

1. INTRODUCTION

This specification covers the application of AMP\* Standard COPALUM\* Terminals and Splices. These ring tongue terminals, butt splices and parallel splices provide reliable, low-cost terminations for both aluminum and aluminum/copper wire combinations. Stranded or solid, round or rectangular conductors falling within a specified CMA (circular mil area) range may be terminated individually or in combinations in the same wire barrel. Also, the same product can be crimped to uninsulated wire using a bar crimp, or to film-insulated wire using an insulation-piercing crimp.

NOTE: All dimensions are given in inches unless otherwise specified.

2. REFERENCE MATERIAL

2.1. AMP Product Specification 108-13013 covers applicable performance requirements.

2.2. The following AMP technical publications contain information on tooling operation, maintenance and inspection.

IS 1310	IS 2353	IS 2397	CM 2426	IS 2456
IS 1410	IS 2366	IS 2424	IS 2432	IS 2458
CM 1950	IS 2393	IS 2425	IS 2433	IS 2465
IS 2352	IS 2394			

Refer to the tables in Section 5 of this document for a complete cross-referencing of tooling to instructional materials, and of tooling to important selection information.

2.3. Customer Drawings for specific products are available from the responsible AMP engineering department. The information on Customer Drawings takes priority if there is a conflict with this specification or with any other technical documentation supplied by AMP Incorporated.

2.4. The Customer Hotline at the top of this page will connect you to an AMP Field Engineering representative. When you call for information, identify the COPALUM product line by the following numbers: REF PART NO. 50720; PRODUCT CODE 3014. The representative will then be able to direct you to people within AMP who are qualified to answer your questions effectively.

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		<b>APPLICATION SPECIFICATION</b>		<b>AMP</b>   AMP INCORPORATED Harrisburg, Pa. 17105	
		ENGINEERING APPROVAL & DATE William J. Vockroth 2/2/88			NO. 114-02121
		PAGE 1 of 9	TITLE STANDARD COPALUM TERMINALS AND SPLICES		
LTR	REVISION RECORD				

### 3. PRODUCT FEATURES

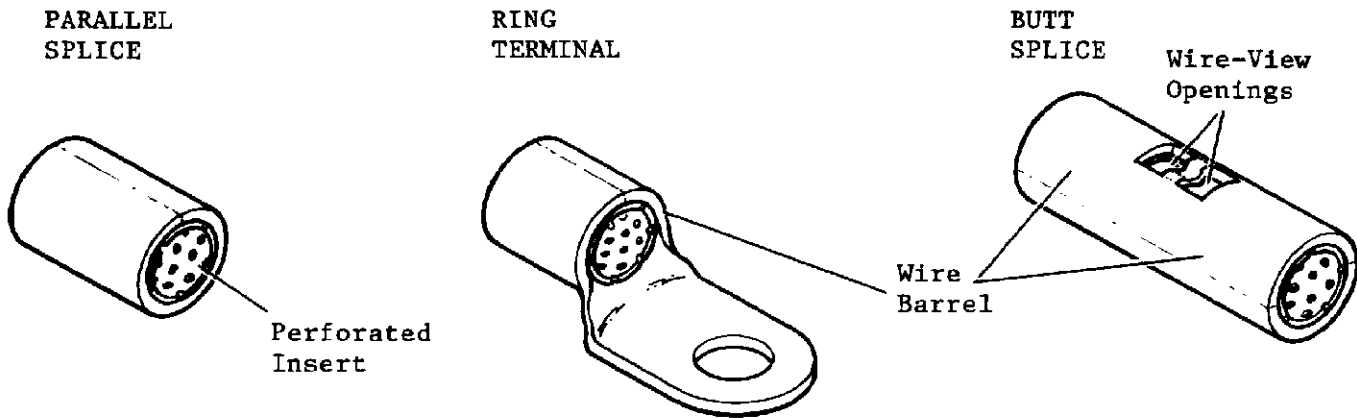


Fig. 1. Product Features

### 4. REQUIREMENTS

4.1. The type of crimp used must be determined by the following set of requirements:

- A. The bar crimp is designed to crimp bare wire only. To crimp insulated or film-insulated wire using the bar crimp, you must first strip the insulation to the appropriate length shown in the following table. Also, the bar crimp may be used to crimp solid or stranded wire in either aluminum/copper combinations or aluminum.

NOTE: When bar-crimping 3 or more rectangular conductors, crimp them on edge. DO NOT crimp them across the widths of the conductors (See Figure 2).

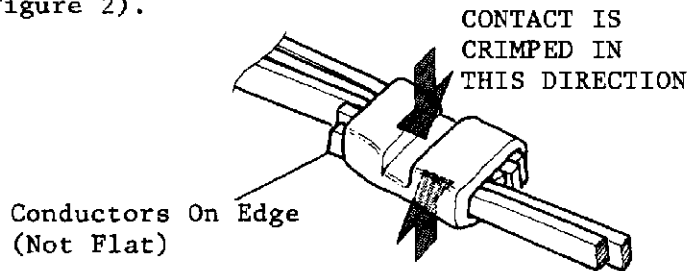


Fig. 2. Crimping 3 or More Rectangular Conductors

When using the bar crimp for aluminum-to-copper applications in butt splices, the copper wire should be one standard wire-gage range smaller than the aluminum wire. This compensates for their different physical properties. For example, use a number 6 aluminum wire with a number 8 copper wire. However, when two or more wires are used in either end of a butt splice, the combined wire CMA in a given wire barrel must be within the specified range listed in the table in Paragraph 4.2.

CONNECTOR MARKING AND ALUMINUM WIRE SIZE	COPPER WIRE SIZE	STRIP LENGTH (NOMINAL)
20-18	22-18	5/16
16-14	18-14	
12-10	14-10	3/8
8	10-8	7/16
6	8-6	
4	6-4	19/32
2	4-2	
1/0	2-1/0	3/4
2/0	1/0-2/0	
3/0	2/0-3/0	
4/0	3/0-4/0	25/32
250 MCM	4/0-250 MCM	1-3/16
300 MCM	250-300 MCM	1-5/16
400 MCM	300-400 MCM	1-7/16
500 MCM	400-500 MCM	1-9/16

- B. The insulation-piercing crimp is designed for use with film-insulated wire only.

CAUTION: Stripping the film insulation is not required. The insulation-piercing crimp is designed for use with unstripped film-insulated wire. Crimp bare wire only with the bar crimp. Otherwise, the result will not comply with UL standards and may cause a fire hazard.

Use the insulation-piercing crimp only with solid copper or aluminum wire, or stranded copper wire.

NOTE: DO NOT crimp stranded aluminum wire using the insulation-piercing crimp.

Also, the following rules apply, as appropriate, to the crimping of wires by the insulation-piercing method (the letter references in parentheses refer to the corresponding view in Figure 3):

1. In a solid aluminum to stranded copper application, the CMA of the copper conductors should be 40% or less of the combined wire CMA being crimped. (A)
2. No more than 10 equal-size round (B) or 6 equal-size square (C) conductors may be crimped in the same wire barrel.
3. If "T" equals thickness and "W" equals width, 4 identical rectangular conductors (D) where  $T \geq 1/4 W$  or 2 identical rectangular conductors (E) where  $T \leq 1/4 W$  may be crimped in the same wire barrel.
4. Certain combinations of wire sizes and shapes may not physically fit into the recommended terminal or splice, even though the combined wire CMA suggests a proper wire barrel load. In these cases where 7 or more equal round conductors or a solid-aluminum/stranded-copper combination is used, the next larger size terminal or splice may be used with the proper

corresponding tooling. However, the combined wire CMA MUST be at least 50% of the maximum CMA rating for the larger connector.

5. For magnet wire applications, crimp no more than 10 magnet wires (without lead wire) in one wire barrel. Use a parallel splice for applications where the lead wire CMA is less than the combined magnet wire CMA and there are less than 6 conductors total. Use a butt splice when the lead wire CMA is equal to or greater than the combined magnet wire CMA.
  
6. When crimping different-size solid conductors, size should never vary by more than one standard wire-gage range; and preferably not by more than one-half standard wire-gage range. Look at the table in Paragraph 4.1.A. of this specification for example; when using a number 18 aluminum wire a number 22 copper wire is acceptable, but a number 20 copper wire is preferred.

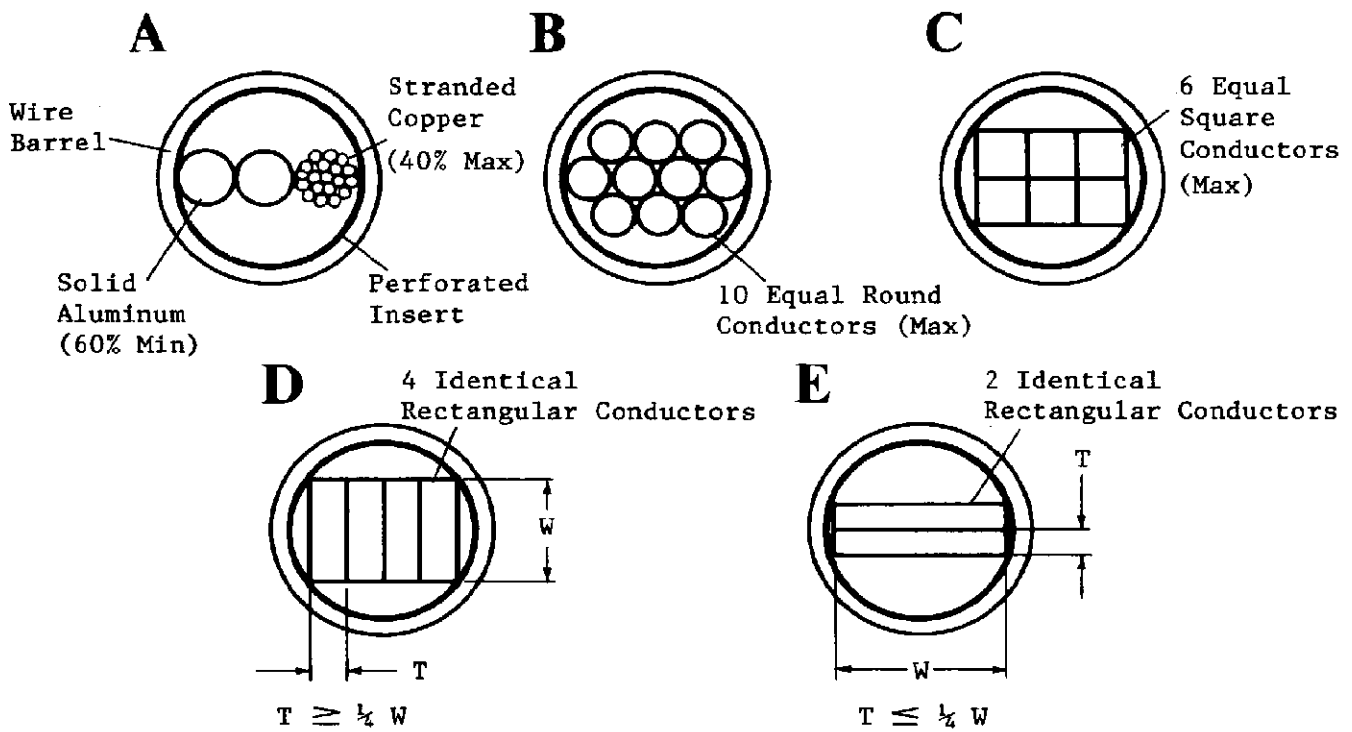


Fig. 3. Wire Loading for Insulation Piercing Crimping

4.2. CMA is the major determining factor in selecting a wire loading for a specific COPALUM product. The following table compares standard wire-gage ranges to the CMA ranges of copper wire and aluminum wire.

ALUMINUM		COPPER	
WIRE SIZE	CMA RANGE	WIRE SIZE	CMA RANGE
20 - 18	810 - 2,050	22 - 20	509 - 1,290
16 - 14	2,050 - 5,180	18 - 16	1,290 - 3,260
12 - 10	5,180 - 13,100	14 - 12	3,260 - 8,230
8	13,100 - 20,800	12 - 10	5,180 - 13,100
6	20,800 - 33,100	8	13,100 - 20,800
4	33,100 - 52,600	6	20,800 - 33,100
2	52,600 - 83,700	4	33,100 - 52,600
1/0	83,700 - 119,500	2	52,600 - 83,700
2/0	119,500 - 150,500	1/0	83,700 - 119,500
3/0	150,500 - 190,000	2/0	119,500 - 150,500
4/0	190,000 - 231,000	3/0	150,500 - 190,000
250 MCM	231,000 - 300,000	4/0	190,000 - 231,000
300 MCM	300,000 - 380,000	250 MCM	231,000 - 300,000
400 MCM	380,000 - 478,000	300 MCM	300,000 - 380,000
500 MCM	478,000 - 600,000	400 MCM	380,000 - 478,000

4.3. In most crimping operations for electrical termination products it is important to measure a crimp height on the finished product. But with COPALUM products it is more critical for the tooling to close to the correct measurement. The proper crimping measurements and gaging procedures are given in the instructional material provided with the tooling. Refer to Section 5 of this specification for the instructional material that corresponds to the tooling you wish to use.

4.4 It is important when working with COPALUM products to remember that aluminum wire does not hold up under bending and flexing as well as copper wire.

CAUTION: DO NOT bend aluminum wires more often or more severely than is necessary to position the wires for crimping.

4.5. Before you crimp wires into a COPALUM terminal or splice, it is important to be sure that the wire range stamped on the terminal corresponds to the wire range of the tooling. Also, be sure that the total wire load is within the CMA range specified for the connector you are using.

CAUTION: ALWAYS be certain that the perforated insert is in place before crimping. NEVER remove this perforated insert. Return any COPALUM product that does not have an insert.

4.6. Several connector insulating options are available from AMP for use with COPALUM products. The need for insulation will vary with application.

AMP heat shrink products provide void-free insulation, fitted to the contour of the splice or terminal by applying a controlled heat source. They are thermally

stable and capable of withstanding continuous exposure to a wide range of temperatures. They also provide sound mechanical protection and resist moisture and chemicals. Contact AMP Engineering for proper insulating procedures.

- A. Heat shrink tubing is available in a thin-wall variety with or without sealant, medium-wall or thick-wall flame retardant with sealant, or economy thick-wall with sealant (not self-extinguishing). The shrink ratio for these products is 3 to 1 in all directions, except for the thin-wall-without-sealant variety which has a shrink ratio of 2 to 1.

NOTE: When using heat shrink tubing to cover an in-line wire splice, the tubing must be placed over the wire(s) before the crimping operation is performed.

- B. Insulating tapes may be used if applied liberally so that all exposed connector surfaces and bare wires are completely covered. Heat shrink self-healing (Type 1) tape is available as well as cold shrink (fusion) tape, and Master Electricians Tape. All tapes are rolled with release paper to prevent self-adhesion except for the Master Electricians Tape.
- C. AMP Flameless Heat Gun P/N 600655-1, and Baffle for Flameless Heat Gun P/N 600655-3 are available for applying heat shrink tubing and tape. Flame-exposed heat sources may also be used in applications where flammable materials are not present. However, the Flameless Heat Gun remains the recommended heat source.

## 5. TOOLING TYPES

5.1. Tooling for AMP Standard COPALUM Terminals and Splices can be organized into three general categories:

- A. Hand tools with integral dies are for crimping products in the smaller wire ranges.
- B. Pneumatic tooling with the appropriate crimping head or jaws will crimp small to medium range products.
- C. A Hydraulic power unit with electric controls, and a variety of crimping heads with interchangeable dies are available for crimping medium to large range products.

NOTE: Tooling for the bar crimp technique will mark the product with a square ■; tooling for the insulation-piercing crimp technique will mark the product with a triangle ▲. These designations must be identified on the dies, jaws, or crimping head of the tool before you crimp the product.

5.2. Pneumatic tools 69010 (IS 1410) and 69015 (IS 1310) are equipped with interchangeable crimping heads. Pneumatic tools with base part number 68068 (CM 2426) accept pairs of crimping jaws. The heads and jaws are listed in the tables in Paragraph 5.4. of this specification.

5.3. AMP DYNA-CRIMP\* Electro-Hydraulic Power Units with base number 69120 (CM 1950) will accept Crimping Heads 69099 (IS 2458) and 69082 (IS 2456). The heads accept die sets (see tables in 5.4.)

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5.4. The three tables below provide a complete tooling cross-reference for your convenience. The heads, jaws, and die sets are arranged with the top number representing bar crimp tooling and the bottom number representing insulation-piercing tooling. The first time a specific tool number is listed, the instructional material for that tool is listed in parentheses following the tool number.

HAND TOOLS

WIRE SIZE (Aluminum)	TOOLING
20-18	68040 (IS 2366) 68351-1 (IS 2465)
16-14	68041 (IS 2366) 68140-1 (IS 2465)
12-10	68042 (IS 2366) 68141-1 (IS 2465)

PNEUMATIC TOOLS

WIRE SIZE (Aluminum)	TOOLING		
	69010	69015	68068-[ ]
	HEADS		JAWS
20-18	68029 (IS 2424) 68134 (IS 2432)	- -	- 68118-1 (IS 2393)
16-14	68031 (IS 2424) 68093-1 (IS 2432)	68031 68093-1	68104 (IS 2394) 68100 (IS 2393)
12-10	68030 (IS 2424) 68080 (IS 2432)	68030 68080	68104,68105 (IS 2394) 68100,68101 (IS 2393)
8	68054 (IS 2424) -	68032 (IS 2425) 68081 (IS 2433)	68105 (IS 2394) 68101,68192-1 (IS 2393)
6	- -	69999 (IS 2425) 68082 (IS 2433)	68106 (IS 2394) 68102 (IS 2393)
4	- -	68038 (IS 2425) -	68107 (None) -



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HYDRAULIC TOOLS

WIRE SIZE (Aluminum)	HEADS AND DIE INSERTS FOR 69120	
	HEADS	DIE INSERTS
20-18	69099	- 68134 (IS 2432)
16-14		-
12-10		-
8		68043 (IS 2353) 68084 (IS 2397)
6		68044 (IS 2353) 68085 (IS 2397)
4		68045 (IS 2353) 68086 (IS 2397)
2		68046 (IS 2353) 68130 (IS 2397)
1/0		68047 (IS 2353) 68131 (IS 2397)
2/0		68048 (IS 2353) 68132 (IS 2397)
3/0	69099	68049 (IS 2353) 68133 (IS 2397)
4/0	69082	68050 (IS 2353) 68129 (None)
250 MCM		68034 (IS 2353), 68012 (IS 2352) -
300 MCM		68035 (IS 2353) -
400 MCM		68036 (IS 2353) -
500 MCM	69082	68037 (IS 2353) -

5.5. AMP Pneumatic Tools with base part number 68068, and AMP DYNA-CRIMP Electro-Hydraulic Units with base part number 69120 are available with many accessories and mounting options. For a complete picture of your choices, contact your AMP representative.

6. QUALIFYING SUPPORT

AMP Standard COPALUM Terminals and Splices are UL recognized.



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7. VISUAL AID

Figure 4 shows the conditions that must exist to ensure proper application of AMP Standard COPALUM Terminals and Splices. If your product does not meet these conditions it is not acceptable for use.

**CAUTION:** In ALL cases the perforated insert must be in place BEFORE crimping. DO NOT use any COPALUM product that does not have an insert; but return it to AMP Incorporated.

No Wire Insulation Should Enter The Wire Barrel In Any Jacket Insulation Application

Butt Splice Crimps Should Be Oriented 180° To Each Other To Minimize Bowing

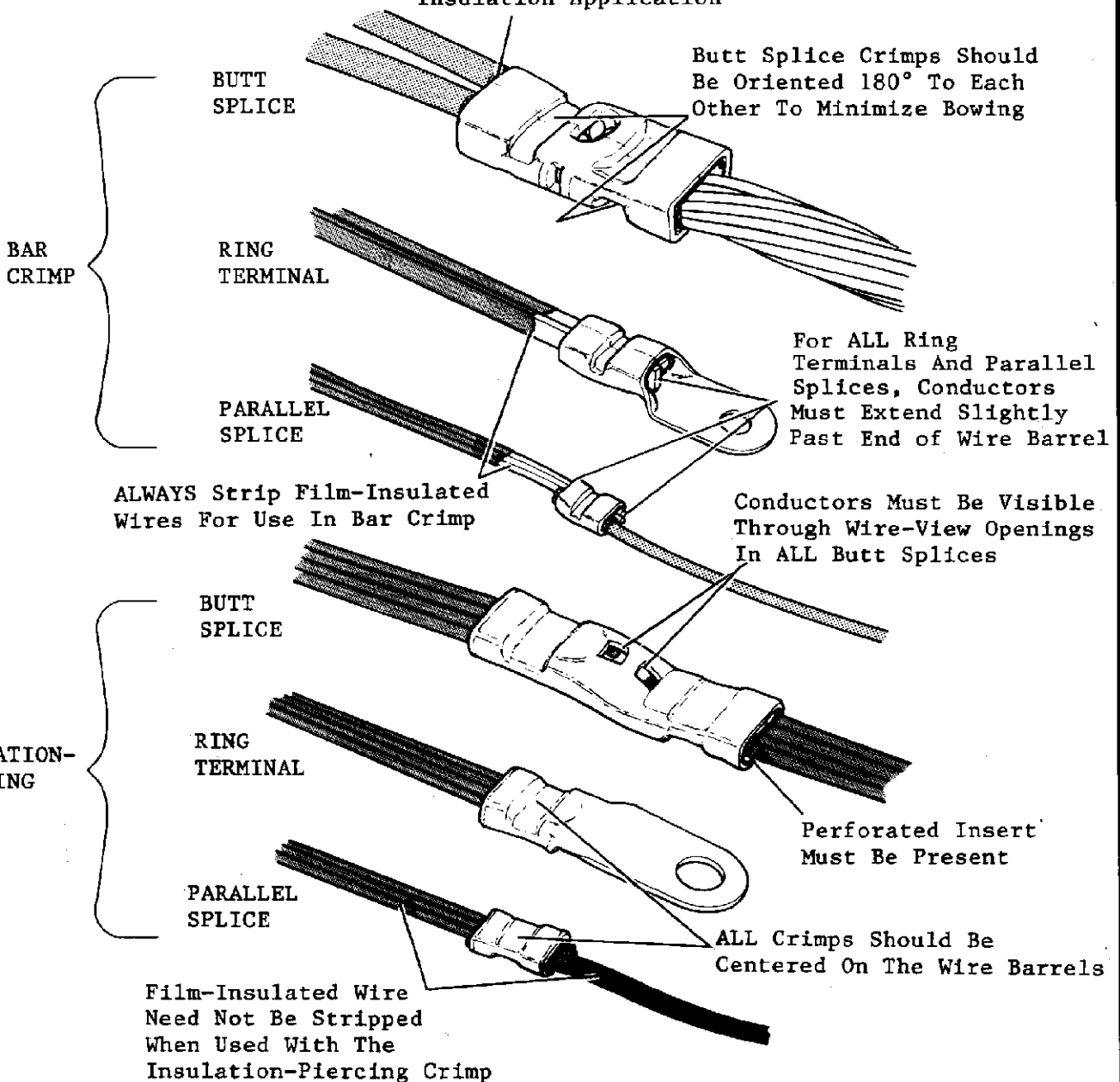


Fig. 4. Visual Aid