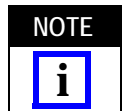




All numerical values are in metric units [with U.S. customary units in brackets]. Dimensions are in millimeters [and inches]. Unless otherwise specified, dimensions have a tolerance of  $\pm 0.13$  [ $\pm .005$ ] and angles have a tolerance of  $\pm 2^\circ$ . Figures and illustrations are for identification only and are not drawn to scale.

## 1. INTRODUCTION

This specification covers the requirements for Flexible Flat Cable (FFC) Housings with contact cavities on 2.54-mm [.100-in.] centers. There are housing designs for connector to connector, connector to printed circuit (pc) board, and card edge applications. The housings are designed for contacts terminated to flat cable with conductors on 2.54-mm [.100-in.] centers which may be solid copper conductor Flat Flexible Cable (FFC), Flat Etched Circuitry (FEC), Flexible Printed Wire (FPW), or conductive ink circuitry cable. The housings will also accept contacts designed for discrete round wire. Contacts can be terminated with hand crimping tools or semi-automatic crimping machines.



For cable with conductors on 1.27-mm [.050-in.] centers, see Application Specification 114-16008.

Refer to Figure 1 for contact and cable features that will be referenced throughout the specification. Use these terms when corresponding with TE Connectivity Personnel to facilitate assistance. The illustrations show individual components that, when assembled, become a connector. Mating connectors become a connector assembly.

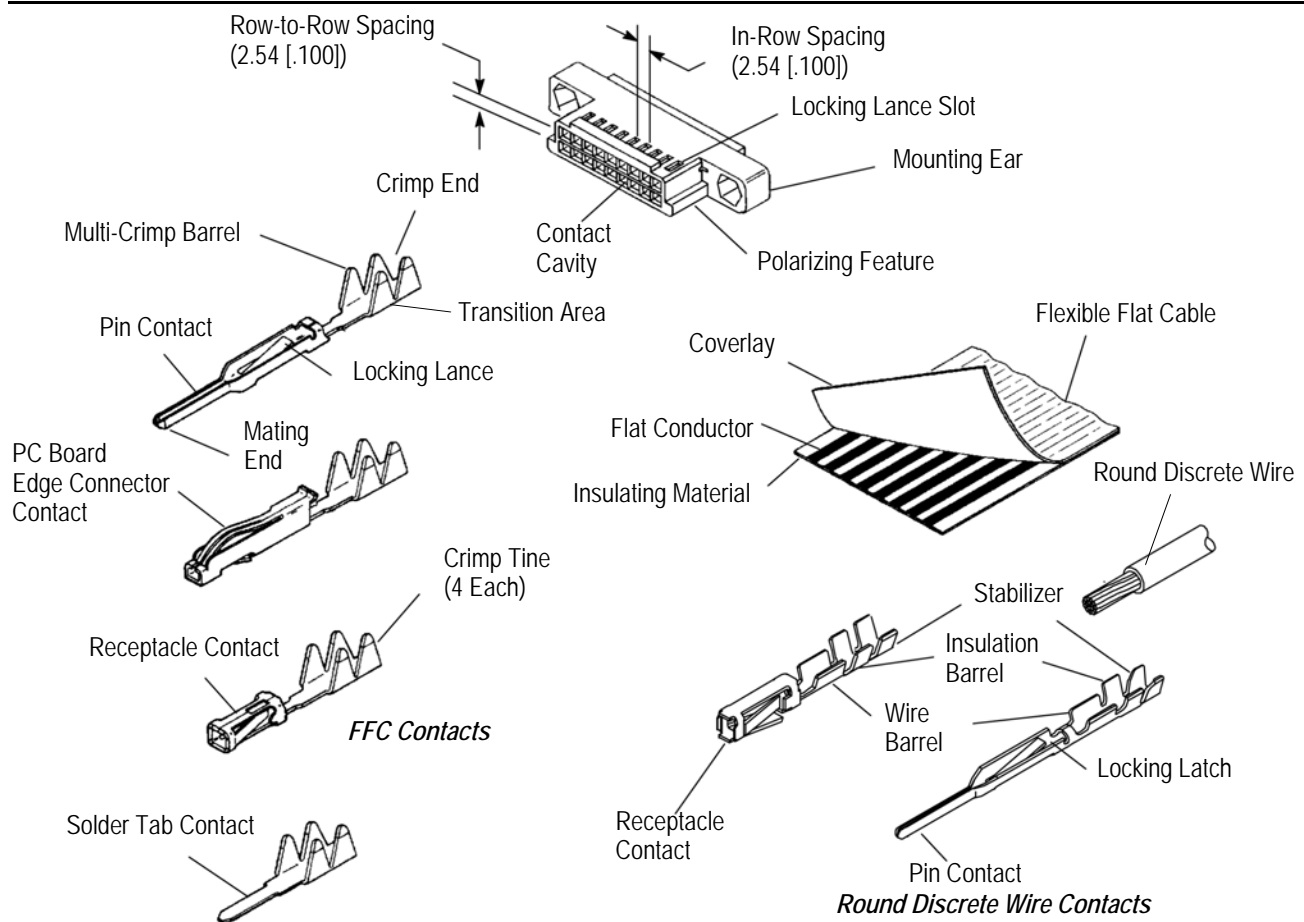


Figure 1

---

## 2. REFERENCE MATERIAL

### 2.1. Revision Summary

- Changed cable length dimension in Figure 5

### 2.2. Customer Assistance

Reference Part Number 88189 and Product Code 5106 are representative numbers of Flexible Flat Cable Housings. Use of these numbers will identify the product line and expedite your inquiries through a service network established to help you obtain product and tooling information. Such information can be obtained through a local TE Representative or, after purchase, by calling the Tooling Assistance Center or Product Information at the phone numbers at the bottom of page 1.

### 2.3. Drawings

Customer Drawings for product part numbers are available from the service network. The information contained in Customer Drawings takes priority if there is a conflict with this specification or with any other technical documentation supplied by TE.

### 2.4. Specifications

Product Specifications 108-40002 for cables and 108-9024 for contacts and housings provide performance tests for the contacts and cables recommended by TE Engineering. Quality Specification 102-16050 provides a recommended process for inspecting crimped contacts.

### 2.5. Instructional Material

The following list includes available instruction sheets (408-series) that provide assembly procedures for product, operation, maintenance and repair of tooling, as well as setup and operation procedures of applicators; and customer manuals (409-series) that provides setup, operation, and maintenance of machines.

- 408-6557 FFC Jackscrew Assemblies and Latch-Type Hardware
- 408-7384 Extraction Tools 91047-[ ]
- 408-7637 Hand Crimping Tool Assembly
- 408-7645 Extraction Tool 91092-1 for FFC Round Wire Pin Contacts
- 408-7646 Extraction Tool 91093-1 for FFC Round Wire Receptacle Contacts
- 408-7665 FFC PC Board Edge Connectors
- 408-7916 Extraction Tools 91200-[ ]
- 408-7973 Hand Crimping Tool 90313-2
- 408-8040 Heavy Duty Miniature Quick-Change Applicators (Side-Feed Type)
- 408-8547 CERTI-CRIMP\* Straight Action Hand Tools
- 408-9564 Hand Crimping Tool Assembly 90273-5
- 409-5875 FFC Terminating Machines 224910-[ ] and 318619-[ ]
- 409-5878 AMPOMATOR\* CLS IV+ Lead-Making Machine

## 3. REQUIREMENTS

### 3.1. Storage

The housings and contacts should remain in their shipping containers until ready for use. The coiled contact reels should be stored horizontally to prevent deformation during storage that could prevent proper feeding through the terminating tooling. The housing and contacts should be used on a first in, first out basis to prevent storage contamination that could occur over an extended period of time.

### 3.2. Features

The basic designs are shown in Figure 1. Other housings are available to accommodate specific design requirements. In keeping pace with industry needs, part number assignments can be affected daily. All design changes affecting the application requirements will be added to this document. Maintaining a current list of all part numbers on this document would require revisions that may not affect application design requirements. To obtain specific and current product part numbers, and for other peripheral information unrelated to application requirements, call one of the phone numbers at the bottom of page 1.

Single and double row housings have in-row contact cavities on 2.54-mm [.100-in.] centers, and double row housings have row-to-row contact cavities on 2.54-mm [.100-in.] centers. All housings are available without mounting ears. Double row housings are available with mounting ears for panel mount applications. Receptacle contact housings have side locking lance slots. Pin contact housings have in line locking lance slots. There are housings with or without polarization and with or without self-locking features. See Figure 2.

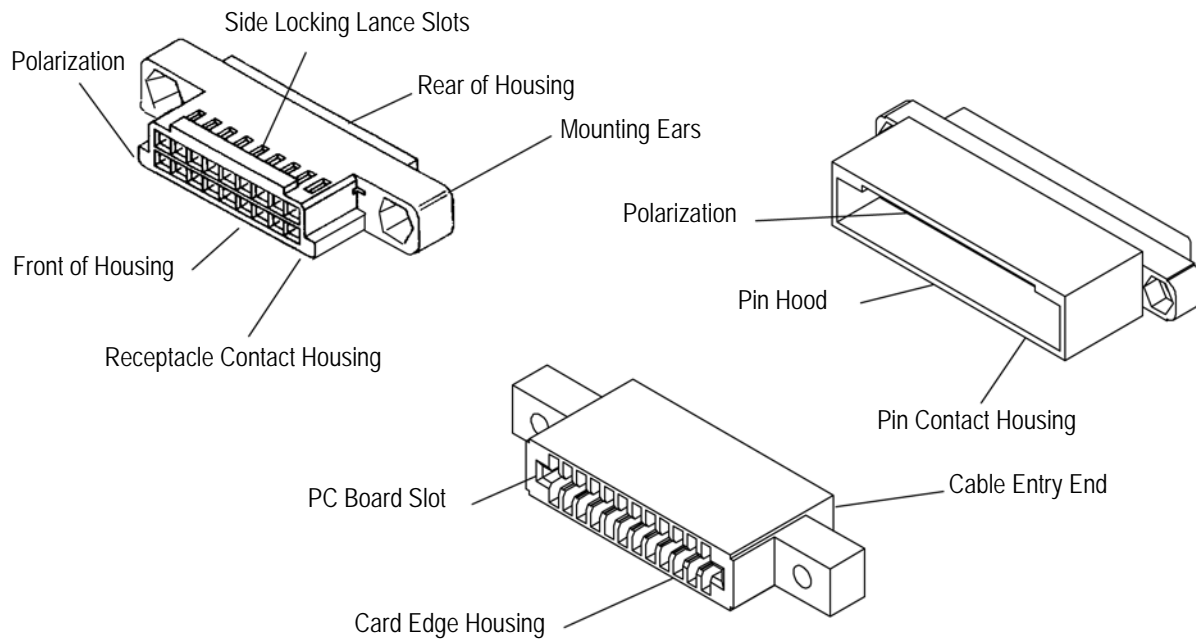


Figure 2

### 3.3. Panel Mount Layout

In a connector assembly where either or both housings have mounting ears either or both can be mounted to a panel. When only one half is to be mounted, it is preferable that it be the pin housing connector. For panel cutout dimensions, see Figure 3.

### 3.4. Contacts

The flexible flat cable and discrete wire contacts described in this specification are available in loose piece and strip form. The descriptions of the various types of contacts is provided in Figures 1 and 4.

### 3.5. FFC Selection and Preparation

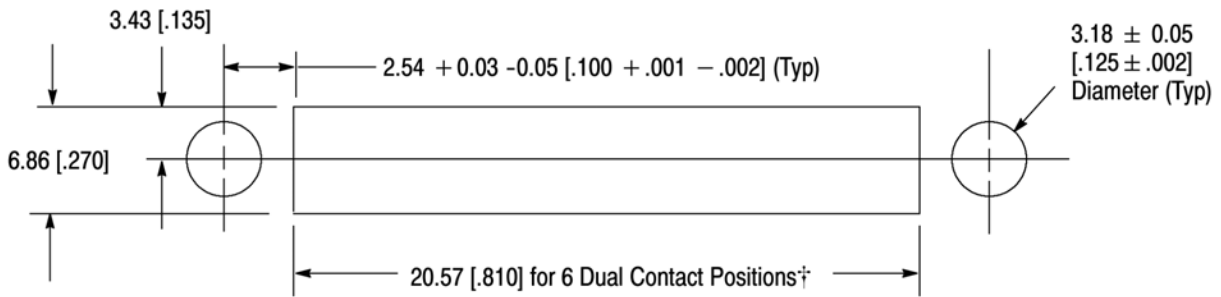
Cable construction recommended for Flexible Flat Cable Contacts is provided in Figure 5.



*There must be a straight conductor length of 6.35 mm [.250 in.] minimum for all terminations. A straight cable length of 40.64 mm [1.600 in.] minimum is required for semi-automatic machines.*

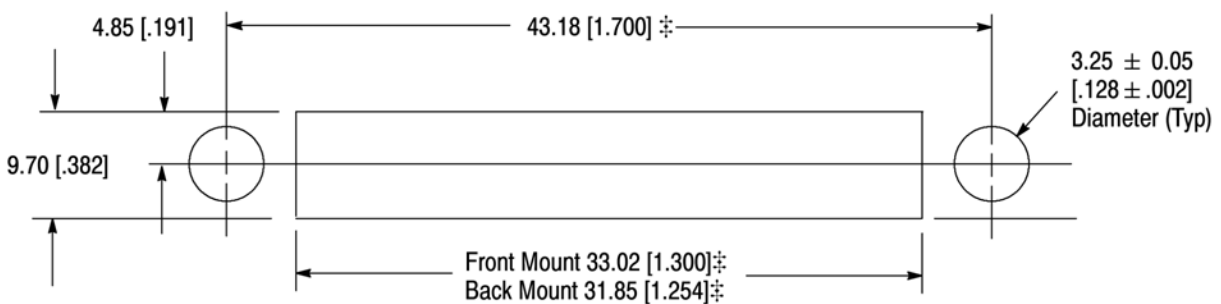


*The optimum conductor width is  $1.27 \pm 0.08$  mm [.050  $\pm$  .003 in.]. The contacts can be used to terminate wider conductors; however, the tines may shave off some of the conductor and create slivers of metal that could cause electrical shorts. If slivers are suspect, brush the tine crimp area. Visually check that there are no slivers bridging from one contact to another, then apply a thin coat of fast-drying sealant over the tine crimp area. For additional information concerning cable requirements, contact TE engineering through the Tooling Assistance Center at the phone number at the bottom of page 1.*



† Dimensions given are for 6 dual (12 contacts) position housing.  
 Add 2.54 mm [.100 in.] for each additional dual contact position.

### Cable Housing Cutout Dimensions



‡ Dimensions given are for 10 dual (20 contacts) position housing.  
 Add 2.54 mm [.100 in.] for each additional dual contact position.

### Card Housing Cutout Dimensions

Figure 3

## LOOSE PIECE AND STRIP (Reel Fed) CONTACTS

### Flexible Flat Cable Contacts

- Solder Tab
- Pin (With and Without Locking Lance)
- Receptacle (High and Standard Pressure)
- PC Board Edge Connector
- Splice

### Discrete Round Wire Contacts

- Pin
- Receptacle

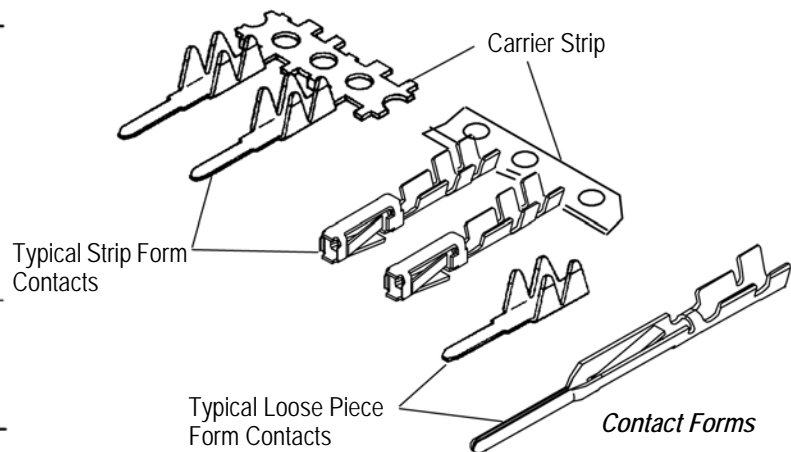
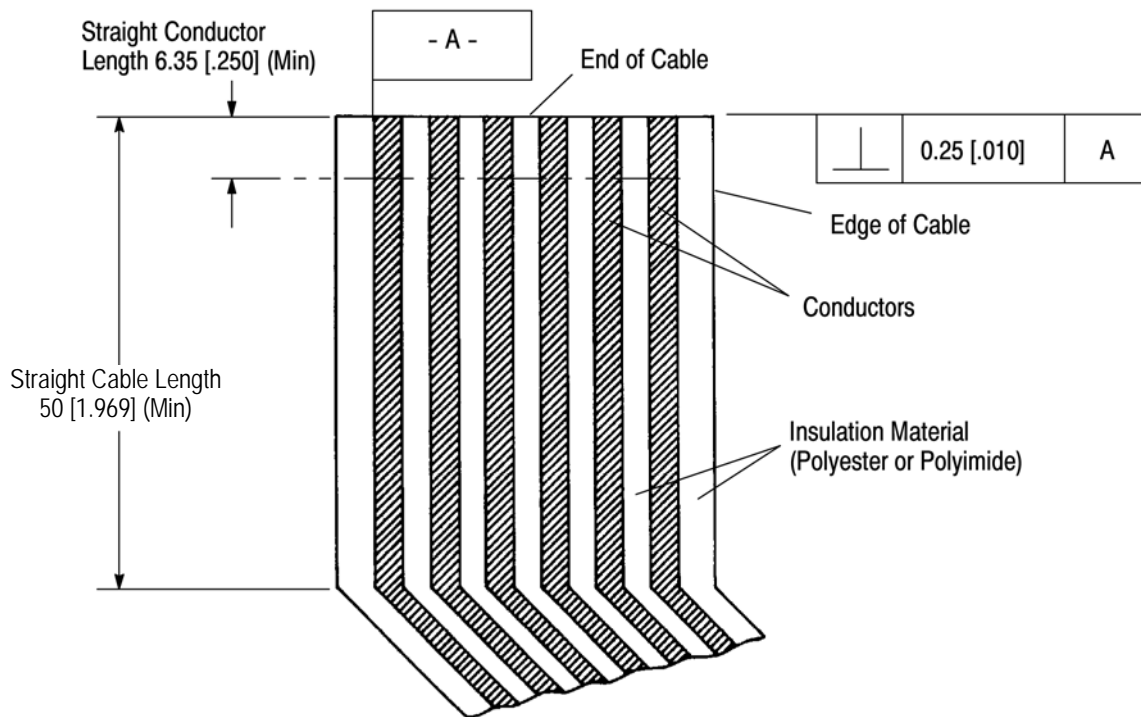


Figure 4



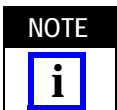
CABLE						
TYPE	COMMERCIAL SPECIFICATION	CONDUCTOR		INSULATION		CRIMP AREA THICKNESS
		WIDTH	THICKNESS	BASE	COVERLAY	
FFC	IPC-FC-220, CLASS 4	1.27 ±0.08 [.050 ±.003]	0.05-0.13 ±0.008 [.002-.005 ±.0003]	0.08-0.31 [.003-.012]	00-0.23 [.000-.009]	0.38 [.015] (Max)
FEC/FPW	IPC-FC-250, CLASS 1, 2, or 3	1.27 ±0.08 [.050 ±.003]	0.05-0.13 ±0.008 [.002-.005 ±.0003]	0.08-0.31 [.003-.012]	00-0.23 [.000-.009]	
COND INK	None	1.27 ±0.08 [.050 ±.003]	1.27 ±0.08 [.050 ±.003]	0.08-0.36 [.003-.014]	00-0.28 [.000-.011]	

Figure 5

### 3.6. FFC Contact Crimp Inspection

#### A. Crimp Alignment

The centerline of the contact crimp end and the centerline of the conductor must be within the angular limit. The tips of all four crimp tines must overlap the conductor edge. The contact transition section and the conductor must be as specified. See Figure 6.



*The conductor and contact transition edges provide surfaces for accurately measuring contact-to-conductor alignment. The cable edge may be used in place of the conductor edge as long as allowances are made for any degree of non-parallelism between the conductor and cable edges.*

#### B. FFC Contact Placement Relative to Cable End

The contact must be crimped to the conductor so that the contact and cable end are within the limits specified. All contacts are to be held relative to all others within 0.15 mm [.006 in.]. See Figure 7.

**Contact Straightness and Crimp Tine Alignment on Conductor**

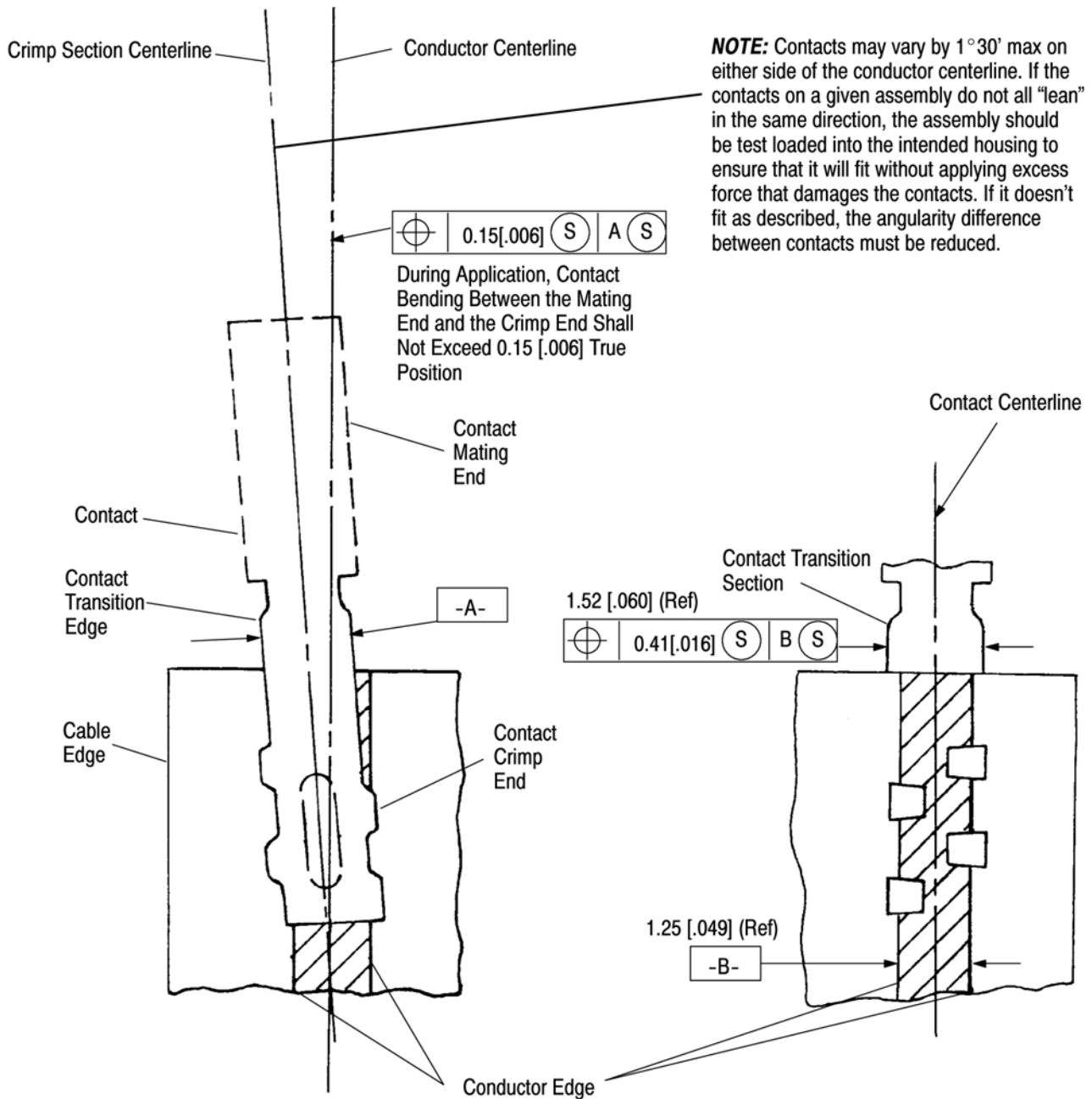
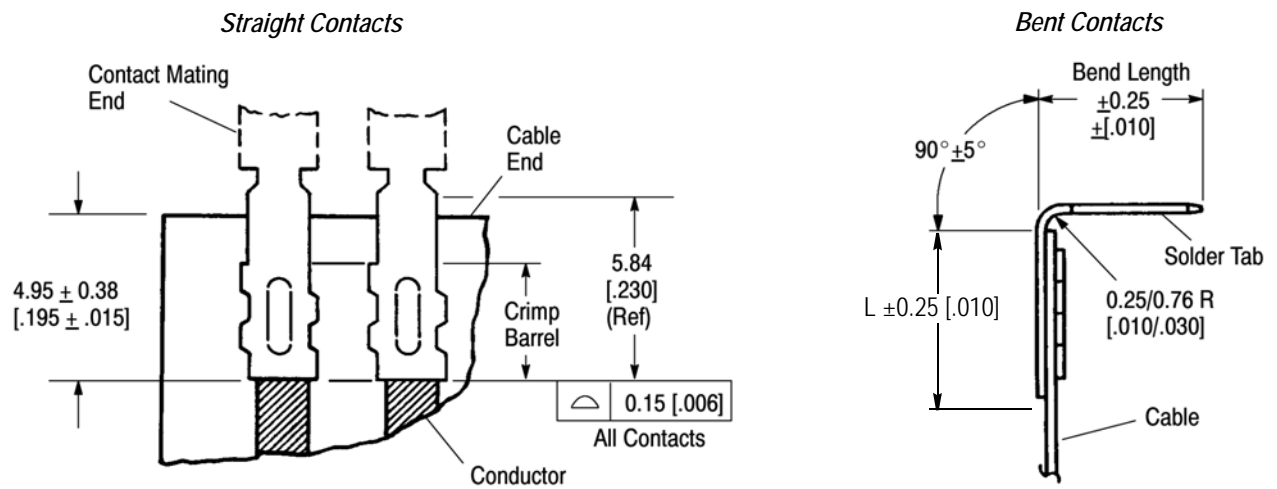


Figure 6



TOTAL CONTACT LENGTH	BEND LENGTH	"L"
9.53 [.375]	4.70 [.185]	4.59 [.181]
9.78 [.385]	6.73 [.265]	2.81 [.111]
11.18 [.440]	6.35 [.250]	4.59 [.181]
19.94 [.785]	16.89 [.665]	2.81 [.111]

Figure 7

### C. Contact to Contact Position

The crimped contact transition sections must be to the dimension specified in Figure 8.

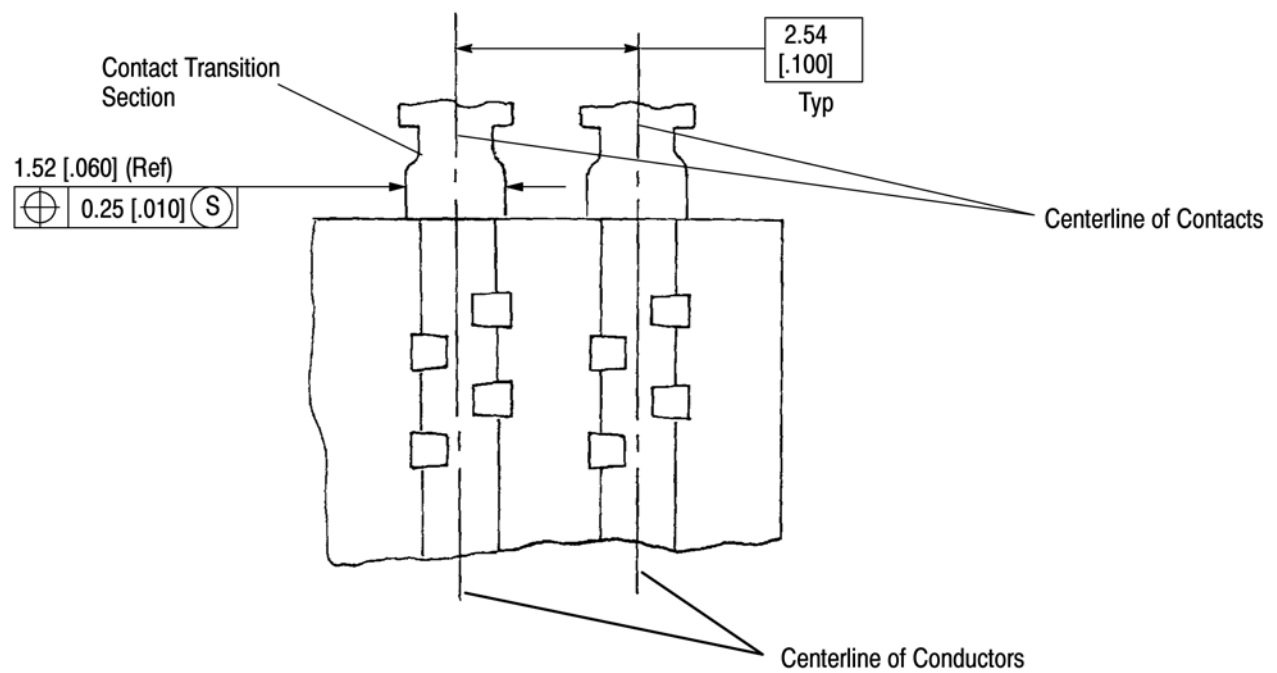
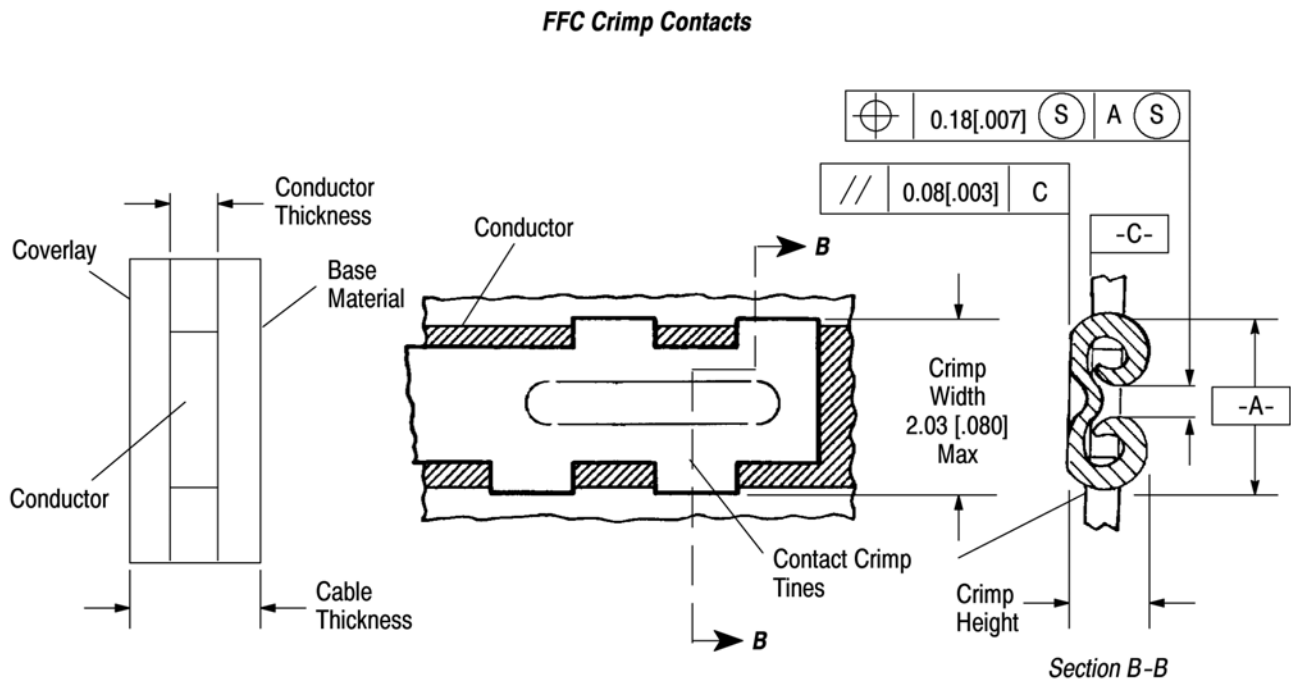


Figure 8



#### D. FFC Contact Crimp Height, Width, Configuration, and Position

Crimp a series of contacts on a test strip of cable, then select a well-centered conductor and remove all extruded insulation material from the crimped area. Use a standard flat micrometer to measure the crimp height and crimp width at the center most portion of the contact crimp barrel and compare them with the specified dimensions in Figure 9.



CONDUCTOR		CABLE THICKNESS (Max)	CRIMP HEIGHT*	MATERIAL THICKNESS (Max)	
MATERIAL	THICKNESS			BASE	COVERLAY
COPPER TE Std or Equivalent	0.05-0.08 [.002-.003]	0.28 [.011]	0.91 ± 0.05 [.036 ± .002]	0.08 [.003]	0.08 [.003]
COPPER	0.05-0.08 [.002-.003]	.015 [.006]	0.86 ± 0.03 [.034 ± .001]	0.05 [.002]	0.05 [.002]
	0.05-0.08 [.002-.003]	0.33 [.013]	0.94 ± 0.03 [.037 ± .001]	0.13 [.005]	0.13 [.005]
	0.10-0.13 [.004-.005]	0.38 [.015]	0.94 ± 0.03 [.037 ± .001]	0.18 [.007]	0.10 [.004]
COND INK	0.008-0.025 [.0003-.0010]	0.20 [.008]	0.86 ± 0.03 [.034 ± .001]	0.18 [.007]	0.10 [.004]
		0.31 [.012]	0.91 ± 0.03 [.036 ± .001]	0.20 [.008]	0.10 [.004]
		0.38 [.015]	0.97 ± 0.03 [.038 ± .001]	0.28 [.011]	0.10 [.004]

\*This is the optimum crimp height for cables meeting dimensional requirements provided in the table. Other cables can be used with these contacts and termination tooling. New applications must be tested to be sure they meet your electrical and mechanical requirements, and new crimp heights established with a tolerance of ± 0.03 mm [± .001 in.]. Refer to the customer manual with the machine for crimp height adjustment.

Figure 9



### E. Crimp Orientation, Contact Carrier Cutoff Tab, and Burr Allowance

Orientation of the contact to the cable should be such that the tines will penetrate the thinner coverlay material rather than the cable base material. The carrier cutoff tab and burr shall not exceed the limits shown. See Figure 10.

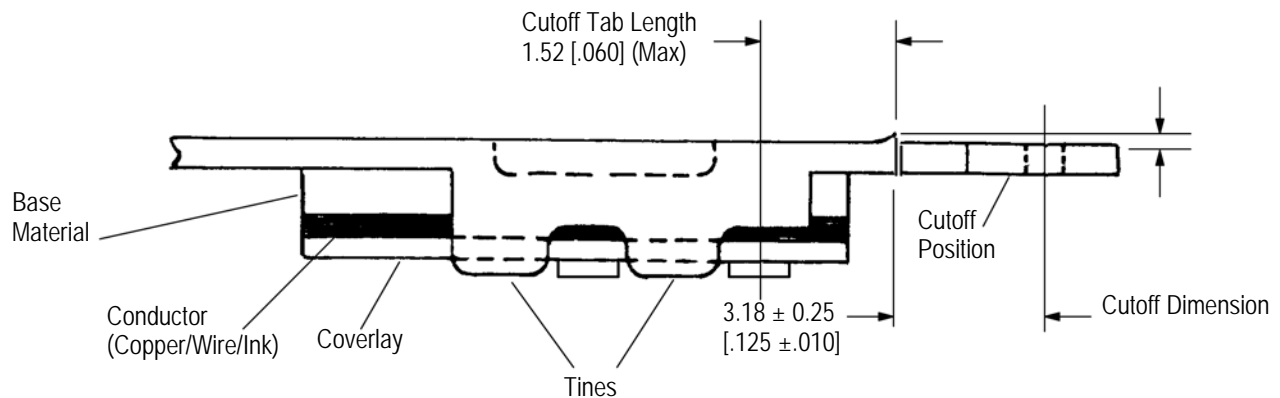
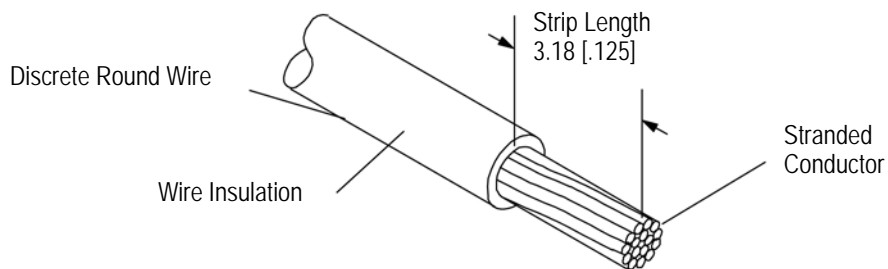


Figure 10

### 3.7. Discrete Wire Selection and Preparation

The contacts for discrete round wire are designed for stranded conductor wire only. There are designs to accommodate various wire sizes and insulation diameters. They can be used to tap onto flat conductor cable or to bridge over damaged flat conductors. The wire strip length is the same for all discrete wire contacts. See Figure 11.



WIRE SIZE (AWG)	INSULATION DIAMETER	CRIMP HEIGHT
32 through 28	0.64-1.22 [.025-.048]	0.58 ±0.03 [.023 ±.001]
26	0.64-1.22 [.025-.048]	0.69 ±0.03-0.05 [.027 ±.001-.002]
26 through 24	1.02-1.42 [.040-.056]	0.64 ±0.03-0.05 [.025 ±.001-.002]
	1.02-1.75 [.040-.069]	
22	1.02-1.42 [.040-.056]	0.71 ±0.05 [.028 ±.002]
	1.02-1.75 [.04-.069]	

Figure 11

### 3.8. Discrete Wire Contact Crimp Inspection

#### A. Crimp Height

The crimp applied to the wire barrel portion of the contact is the most compressed area and is most critical in ensuring optimum electrical and mechanical performance of the crimped contact. The crimp height must be within the dimensions provided in Figure 11.

#### B. Effective Crimp Length

The effective crimp length is the area where the crimp pressure is applied over the length of the wire barrel. It should be approximately centered and does not include the bellmouths. See Figure 12.

#### C. Bellmouths

The front and rear bellmouths are caused by the extrusion of metal during crimping and must be within the range specified in Figure 12.

#### D. Cutoff Tab and Burr

The cutoff tab and burr resulting from the contact being cut from the carrier strip must be within limits shown to allow the contact to be fully inserted and seated in the housing. See Figure 12, View A.

#### E. Wire Barrel Flash

The wire barrel flash at the bottom of the wire barrel results from applied crimp pressure and must be within the dimension provided in Figure 12, Section X-X.

#### F. Stabilizer

Stabilizers must not be crimped, deformed, or otherwise damaged.

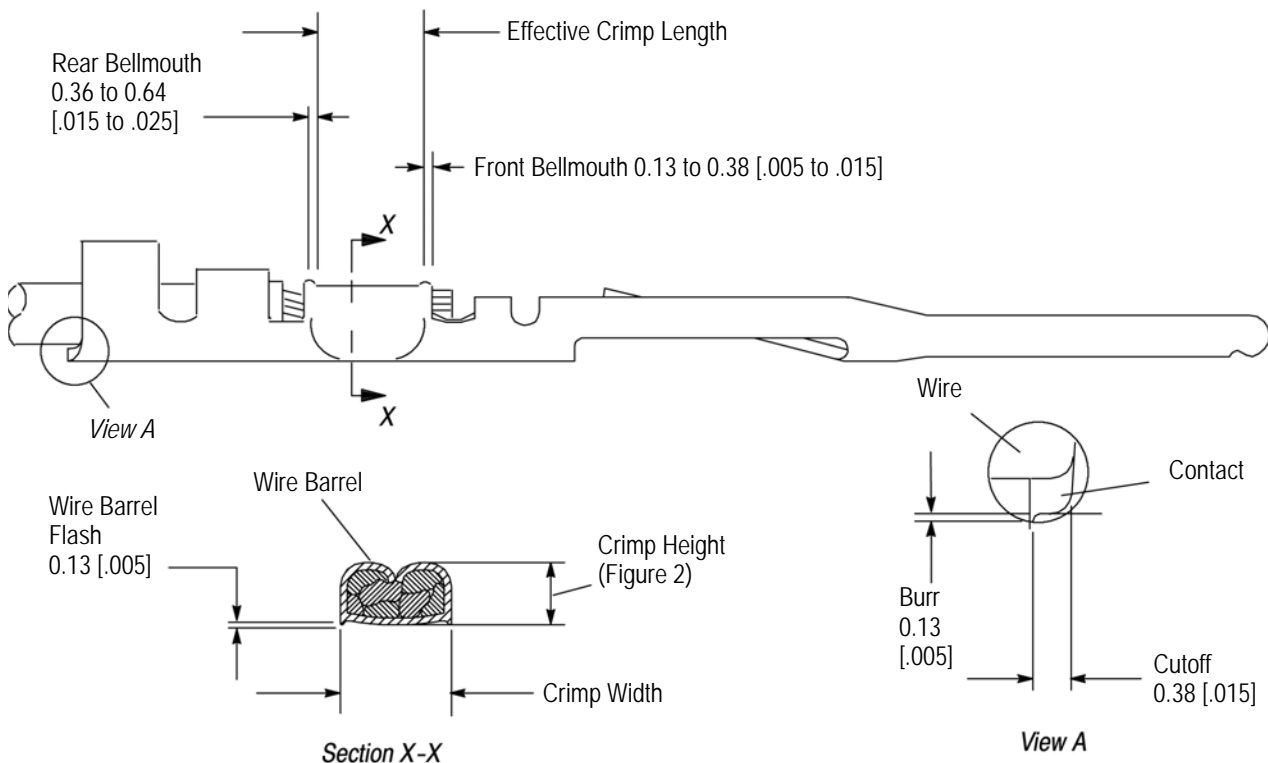


Figure 12

### G. Insulation Barrel Crimp

The insulation barrel must support the insulation of the wire without cutting into it. The ends of the insulation barrel must touch the insulation of the wire but they must not penetrate through it. Care must be taken to prevent cutting, nicking, or scraping of the insulation during the crimping procedure.

### H. Wire Location

After crimping, the conductor and insulation must be visible in the transition area between the wire barrel and insulation barrel. The conductor end of both the insulated wire and magnet wire must be within the limit provided in Figure 13.

### I. Wire Barrel Seam

Wire barrel seam shall be completely closed with no conductor strands protruding from it. See Figure 13.

### J. Twist or Roll

The crimped wire and insulation barrels must be aligned with the uncrimped portion of the contact to within the limit shown in Figure 13.

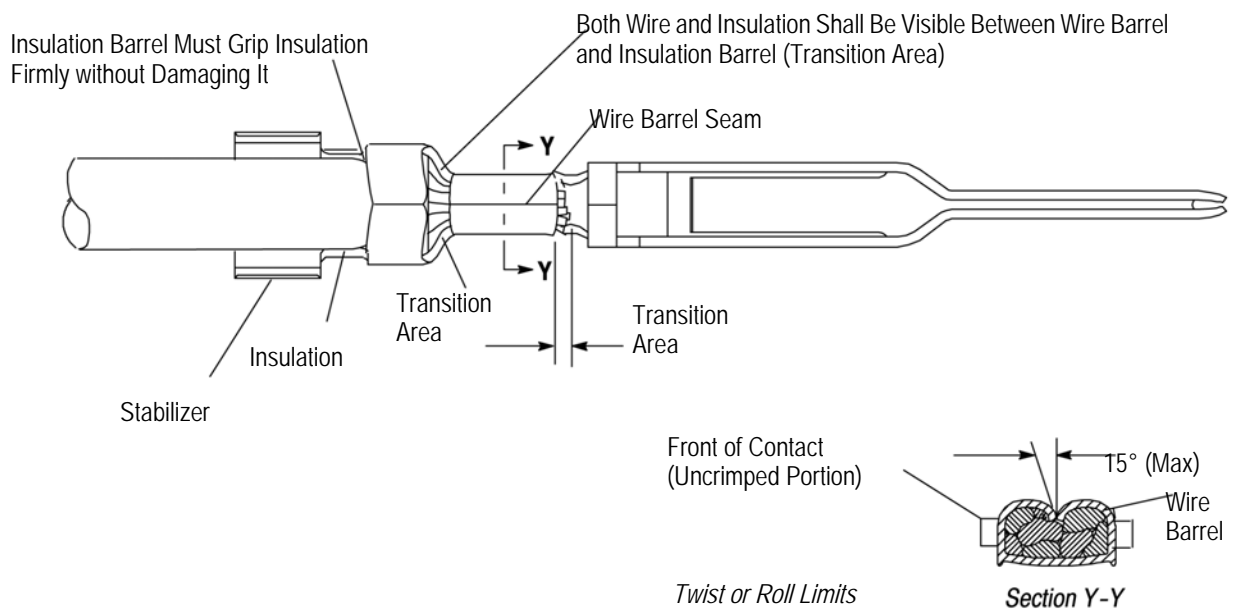


Figure 13

### K. Straightness

The force applied during crimping may cause some bending between the crimped wire barrel and the uncrimped portion of the contact. Such deformation is acceptable within the up-and-down and side-to-side limits provided in Figure 14.

#### Up-and-Down

The crimped contact, including cutoff tab and burr, shall not be bent above or below the flat section of the contact represented by the datum line in Figure 14.

#### Side-to-Side

The side-to-side bending of the contact may not exceed the limits from center indicated by the datum line in Figure 14.

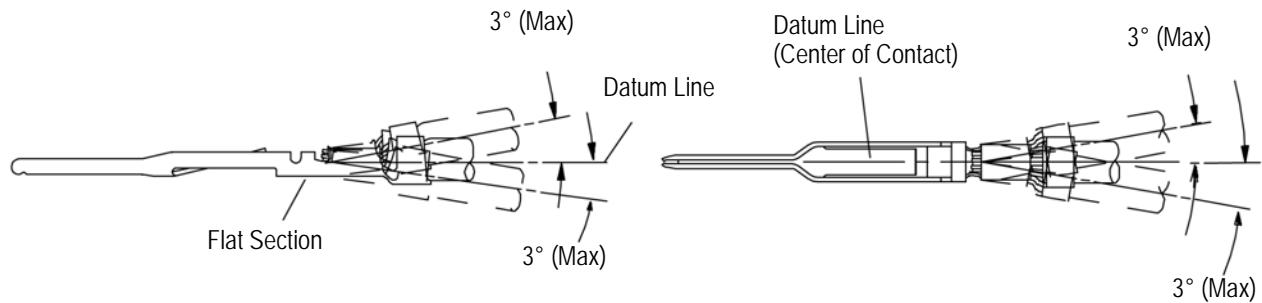


Figure 14

### 3.9. Card Edge Connector PC Board

Card edge connectors are designed for a thickness range which includes the pc board and pads. The overall width of the pc board must be within the tolerance specified to ensure alignment of the contacts with the circuit pads. If the pc board must be wider than the entry slot in the connector, a notch must be made in the pc board deep enough to ensure engagement depth. See Figure 15.

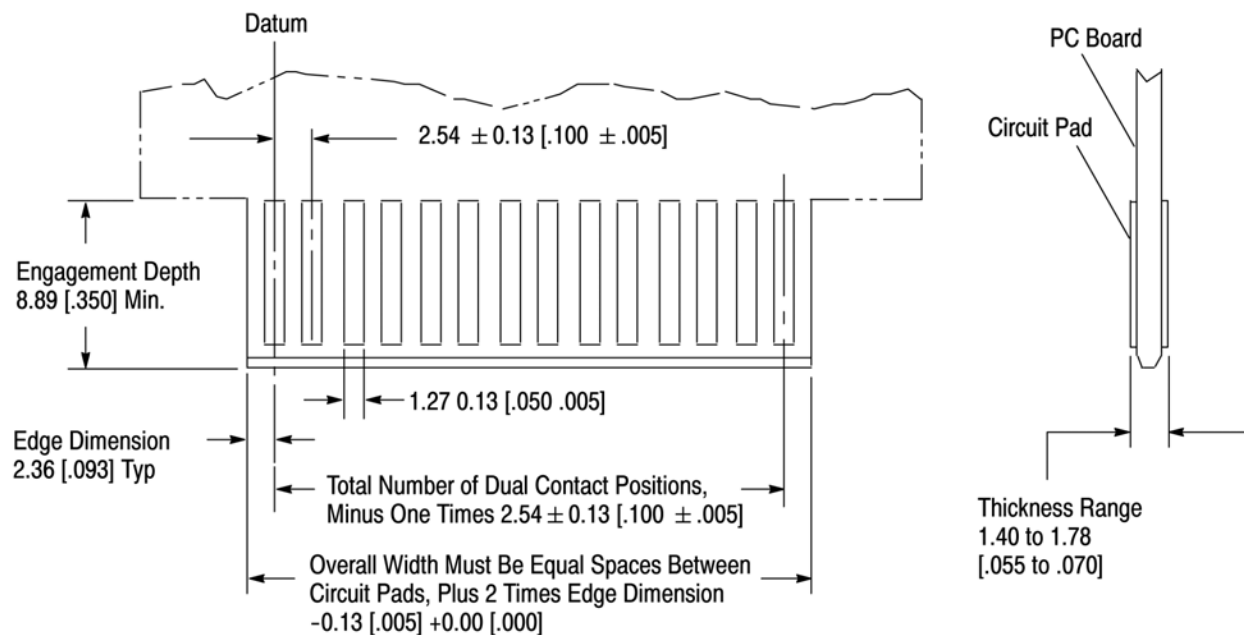


Figure 15

### 3.10. Hardware

Fixed and turnable jackscrews are available to secure mating connectors. When only one connector is to be panel mounted, the fixed jackscrew should be used on that connector. See Figure 16.

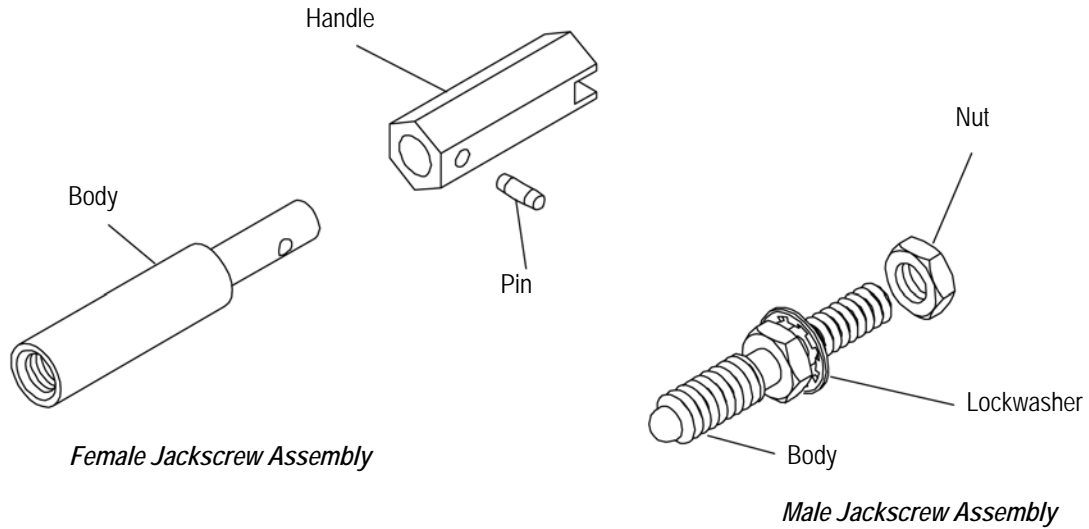


Figure 16

### 3.11. Ancillary Items

There are on-contact and inter-contact keying plugs to provide individualized keying of card edge mount connectors. There is also a retaining spring available to help hold the pc board in the card edge connectors. See Figure 17.

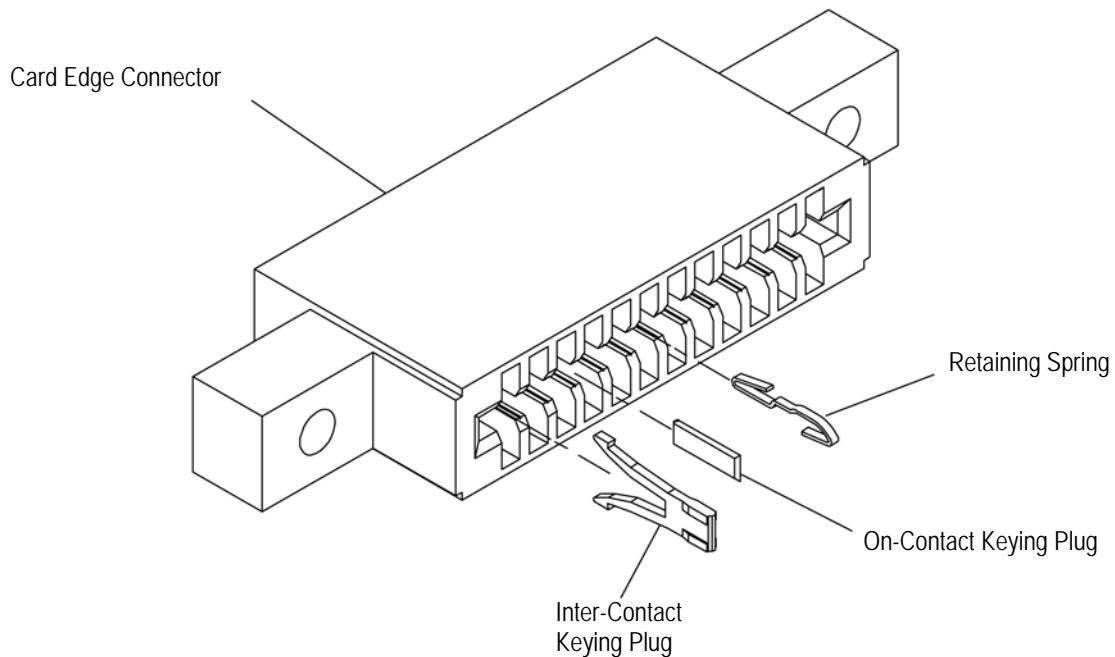


Figure 17



*A slot must be cut in the pc board to accept the inter-contact and on-contact keying plugs. A slot must also be cut in the flat cable when an on-contact keying plug is used. See Figure 18.*

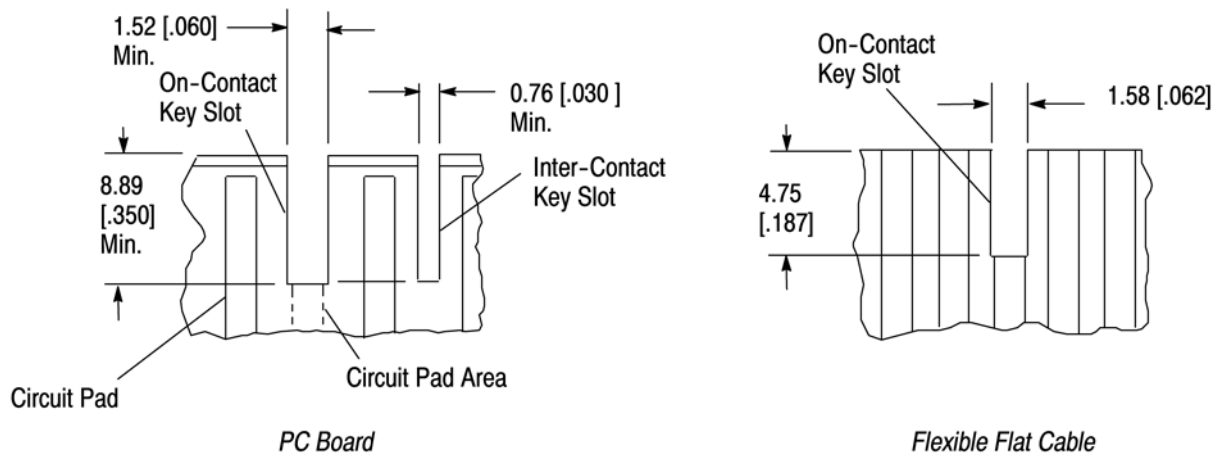


Figure 18

### 3.12. Repair



Damaged contacts, or contacts attached to damaged wire can be removed and replaced with new ones using the tools shown in Figure 19. Note that there is one style of extraction tool for side locking latch housings and another style for in-line locking latch housings. When cutting a contact from the wire, cut the wire as close as possible to the damaged area to preserve as much wire as possible.

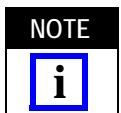
### 3.13. Workmanship

Carefully examine both side of the crimped contact to be sure that the termination meets the requirements of this specification. The crimp area must show no signs of cracking or tearing due to mishandling or incorrect adjustment of the tooling.

## 4. QUALIFICATION

Flat Flexible Cable is Listed by Underwriters Laboratories Inc. (UL) in File E53793 and is Certified by CSA International in File LR45924.

## 5. TOOLING



The tool selection for terminating contacts to discrete wire will depend on the wire size and insulation diameter. See Figure 19.

WIRE SIZE RANGE (AWG)	INSULATION DIA RANGE	APPLICATOR PART NUMBER	HAND TOOL
32 - 26	0.64-1.22 [.025-.048]	466242	90313-2
30 - 26	0.71-1.22 [.028-.048]	466933	
26 - 22	1.09-1.37 [.043-.054]	466909	90222-6
24 - 22	1.02-1.42 [.040-.056]	567308	
	1.02-1.42 [.040-.056]	466572	

Figure 19

5.1. Hand Tools

There are hand tools for terminating loose piece discrete wire contacts to stranded round conductor wire and there is a hand tool for terminating loose piece flexible flat cable conductors to solid flat conductor cable. There is also a hand tool to form solder tabs after they have been terminated to flat cable. See Figure 20.

5.2. Semi-Automatic Machines

There are semi-automatic machines to terminate strip-form contacts to flat cables and there are mini-applicators and an AMPOMATOR power source for terminating discrete wire contacts to round conductor wire. The tooling for crimping round discrete wires will depend on the contact wire size, insulation diameter, and whether or not the contact has a stabilizer. See Figure 20.

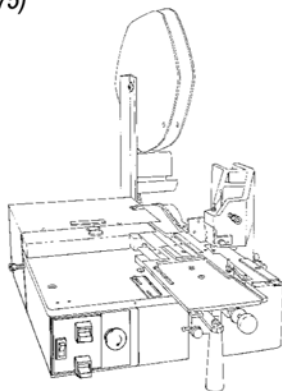
5.3. Extraction Tools

There is an extraction tool to remove single discrete wire contacts and there is a series of multiple blade tools corresponding with multiple position housings to remove contacts terminated to flat cable. The tools are designed to depress the locking lances without deforming them. The shorter blade tools are for side locking lance housings and the longer blade tools are for in-line locking lance housings. See Figure 20.

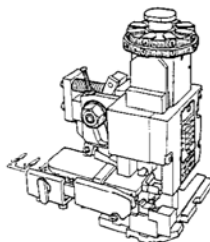


*FFC Termination Machine 528000-7;  
Base Machine (Uses Applicator  
5-528441-5)*

**Flexible Flat Cable Machines  
224910-1, -2 and 318619-1, -2  
(409-5875)**



**Round Discrete Wire  
Mini-Applicator (Typ)  
(408-8040)**



**Round Discrete Wire  
AMPOMATOR CLS 356500-1  
(409-5878)**

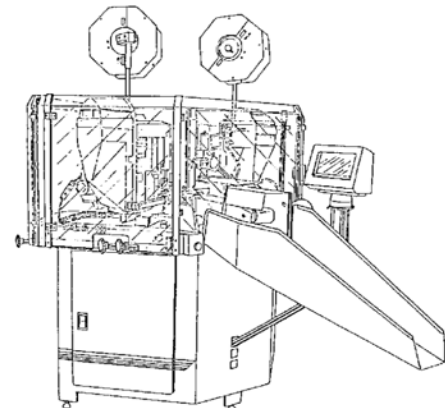
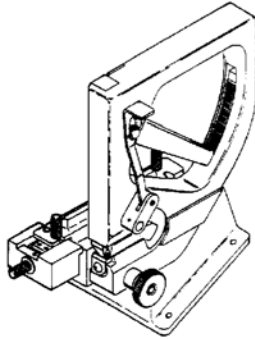


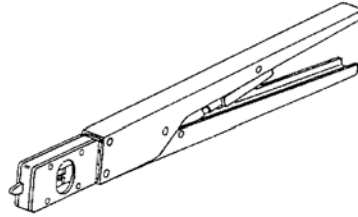
Figure 20 (Cont'd)



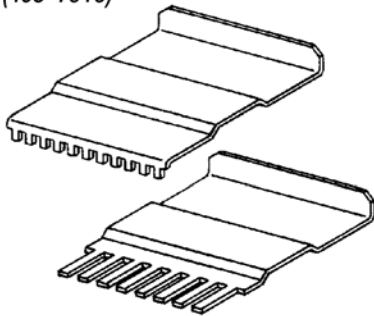
*Flexible Flat Cable  
Hand Crimping Tool 90273-5  
(408-9564)*



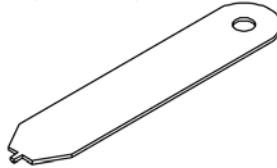
*Round Discrete Wire Hand Crimping Tools  
90313-2, 91537-1 (408-7973 , 408-8547)*



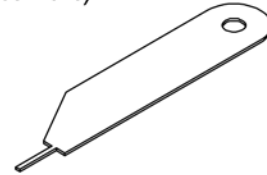
*91200 (Base Number) for FFC Housings  
With Side Locking Lance Slots  
(408-7916)*



*91093 (Base Number) for FFC Housings  
With Side Locking Lance Slots  
(408-7646)*



*91092 (Base Number) for FFC Housings  
With In-Line Locking Lance Slots  
(408-7645)*



*91047 (Base Number) for FFC Housings  
With In-Line Locking Lance Slots  
(408-7384)*

*Figure 20 (End)*

## 6. VISUAL AID

The illustration below shows a typical application of this product. This illustration should be used by production personnel to ensure a correctly applied product. Applications which DO NOT appear correct should be inspected using the information in the preceding pages of this specification and in the instructional material shipped with the product or tooling.

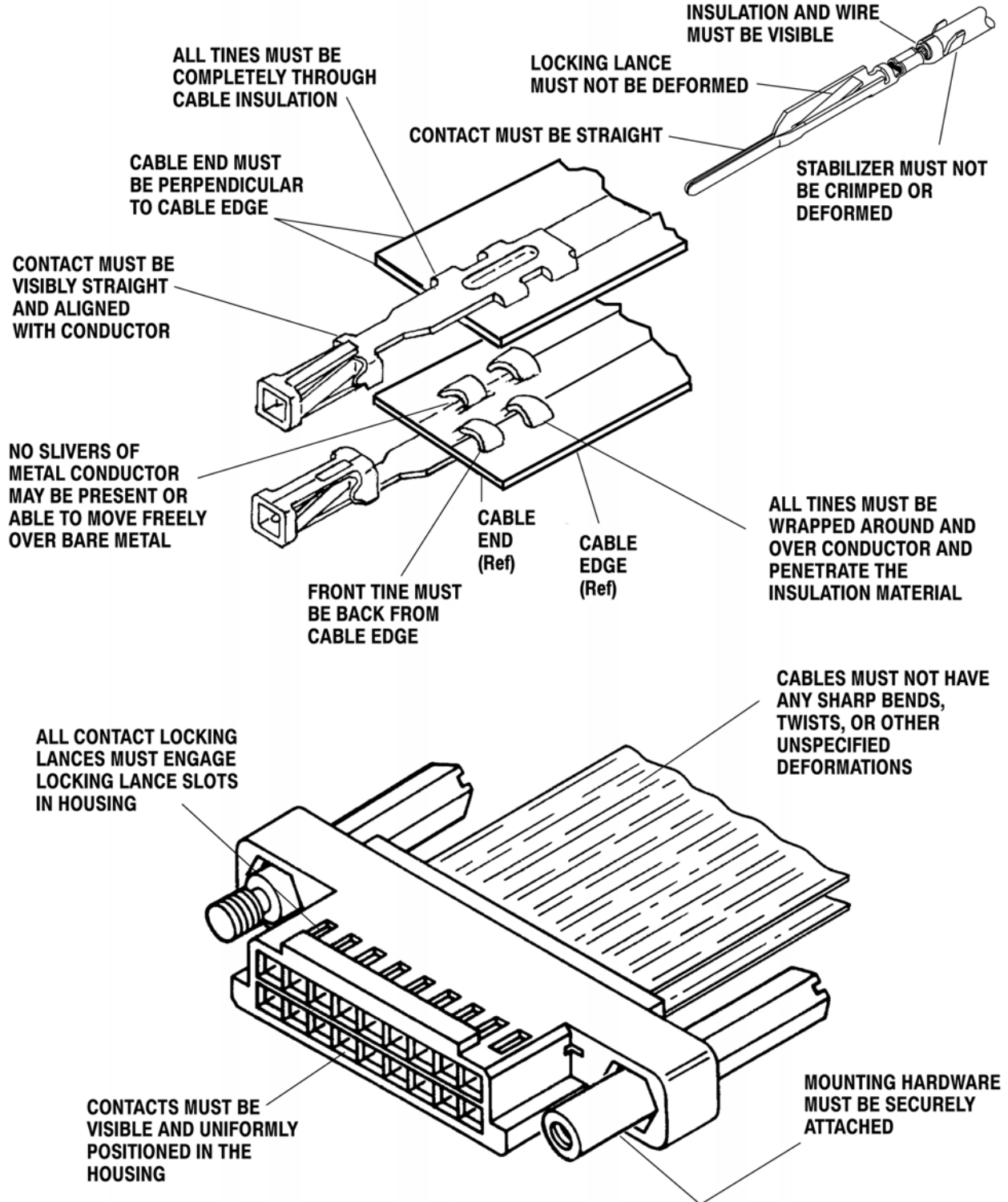


FIGURE 21. VISUAL AID