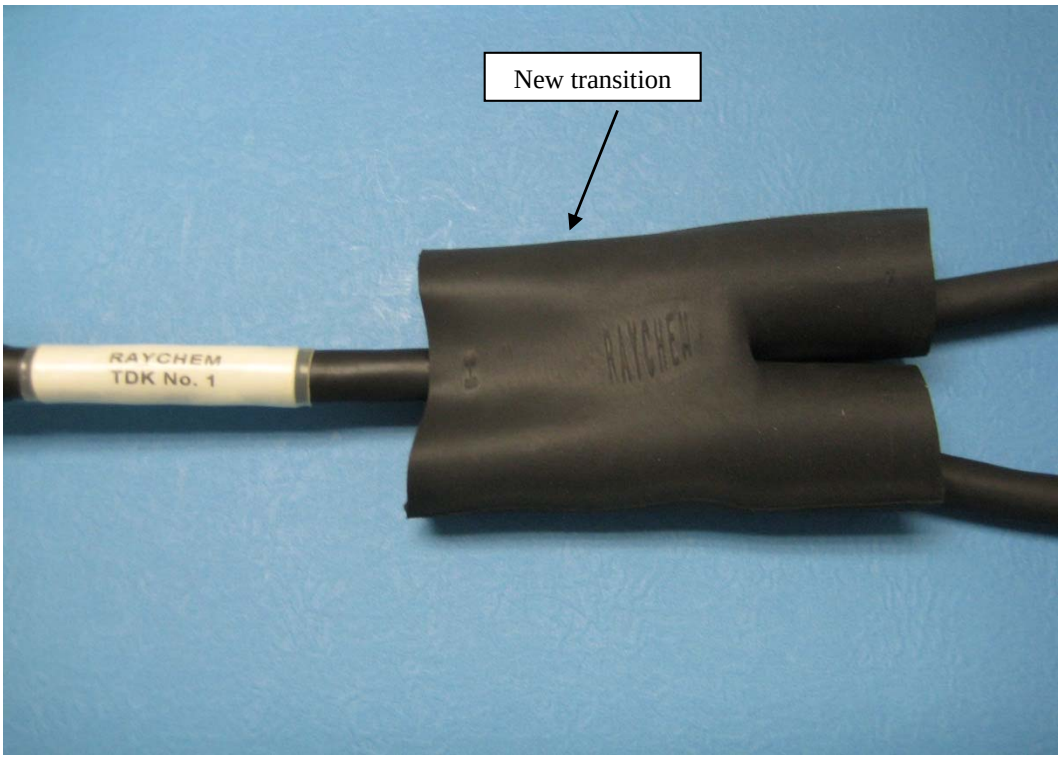


Figure 8-6

- Leave the connectors in place if possible. If a connector or boot is too large to permit the transition to pass over it, remove the connector (Paragraph 2.2) and boot (Paragraph 3.1) as required.

Step 11
Shrink the center section of transition in place leaving the adhesive leg areas expanded. Adjust the center of transition snugly in the crotch as it recovers and align its seams so that the seams will become straight lines when the transition fully recovers (Figure 8-7) (See Tool Appendix).

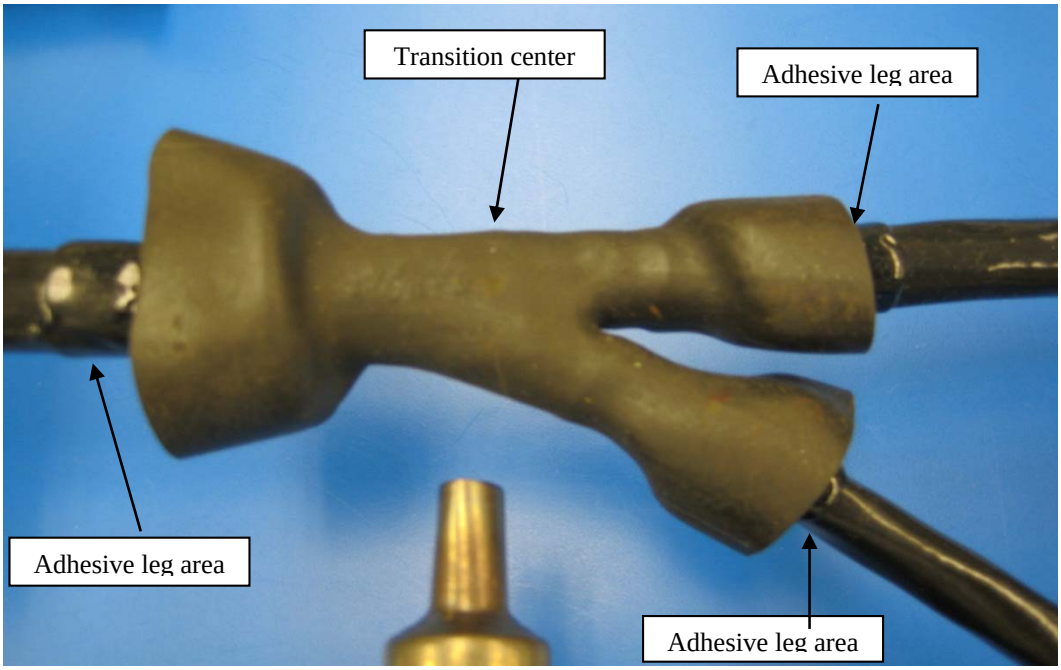


Figure 8-7

Step 12
Clean excess adhesive from each end of the transition.

- For hot melt adhesive use a wooden paddle or equivalent.
- For thermosetting (epoxy) adhesive use cloth or tissue.

Step 13
If connectors or boots were removed to permit transition installation, re-install connectors (Paragraph 2.2) and boot (Paragraph 3.2) as required.

Step 14
Cure the adhesive according to the instructions for the adhesive used.

- The bond line must not be moved or stressed during the cure time.

Step 15
Test per following procedures:

a. Insulation resistance (IR) of component wires.

b. Shield-to-wire insulation resistance (500 Mega-Ohms, min.).

9.0 Adhesive Bonded Joint Repair

The joints where boots and transitions are bonded to cable jackets require repair if there is any gap visible at the interface.

Step 1
Wipe off any dirt, oil or grease in the area to be repaired.

Step 2
If oil or grease is present or suspected, clean area to be bonded with disposable wipers wet with Isopropyl Alcohol (IPA), and allow to dry for at least five minutes.

Step 3
Use an applicator stick to work adhesive into the space between the jacket and boot or transition (Figure 9-1).

- Refer to Table 3-2 for adhesive selection.

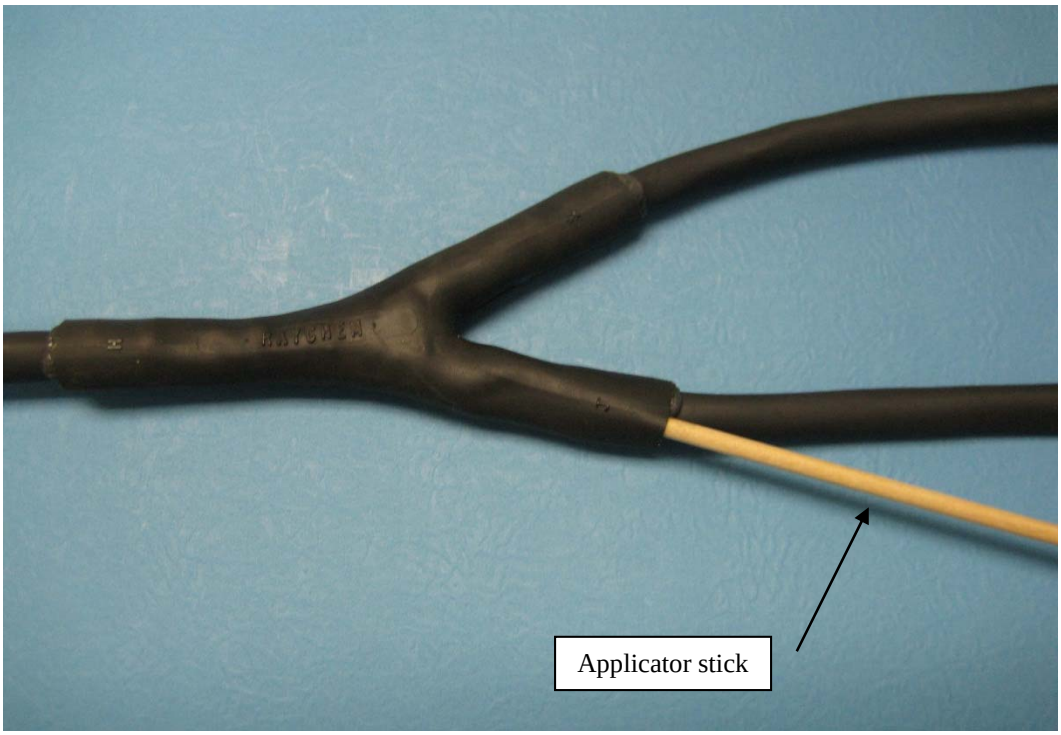


Figure 9-1

Step 4
Heat the bond area using a ThermoGun heating tool to make sure that the boot or transition is shrunk fully onto the jacket (See Tool Appendix).

Step 5
Clean excess adhesive from the area.

- For hot melt adhesive use a wooden paddle or equivalent.
- For thermosetting (epoxy) adhesive use clean cloth or tissue.

Step 6
Cure the adhesive according to the instructions for the adhesive used.

- The bond line must not be moved or stressed during the cure time.

*

* *

Appendix

Appendix A: List of Tools

Connector pliers	Bendix Model 11-6147-1 or equivalent
Crimp tool for Mini-Seal splices	Raychem Model AD-1377
Thermal knife	HOTnife thermal knife, Model 2A, Meisei Corporation
CV-1983	Thermo Gun hot air heating tool
TG-23	Reflector for boots and transitions up to 1.75 inch diameter
TG-24	Reflector for boots and transitions up to 3 inch diameter
AD-1962	Reflector & Adapter for medium and large transitions
Steinel HL 1802E	ThermoGun hot air heating tool
HL1802E-074616	SolderSleeve reflector
HL1802E-070519	Tubing reflector
HL1802E-070618	9-mm diameter reduction nozzle
IR-550	Infrared heating tool

Repair holding fixtures for SolderTacts contacts

SolderTacts Contact Part Number	Fixture Number
D-602-07	AD-1485
D-602-08	AD-1485
D-602-12	AD-1485
D-602-13	AD-1485
D-602-16	AD-1508
D-602-17	AD-1508
D-602-18	AD-1481
D-602-19	AD-1481
D-602-28	AD-1481
D-602-29	AD-1481
D-602-38	AD-1481
D-602-39	AD-1481
D-602-54	AD-1480
D-602-55	AD-1480
D-602-44	AD-1480
D-602-45	AD-1480
D-602-0094	AD-1494
D-602-0095	AD-1494
D-602-0104	AD-1494
D-602-0105	AD-1494
D-602-0106	AD-1494
D-602-0107	AD-1494

Appendix B: Glossary of Terms

Adapter	(Also “backshell adapter”) Connector backshell used to attach heat-shrinkable boot to rear of connector.
Boot, heat-shrinkable	Molded component used at rear of connector to provide sealing, protection, and strain relief.
Bulbous boots	Boots which provide considerable room behind a connector for shield bussing, termination or potting. Typically used in ground vehicles, ground support equipment, in shipboard equipment, and over bulky terminations. Boots are available in straight and right-angle shapes.
Low Profile boots	Boots which provide minimum bulk with maximum strain relief. They do not normally provide space behind the connector for bussing or termination. Typically used in airborne applications and wherever space is critical. Boots are available in straight and right-angle shapes.
Uni-boots	Flexible boots which can be formed to a desired angle of entry during installation. When reheated, a Uni-boot can easily be pulled back from the connector for making wire modifications and repairs. Typically used to provide easy repair ability with shielded adapters and shielded cables. To provide adequate strain relief, Uni-boots must be used with either a terminated shield or strain-relief tape. They are never potted.
Thermal knife	Electrically heated blade used to score heat-shrinkable materials prior to removal and disassembly.
Thermal stripper	Electrically heated wire stripper used to remove insulation without damage to conductor.
ThermoGun	Hot air heating tool is used for installing and removing heat-shrinkable molded parts and tubing.
Transition, heat-shrinkable	Elastomeric molded component used to form junctions and breakouts in harnesses, and to provide sealing, protection, and strain relief.

Note:

*Surface preparation:
The surface preparation is based on ASTM D 2671-09, Paragraph 100.2.1 and 100.2.2. This standard has been approved for use by agencies of the Department of Defense.
Light surface abrasion is recommended whenever possible, because it promotes good cleaning and it increases the surface area for bonding. A final surface wipe with acetone or Isopropyl Alcohol (IPA) is also useful.
Some cleaning techniques may provide better results than others. Users should determine the best techniques for their particular applications.

Disclaimer:

All of the present information, including drawings, illustrations, and graphic designs reflects our present understanding and is believed to be correct and reliable.

Users, however, should independently evaluate the suitability of each product for the designed application. Under no circumstances does this constitute an assurance of any particular quality or performance. Such an assurance is only provided in the context of our product specifications or explicit contractual arrangements. Our liability for these products is set forth in our standard terms and conditions.