

SECTION 2

CHAPTER 3

PREPARING WIRE AND CABLE

INTRODUCTION

1. Before wire and cable can be installed in aircraft and connected to components it must be prepared by cutting to the appropriate lengths and preparing the wire ends for attachment to connectors, terminal lugs or solder splices, etc.

CUTTING WIRE AND CABLE

General

2. Cut all wires and cables to lengths given on drawings or wiring diagrams. Cut wire and cable so that cut is clean and square and wire is not deformed (refer Figure 3-1). After cutting, reshape large diameter wire with pliers, if necessary.



MAKE SURE THAT BLADES OF CUTTING TOOLS ARE SHARP AND FREE FROM NICKS. A DULL BLADE WILL DEFORM AND EXTRUDE WIRE ENDS.

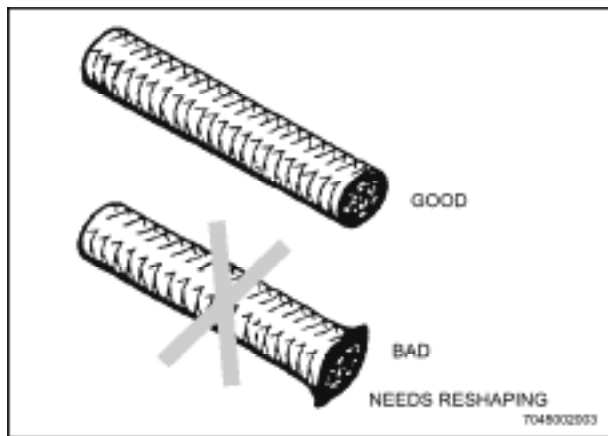


Figure 3-1 Wires After Cutting

Cutting Copper Wire and Cable

3. To cut heavy gauge copper wires or cables, use a fine tooth hacksaw. A fine tooth hacksaw has 20 or more teeth per inch. See Figure 3-2 Wire Cutting Tools for use of hack saw and saw vice which protects heavy wire during cutting. Heavy or light copper wires can also be cut with bench shears.

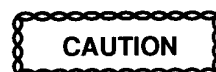
4. To cut a few light gauge copper wires, use diagonal pliers as shown in Figure 3-2. Do not attempt to cut wires larger than AWG-8 with diagonal pliers.

Cutting Aluminium Wire

5. Be careful when cutting aluminium wire to avoid deforming the conductors. Aluminium wire is more brittle than copper, and if deformed, aluminium wire should be reshaped carefully.



NEVER CUT ALUMINIUM WIRE WITH TOOLS THAT HAVE RECIPROCATING MOTION, SUCH AS A HACK SAW. RECIPROCATING CUTTING ACTION "WORK HARDENS" ALUMINIUM. THIS WILL LEAD TO BROKEN AND TORN STRANDS.



IF CUTTING TOOL HAS BEEN USED FOR OTHER METALS, WIPE BLADES CLEAN BEFORE CUTTING ALUMINIUM. COPPER OR STEEL CHIPS WILL CAUSE ALUMINIUM TO CORRODE.

6. Special cable shears with concave cutting edges such as pruning shears may also be used to cut aluminium wire.

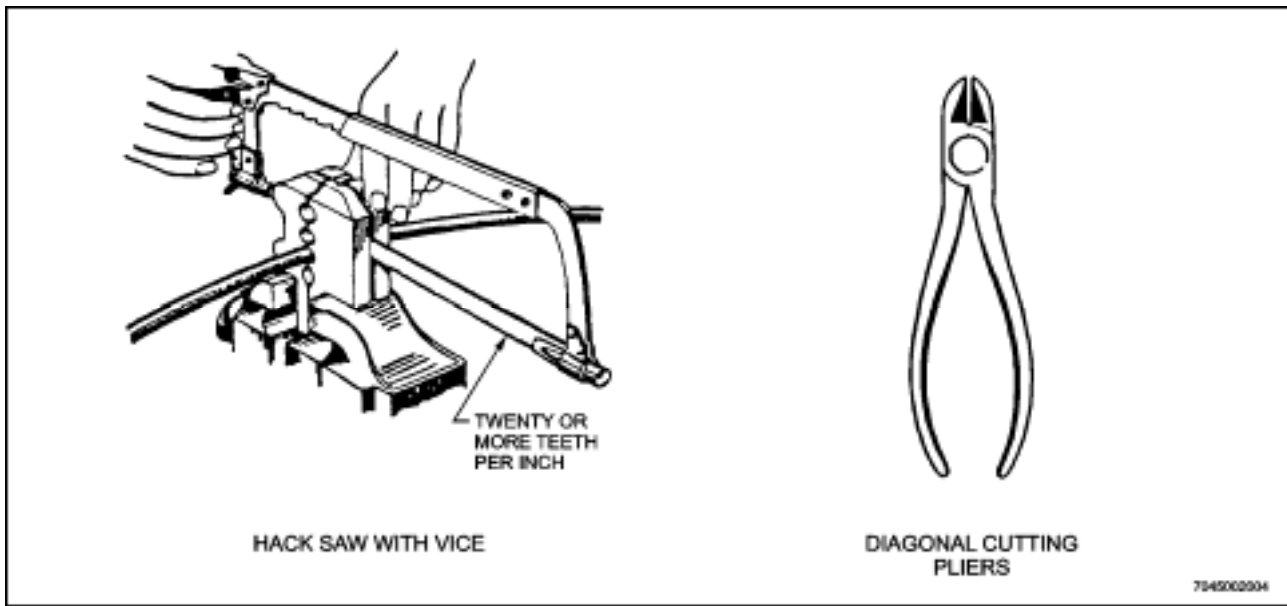


Figure 3-2 Wire Cutting Tools

STRIPPING WIRE AND CABLE

7. Before wire can be assembled to connectors, terminals, splices, etc, the insulation must be stripped from connecting ends to expose the bare conductor. For attachment to solder type connectors, enough insulation must be stripped so that the conductor will bottom in the solder cup and leave a small gap between the top of the solder cup and cut end of the insulation. Stripping dimensions for MS connectors are found in Section 2, Chapter 10, for RF connectors in Section 2, Chapter 12, and for terminals in Section 2, Chapter 6.

Stripping Methods for Copper Wire

8. Copper wire may be stripped in a number of ways depending on size and insulation.

Stripping Methods for Aluminium Wire

9. Strip aluminium wires very carefully. Take extreme care not to nick aluminium wire as strands break very easily when nicked.

General Stripping Instructions

10. When stripping wire observe the following precautions:

- a. When using a hot blade stripper, make sure blades are clean. Clean blades with a brass wire brush as necessary. The hot blade stripper will not strip wire with glass braid or asbestos insulation.
- b. Make sure all stripping blades are sharp and free from nicks, dents, etc.

- c. When using any type of wire stripper, hold wire perpendicular to cutting blades.
- d. Adjust automatic stripping tools carefully. Follow manufacturer's instructions to avoid nicking, cutting, or otherwise damaging any strands. This is especially important for all aluminium wires and for copper wires smaller than No 10. Examine stripped wires for damage and adjust tool as necessary. Cut off and restrip (if length is sufficient); or reject and replace any wires with more than the allowable number of nicked or broken strands given in Table 3-1.

NOTE

Longitudinal scratches in copper wire are not considered cause for rejection or rework.

Table 3-1 Allowable Nicked or Broken Strands

Wire Size (AWG)	Nicked or Broken Strands
Copper	
22 - 12	None
10	2
8 - 4	4
2 - 0	12
Aluminium, all sizes	None

- e. Ensure insulation is clean-cut with no frayed or ragged edges. Trim if necessary.

- f. Ensure all insulation is removed from stripped area. Some types of wires are supplied with a transparent layer between the conductor and primary insulation. If this is present, remove it.
- g. When using hand plier strippers to remove lengths of insulation longer than 19mm, it is easier to do in two or more operations.
- h. Retwist copper strands by hand or with pliers if necessary to restore natural lay and tightness of strands.
- i. Precision hand pliers have die type blades that are designed for a specific insulation wall thickness and type of conductor. Table 3-2 lists manufacturers part numbers for one acceptable model. Equivalent tools may be used.



DUE TO THE DIFFERENCES IN THE DIAMETER OF "GENERAL PURPOSE" AND "SMALL DIAMETER" CONDUCTORS, THE BLADE SET USED SHOULD BE THE ONE SPECIFIED FOR THE WIRE BEING STRIPPED.

- j. **Precision Blade Wear** - Although these blades are hardened to provide long life, they will wear in time. When the blade no longer provides a satisfactory removal of insulation when used with the correct size and type of wire, it should be replaced.
- k. **Cleaning Wire Gripping Surfaces of Precision Tools** - Wire gripping surfaces on precision strippers can become loaded with insulating material in time. This condition causes the wire to slip in the grippers and results in an unsatisfactory strip. Clean these gripping surfaces with a stiff brush as needed.
- l. **Wire Cutters** - Shear type wire cutters (PN 45-123 or equivalent) are recommended for cutting wire prior to stripping. Standard diagonal cutting pliers will crush and deform the ends of the conductors and increase the force necessary to slide the slug of insulation off the wire. Smooth cut round ends are also easy to insert into the crimp wells of terminals and contacts.



ENSURE ADEQUATE VENTILATION IS PROVIDED WHEN A HOT-BLADE STRIPPER IS USED TO STRIP TFE-INSULATED WIRE.

Stripping Wire with Hot-Blade Stripper

11. The procedure for stripping a wire with a hot-blade stripper is as follows:

- a. Adjust blades to correct opening for size of wire to be stripped.
- b. Adjust stop by means of knurled brass nut on top of hood for desired stripping length between 6.5 and 38mm.
- c. Adjust each blade to proper heat by testing on sample pieces of wire. Use minimum heat that will remove insulation satisfactorily without damaging strands.
- d. Insert wire until it butts against stop.
- e. Press foot pedal to bring heated blades against insulation.
- f. Twist wire with lay of strands about 90 degrees and pull out.

Stripping Kapton Wire with a Hand Stripper

12. The procedure for stripping Kapton wire or cable with a hand stripper is as follows (see Figure 3-3):

- a. Insert wire into exact centre of correct cutting slot for wire size to be stripped. (Each slot is marked with wire size).
- b. Close handles together as far as they will go.
- c. Partially release handles so that the jaws of the stripper remain open and the blades and gripper pads also open to permit removal of the wire.
- d. Remove stripped wire.
- e. Continue to release handles so that the jaws snap closed and the stripper is ready to use again.

NOTE

When the handles are partially released, the stripper jaws remain open so the wire can be removed without kinking the conductor. (refer to Fig 3-3, step c).

Table 3–2 Identification of Precision Stripper and Blades

Wire Stripper Identification			
Wire Type	Gage	Stripper PN	Blade PN
MIL-W-22759 /9,/10 /11,/12, /22,/23 /16,/17,/32, /33,/34,/35, /41,/42,/43 /18,/19 /44,/45,/46	16-26	45-174	L5563
	10-14	45-173	L5562
	16-26	45-1212	L5560
	10-14	45-1611	L5559
	16-26	45-1987	45-1987-1
	10-14	45-1611	45-1611-1
	16-26	45-1551	45-1551-1
	10-14	45-1608	45-1608-1
	16-26	45-1513	45-1513-1
	10-14	45-1611	45-1611-1
MIL-W-81044 /6,/7 /9,/10 /12,/13 /16,/17	16-26	45-171	L5211
	10-14	45-170	L5210
	16-26	45-174	L5563
	10-14	45-173	L5562
	28-30	45-178	L5561
	16-26	45-1513	45-1513-1
	10-14	45-1611	45-1611-1
	16-26	45-1610	45-1610-1
10-14	45-1611	45-1611-1	
MIL-DTL-81381 /1,/2,/5,/6, /7,/8,/9,/10 /3,/4 /11,/12,/13, /14,/22 /17,/18,/19,/20 /21	16-26	45-1551	45-1551-1
	10-14	45-1609	45-1609-1
	16-26	45-1610	L5563
	10-14	45-1611	L5562
	16-26	45-1654	45-1654-1
	10-14	45-1608	45-1608-1
	16-26	45-1672	45-1672-1
	16-26	45-1523	45-1523-1
MIL-C-85485 /5,/6,/7,/8,/9, /10,/11,/12	16-26	45-1924	45-1924-1
	10-14	45-1925	45-1925-1
Wire Wrap	30	45-179	L7625
Solid Wire	24-30	45-169	L9300
General Purpose	26-30	45-172	L5436
	16-26	45-171	L5211
	10-14	45-170	L5210
Note: Specification MIL-W-81381A and the various commercial specifications used for procuring aerospace wire provide for various wall thickness of insulation. The stripper part numbers identify the strippers and blades for each variation.			

Stripping Dimensions for Assembly to Connectors

13. Stripped length of wires that are to be attached to solder-type connectors should be such that when stripped conductor bottoms in solder cup there will be a gap of approximately 0.76mm between the end of the cup and the end of the insulation, for inspection purposes.

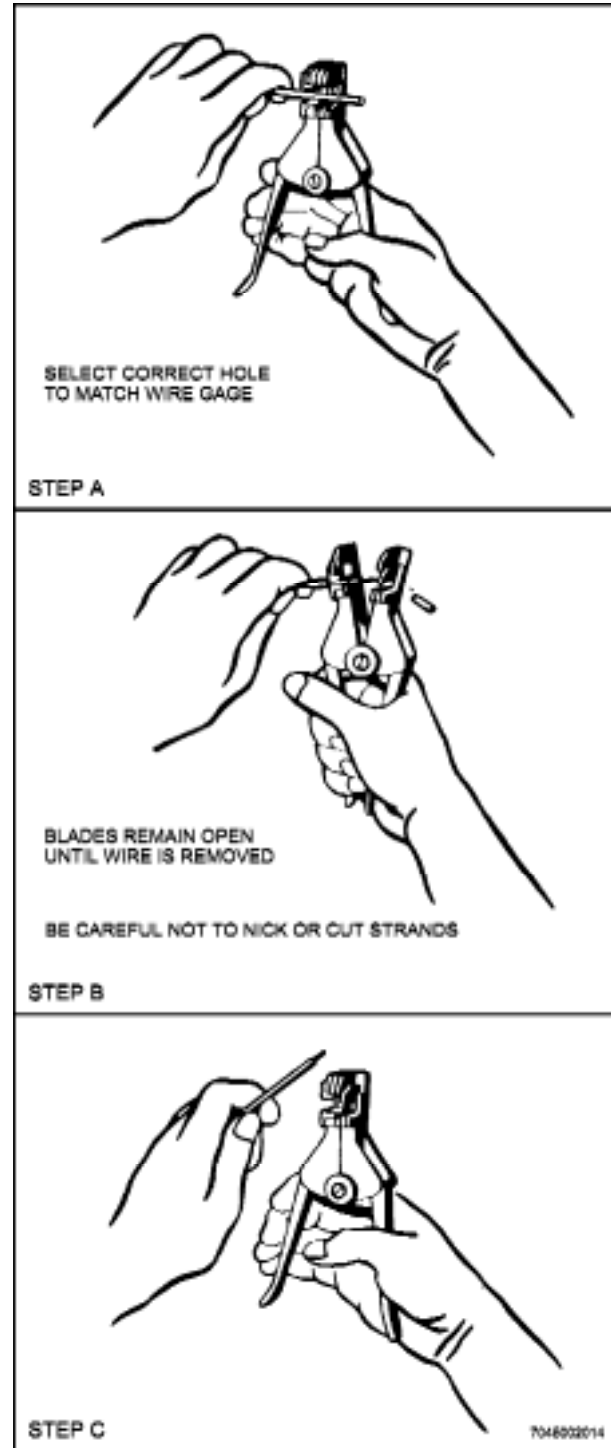


Figure 3–3 Stripping Wire With Hand Stripper

TINNING COPPER WIRE AND CABLE**General**

14. Before copper wires are soldered to connectors, the ends exposed by stripping are tinned to hold the strands solidly together. The tinning operation is considered satisfactory when the ends and sides of the wire strands are fused together with a coat of solder. Do not tin wires which are to be crimped to Class K (fireproof) connectors, wires which are to be attached to solderless terminals or splices, or wires which are to be crimped to removable crimp-style connector contacts.

Tinning Methods

15. Copper wires are usually tinned by dipping into flux and then into a solder bath. In the field, copper wires can be tinned with a soldering iron and rosin core solder.

Extent of Tinning

16. Tin conductor for about half its exposed length. This is enough to take advantage of the closed part of solder cup. Tinning or solder on wire above the cup causes wire to be stiff at point where flexing takes place. This will result in wire breakage.

WARNING

ENSURE ADEQUATE VENTILATION AND EXERCISE CARE WHILE USING A SOLDER POT. SOLDER FUMES ARE TOXIC AND THE HAZARD OF SEVERE BURNS EXISTS.

Flux and Solder

17. The solder used is a mixture of 60% tin and 40% lead. Maintain the temperature of the solder pot between 235°C and 260°C, this will keep solder in a liquid state. Skim surface of solder pot as necessary with a metal spoon or blade to keep the solder clean and free from oxides, dirt, etc.

CAUTION

DO NOT USE ANY OTHER FLUX OR SOLDER FOR TINNING COPPER WIRES FOR USE IN AIRCRAFT ELECTRICAL SYSTEMS.

Dip-Tinning Procedure

18. Dip-tin wires smaller than No. 8 about eight or ten at a time. Dip-tin wires size No. 8 and larger individually. (See Figure 3-4).

CAUTION

DURING TINNING OPERATION, TAKE CARE NOT TO MELT, SCORCH OR BURN THE INSULATION.

19. The procedure for dip tinning is as follows:

- a. Prepare flux and solder as described in paragraph 11.
- b. Ensure that exposed end of wire is clean and free from oil, grease, and dirt. Strands should be straight and parallel. Dirty wire should be re-stripped.
- c. Grasp wire firmly and dip into dish of prepared flux to a depth of about 3mm.
- d. Remove wire and wipe off excess flux.
- e. Immediately dip into molten solder. Dip only half of stripped conductor length into solder.
- f. Manipulate wire slowly in solder bath until it is thoroughly tinned. Watch the solder fuse to the wire. Do not keep the wire in bath longer than necessary.
- g. Remove wire if excess solder is noted and remove excess with solder sucker or equivalent.

NOTE

The thickness of the solder coat depends on the speed with which the wires are handled and the temperature of the solder bath. Never shake or whip wire(s) to remove excess flux or solder.

- c. Move the soldering iron to the opposite side of the wire and tin half of the exposed length of conductor.

Table 3-3 Approximate Soldering Iron Sizes for Tinning

Wire Size (AWG)	Soldering Iron Size (Heat Capacity)
20 - 16	65 Watts
14 & 12	100 Watts

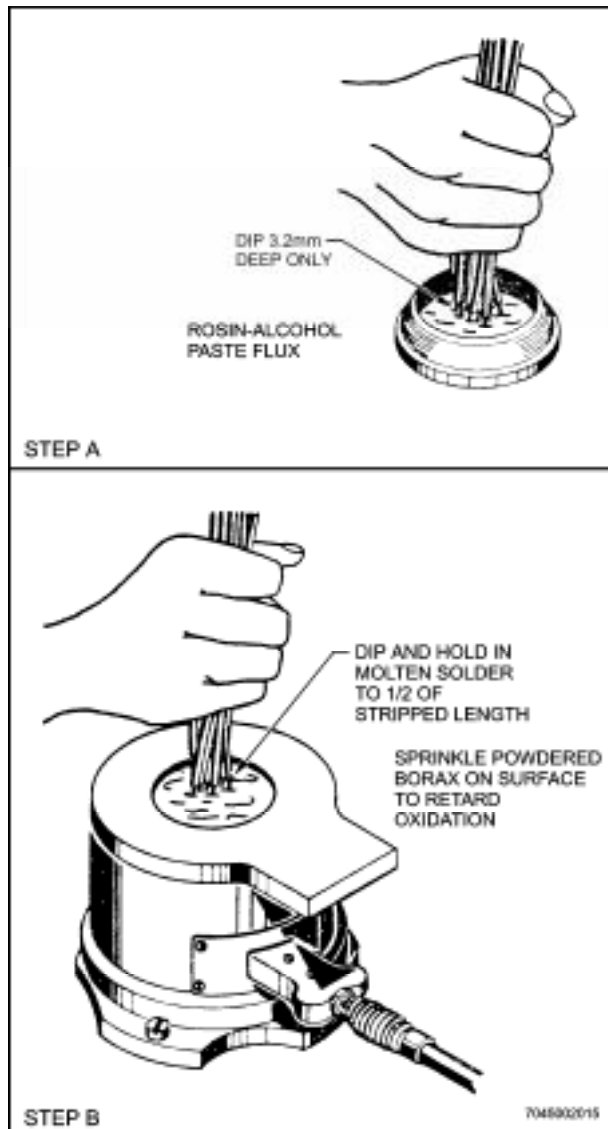


Figure 3-4 Dip-Tinning in Solder Pot

Soldering Iron Tinning Procedure

20. In the field, wires smaller than size No. 10 may be tinned with a soldering iron and rosin-core solder as follows (see Figure 3-5):

- a. Select a soldering iron having suitable heat capacity for wire size as listed in Table 3-3. Make sure that the iron is clean and well tinned.
- b. Prime by holding iron tip and solder together on wire until solder begins to flow.

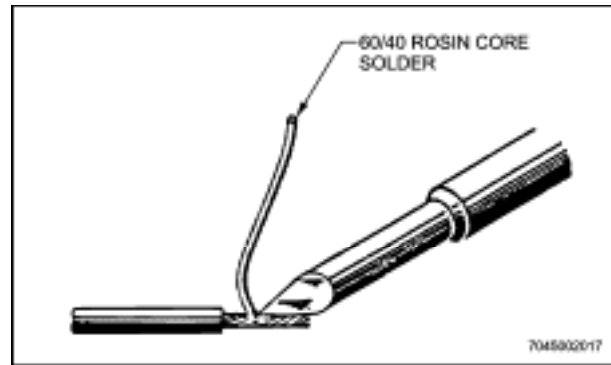


Figure 3-5 Tinning Wire With Soldering Iron

TERMINATING SHIELDED CABLE

General

21. Shielded cable has a metallic braid over the insulation to provide a barrier against electromagnetic interference. To obtain a satisfactory result from shielded cable, the shield must be unbroken and must extend to a point as near to the end of the conductor as practicable. Shielded cable is either grounded or dead-ended at each end as required by the individual installation.

Stripping Jacket on Shielded Cable

22. Most shielded cable has a thin extruded plastic coating over the shielding braid. Strip this off as far as necessary with a hot blade stripper, as described in paragraph 5. The length of the strip depends on the method of shield termination and type of wire connection. Strip the outer jacket back far enough for ease in working. If no hot-blade stripper is available, use plier type hand strippers for sizes No. 22 through No. 10 and a knife for sizes larger than No. 10. Be careful not to damage the shielding braid.

Grounded Shield Termination

23. Grounded shield termination procedure is as follows:

- a. Strip the shielded wire as shown in Figure 3-7.
- b. Comb out the exposed shielding and fold back over the jacket.
- c. Ensure that the shield braid strands are flat and smooth.

NOTE

Solder sleeve terminations consist of a heat shrinkable insulation sleeve with an integral solder preformed with flux and thermal indicator, and two integral rings of sealing material. When the solder sleeve is placed over a cable and heated, the solder melts and flows connecting the ground lead to the shield. The outer sleeve shrinks and the thermoplastic insert melts, encapsulating the termination. The result is a soldered, strain relieved, environmentally protected termination. Solder sleeves are available with or without preinstalled leads.

WARNING

USE ONLY HOT AIR GUN M83521/5-01 OR EQUIVALENT ON FUELLED AIRCRAFT.

WARNING

USE OF NITROGEN WITH HOT AIR GUN M83521/5-01 IN AN ENCLOSED AREA CAN BE HAZARDOUS. ENSURE AREA IS WELL VENTILATED.

CAUTION

SOLDER SLEEVES MAY ONLY BE USED IN AREAS WHERE THE TEMPERATURE DOES NOT EXCEED 150°C.

NOTE

The heat shrinkable solder sleeves listed in Table 3-4 are qualified to SAE AS 83519 and are appropriate for terminating shielded cables, however they should not be used in lieu of alternate methods detailed in specific aircraft maintenance publications, without prior engineering approval.

- d. Measure the diameters "A, B and C" as shown in Figure 3-6.
- e. Select the appropriate size sleeve from Table 3-4.
- f. Position the solder sleeve over the assembly so that the solder ring is centred over the shielding as shown in Figure 3-7.
- g. Install solder sleeves using approved tooling listed in Table 3-5.
- h. Hold assembly horizontal and position sleeve in heat shield.
- i. Rotate assembly while heating to achieve proper solder penetration and uniform sleeve shrinkage. About 10 to 30 seconds are required for complete solder melt and flow.
- j. Continue to apply heat until solder brightens and starts to flow toward the thermoplastic inserts at either end of sleeve.
- k. As soon as the solder flow is observed, withdraw the heat.
- l. When the solder joint has been made, hold the work firmly in place until the joint has set. Disturbing the finished work will result in a joint mechanically weak, and with high electrical resistance. Allow solder joints to cool naturally. Do not use liquids or air blasts.

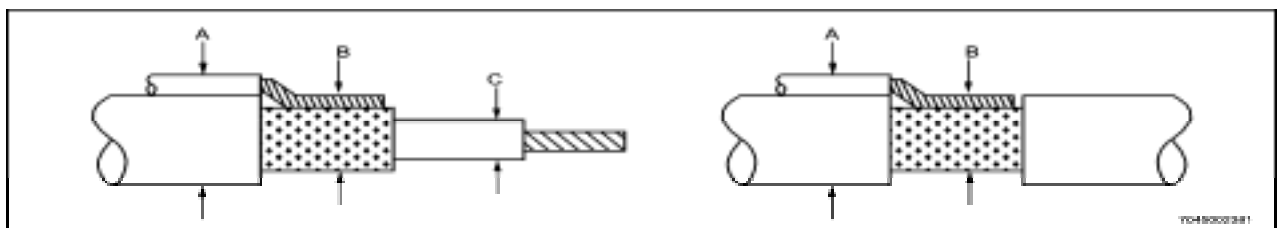


Figure 3-6 Combined Cable Diameter Measurements

**Table 3–4 Heat Shrink Solder Sleeves For Tin and Silver Plated Conductors
(Splice Temperature rating 150°C) Maximum**

Part Number	Gauge of Pre-installed Ground Lead	A Maximum	B Minimum	C Minimum
M83519/1-1	-	2.7	0.9	0.5
M83519/1-2	-	3.7	1.4	0.8
M83519/1-3	-	5.0	2.2	1.3
M83519/1-4	-	6.5	3.3	1.8
M83519/1-5	-	7.6	4.3	2.5
M83519/2-1	20	2.7	0.9	0.5
M83519/2-2	20	3.7	1.4	0.8
M83519/2-3	20	5.0	2.2	1.3
M83519/2-4	20	6.5	3.3	1.8
M83519/2-5	20	7.6	4.3	2.5
M83519/2-6	22	2.7	0.9	0.5
M83519/2-7	22	3.7	1.4	0.8
M83519/2-8	22	5.0	2.2	1.3
M83519/2-9	22	6.5	3.3	1.8
M83519/2-10	22	7.6	4.3	2.5
M83519/2-11	24	2.7	0.9	0.5
M83519/2-12	24	3.7	1.4	0.8
M83519/2-13	24	5.0	2.2	1.3
M83519/2-14	24	6.5	3.3	1.8
M83519/2-15	24	7.6	4.3	2.5
M83519/2-16	26	2.7	0.9	0.5
M83519/2-17	26	3.7	1.4	0.8
M83519/2-18	26	5.0	2.2	1.3
M83519/2-19	26	6.5	3.3	1.8
M83519/2-20	26	7.6	4.3	2.5

NOTE

- All dimensions are in mm.
- When using a sleeve with a pre-installed lead (M83519/2-*), A is the diameter of the cable only.
- C is the minimum diameter on which the sleeve will seal.

Table 3–5 Heat Shrink Tooling

Part Number	Description	Use
M83521/5-01	Heat Gun Electric	Installation of heat shrinkable items on fuelled aircraft.
IR500	Infra-red Heat Gun	Installation of heat shrinkable items in workshops etc.
CV-5302	Hot Air Blower	Installation of heat shrinkable items in workshops etc.
PR13	Heat Reflector	Short lengths of tubing up to 6.4mm diameter and high temperature solder sleeves.
PR24	Heat Reflector	Smaller molded parts and tubing 25 to 40mm diameter.
PR24A	Heat Reflector	Larger molded parts and tubing over 12mm diameter.

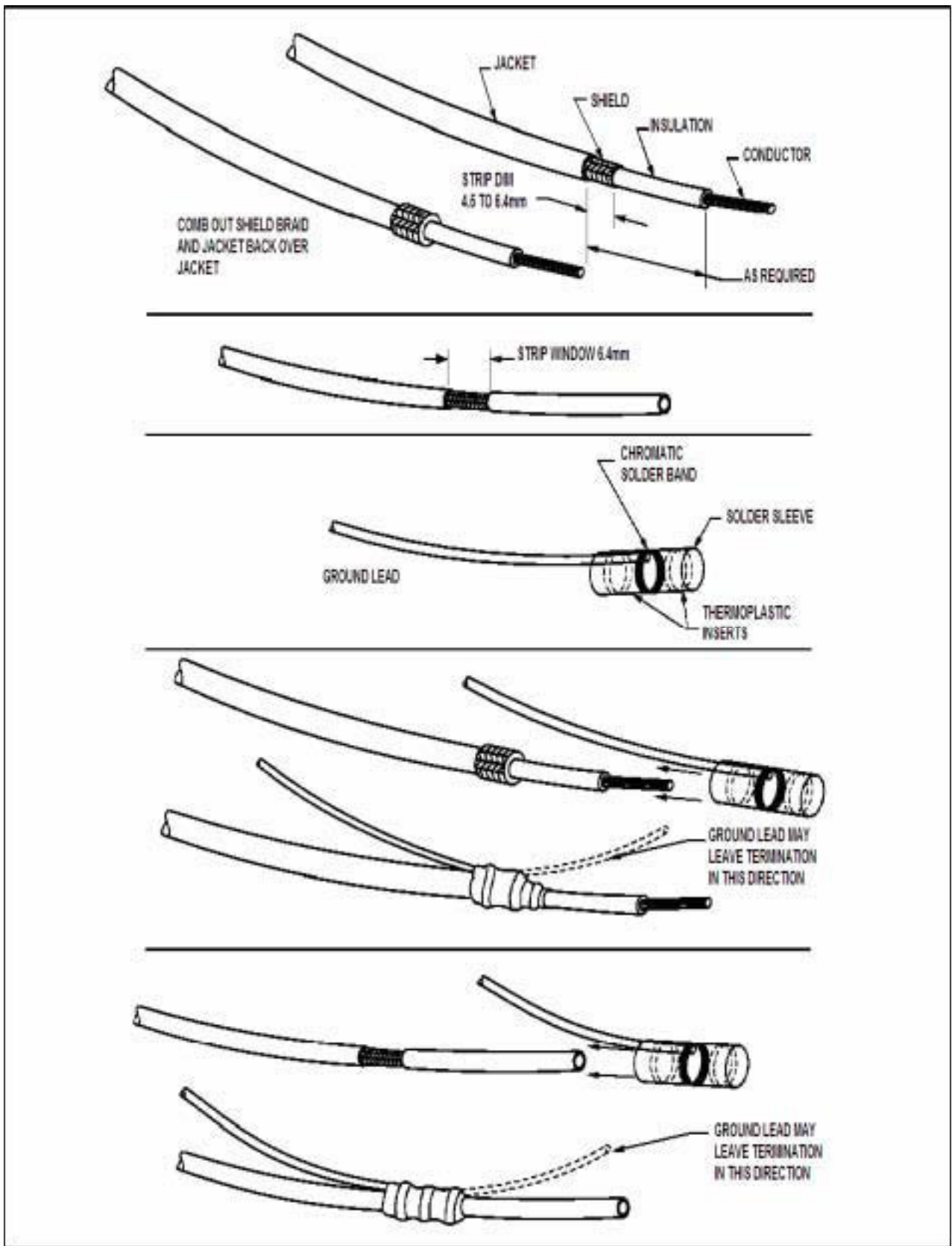


Figure 3-7 Solder Sleeve Shield Termination

Ungrounded (Floating) Shield Termination

24. Ungrounded (floating) shield termination procedure is as follows:

- a. Strip the shielded wire as shown in Figure 3-3.
- b. Comb out the exposed shielding and fold back over the jacket.
- c. Select the appropriate size solder sleeve from Table 3-4.
- d. Make sure that the shield strands are flat and smooth.

WARNING

USE ONLY HOT AIR GUN M83521/5-01 OR EQUIVALENT ON FUELLED AIRCRAFT.

WARNING

USE OF NITROGEN WITH HOT AIR GUN M83521/5-01 IN AN ENCLOSED AREA CAN BE HAZARDOUS. ENSURE AREA IS WELL VENTILATED.



SOLDER SLEEVES MAY ONLY BE USED IN AREAS WHERE THE TEMPERATURE DOES NOT EXCEED 150°C.

- e. Position the solder sleeve over the assembly so that the solder ring is centred over the folded back shielding.
- f. Hold assembly horizontal and position sleeve in heat shield.
- g. Rotate assembly while heating to achieve proper solder penetration and uniform sleeve shrinkage. About 10 to 30 seconds are required for complete solder melt and flow.
- h. Continue to apply heat until solder brightens and starts to flow toward the thermoplastic inserts at either end of sleeve.
- i. As soon as the solder flow is observed, withdraw the heat.
- j. When the solder joint has been made, hold the work firmly in place until the joint has set. Disturbing the finished work will result in a joint mechanically weak, and with high electrical resistance. Allow solder joints to cool naturally. Do not use liquids or air blasts.

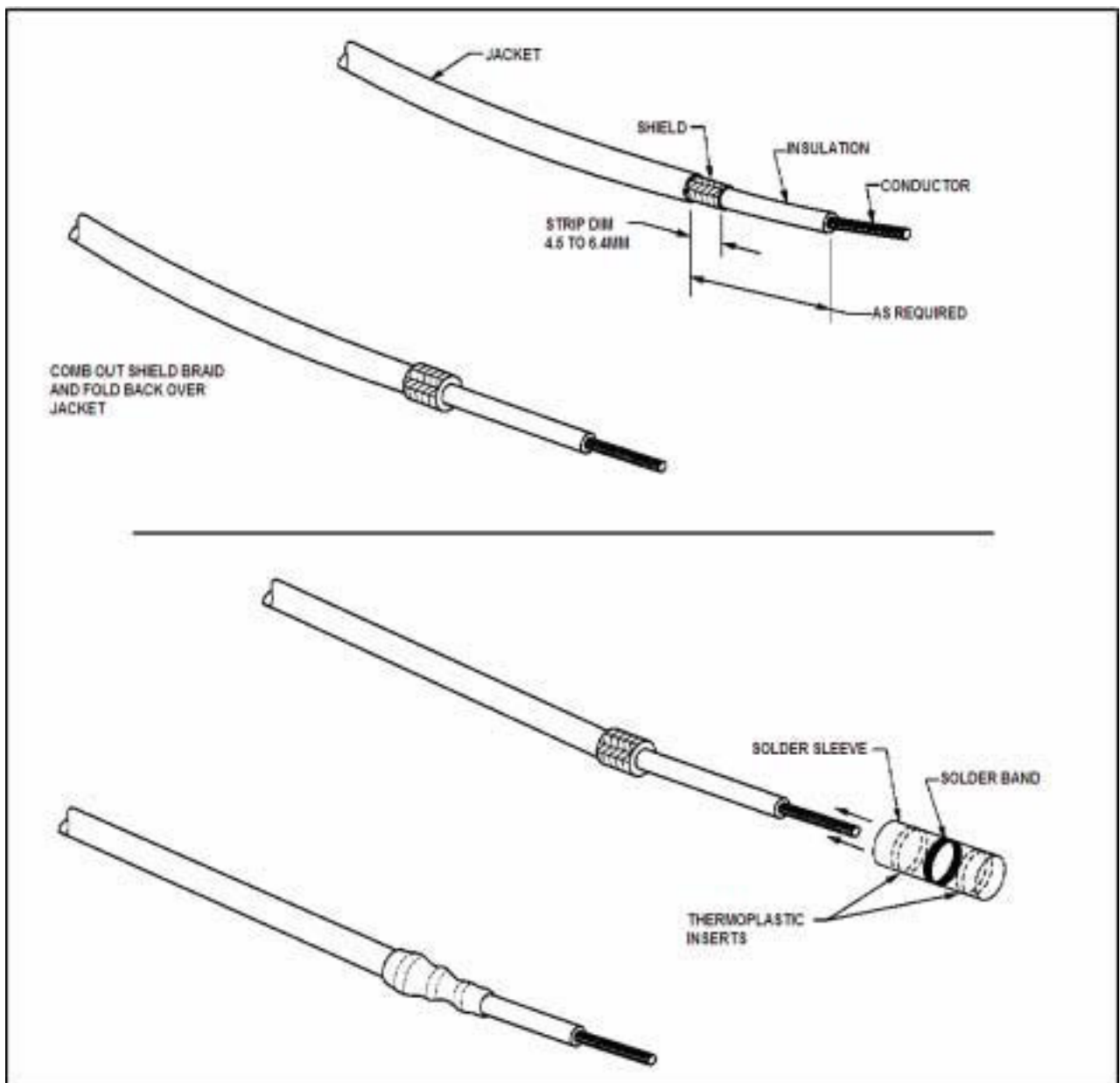


Figure 3-8 Solder Sleeve Floating Shield Termination