

Instruction
Hardware Engineering

No. LMS 11-17

Subject: Flat Cable and Flat Cable Assemblies

APPROVED BY Manager, Hardware Engineering

STATUS Maintenance Revision

PURPOSE This instruction has three sections. The first section enumerates the common properties of flexible, flat cable (rectangular conductor) and flat ribbon cable (round conductor). The second section calls out the stripping, termination, and installation of flat cable (rectangular conductors) and cable assemblies. The third section refers to the termination of flat cable (round conductors) using various connector configurations. Requirements of this instruction shall be met by all L-3 Communications Corporation, Link Simulation & Training Division (hereafter referred to as Link) personnel involved in the manufacture of flat cable assemblies.

AFFECTED FUNCTIONS Hardware Engineering
Manufacturing

REFERENCES None

DEFINITIONS Cable assembly. As referred to herein, cable assembly shall mean a flat cable terminated in a paddle board at one or both ends, or terminated with insulation displacement contact connectors.

Flat cable. As referred to herein, flat cable shall mean multiple solid flat or round conductors laminated in a plastic insulation. (See Figure 1.)

Paddle board. As referred to herein, paddle board shall mean a printed circuit board upon which the flat cable is terminated. (See Figure 2.)

INSTRUCTION

1. Requirements
 - 1.1 Handling and installation. Flat cable and cable assemblies shall be handled only when necessary. Care shall be taken to prevent the cable from being crimped, cut, nicked, abraded, or mutilated.

Where it is necessary to lay out a length or lengths of cable for purposes such as termination or installation, the work area must be clean and free of grease, oil, chips, solder particles, and wire clippings.

- 1.2 Bending. Bending of cable (rectangular conductors) or cable assemblies shall only be done as necessary during installation, termination, etc. The flexibility of cable with stranded, round wire conductors enables it to be folded and clipped when necessary.

When bending is necessary, the minimum inside bend radius shall be 20 times the overall thickness of the thickest cable involved.

- 1.3 Transporting and storage. Prior to termination, the cable (rectangular conductors) shall be wound on reels with a minimum diameter of 3 inches (7.62 cm). It is recommended that cable with stranded, round wire conductors remain on the shipping spool until the time of termination. This restriction disallows precutting lengths prior to termination and prevents unnecessary handling.

a. Cable assemblies with solid, rectangular conductors shall be loosely wound into coils with an inside diameter of 8 inches (20.32 cm) or greater. Cable assemblies with stranded, round wire conductors shall be wound into coils with a minimum inside diameter of 1 inch (2.54 cm). The coils shall be placed in containers free of sharp edges and burrs for transportation and storage.

b. Storage temperature. Storage temperature shall be not less than -85 °F nor greater than +212 °F (-65 °C to +100 °C). Cable coils shall be placed such that the coil plane is in a horizontal position for storage and transportation.

- 1.4 Stripping of insulation (rectangular conductors). The cable end to be stripped shall be sheared transversely 90 degrees ($\pm 1/2$ degree) to the cable.

Conductors shall be cleanly stripped of insulation .188 inch (± 0.031 inch [0.476 cm ± 0.079 cm]) of length. After stripping, the cable shall be examined for conductor and insulation damage. The insulation shall have been removed completely with no removal of copper. A slight discoloration along the edge of the insulation due to melting during stripping is acceptable. Conductors shall not have been crimped or twisted. (See Figure 1.)

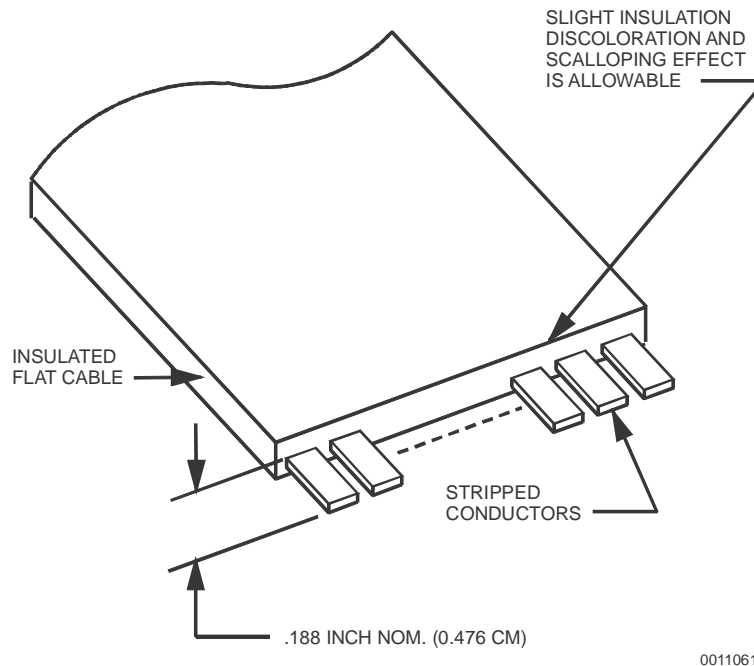


Figure1 Stripping Flat Cable (Rectangular Conductors)

- 1.5 Lap joint terminations (rectangular conductors). Figure 2 illustrates a lap joint connection of cable connectors and paddle board land areas.
- a. Pretinning. The stripped cable conductors shall be pretinned immediately after stripping to prohibit oxidation and to prepare them for reflow soldering to the land areas of the paddle board. Flux shall be applied to the conductors; then they shall be coated with soft tin-lead 60/40 or 63/37 solder. The pretinning of the cable conductors shall not affect the alignment of the exposed conductors or deteriorate the cable insulation in any manner. The pretinning shall completely cover the exposed copper surfaces, except that an exposed area may be allowed along the terminated edge of the cable insulation. This area shall be kept to a minimum.
 - b. Alignment. Cable conductors shall be aligned to within ± 0.005 inch (0.0127 cm) with the land areas to which they are to be connected.
 - (1) The length of overlap of conductor-over-land-area shall be such that .063 inch (± 0.031 inch [0.159 cm ± 0.079 cm]) is maintained

between the end of the cable insulation and the land area end.
(See Figure 2.)

- (2) The cable shall be aligned with the paddle board such that the cable axis is parallel within $\pm 1/2$ degree to the side edges of the paddle board.

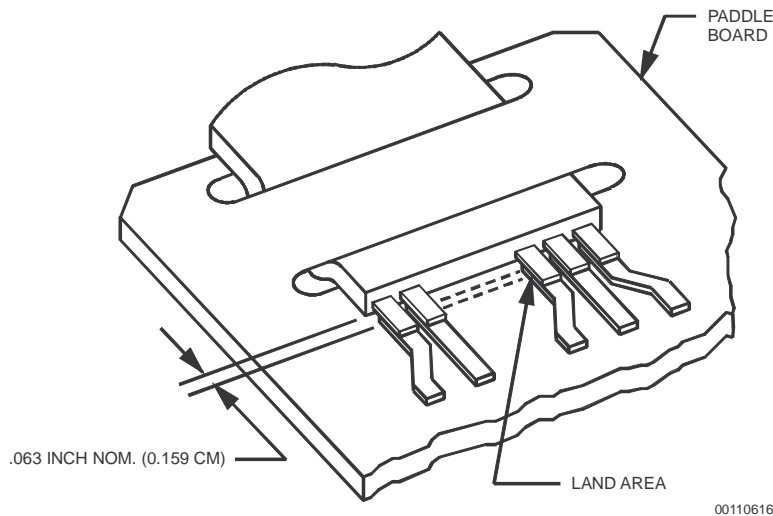


Figure 2 Flat Cable Lap Joint

- c. Reflow soldering. Flux shall be applied to the conductors and land areas.
 - (1) Heat shall be applied such that solder, on both the land areas and the cable conductors, flows to form a smoothly wetted bond. No movement of the cable relative to the land area shall be allowed during the reflow cycle.
 - (2) Flux residues resulting from soldering shall be removed by brushing with a natural-bristle brush dipped in cleaning solvent such as Chlorothene Nu (Link PN 101904). The area shall then be given a warm-water rinse and dried with vented circulating air of 104 °F to 160 °F (40 °C to 71 °C) or an equally effective alternate.

CAUTION: Do not allow solvent containing flux to penetrate into areas used for electrical contact purposes.

- 1.6 Termination of flat cable (round conductors).
- a. Insulation displacement connectors. This connector uses the principle of the “U” contact. Figure 3 shows the various steps of the connection. This procedure may be inverted, having the “U” contact body above the flat cable prior to piercing the insulation. The connectors are designed to accept cable with 28 AWG or 30 AWG. The specified centerline spacing is .050 inch ($\pm .005$ inch [$0.127\text{cm} \pm 0.0127$ cm]).

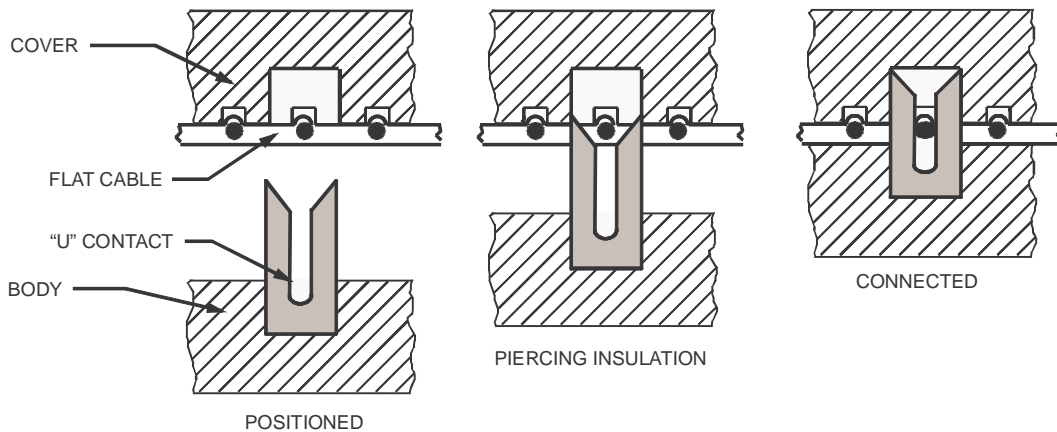


Figure 3 Insulation Displacement Connectors

- b. Pin designations. The connectors used by Link, some of which are supplied by AMP and 3M, are marked to indicate pin 1 as shown in Figure 4. Pin 1 of the connectors shall align with pin 1 of the cable being used. The following color codes for various cables are used to designate pin 1:

LINK CABLE PART NO.	COLOR CODE/MARKING
676773-XX	Edge Marking
1002267-XX	Black Conductor
1005857-XXX	Brown Conductor
1006006-XXX	Brown Conductor
M49055/1-XXA	Edge Marking
M49055/11-XXJ	Edge Marking (Brown Conductor)

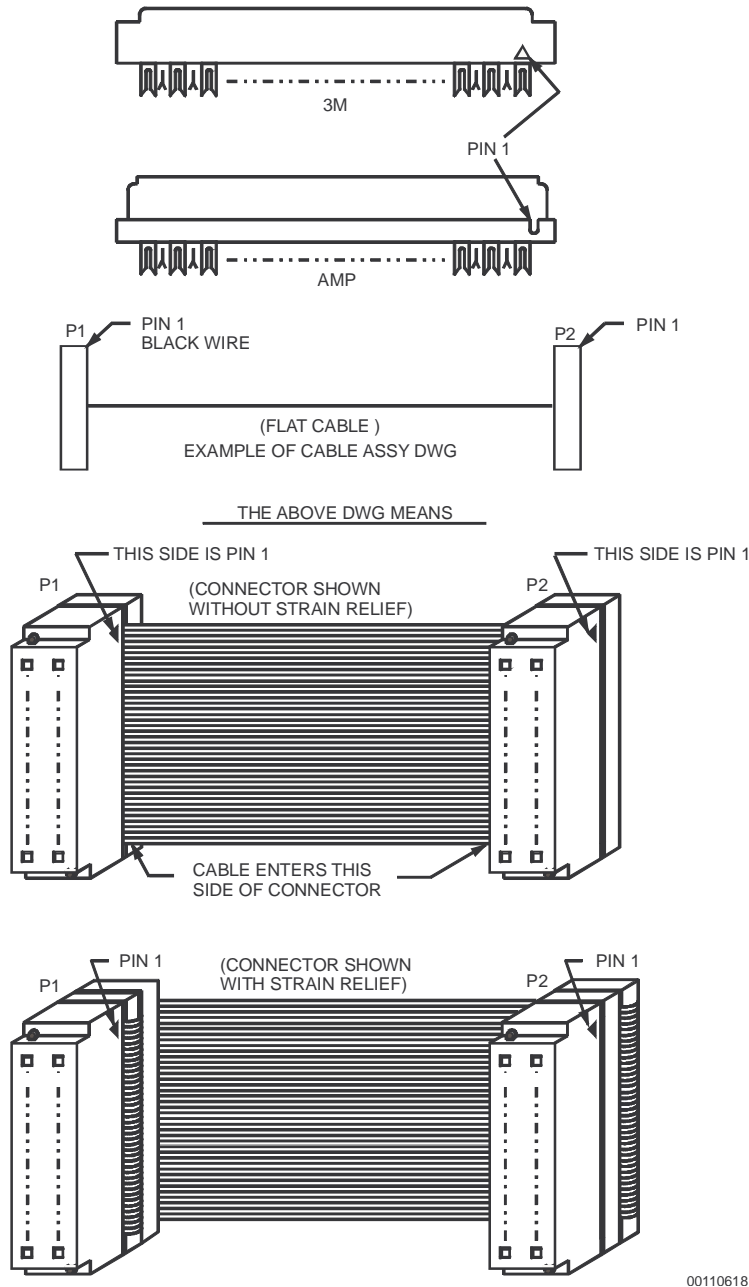


Figure 4 Flat Cable Assemblies

- c. 3M flat cable connector. An exception to this is a connector supplied by 3M. It displays 50 pins, 4 in a row, at an angle as shown in Figure 5.

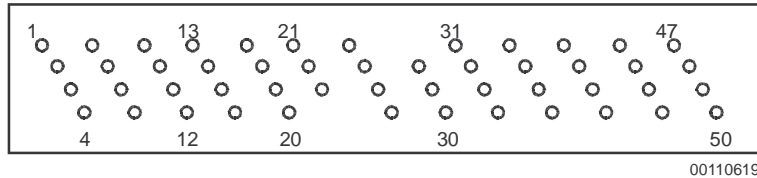


Figure 5 3m Flat Cable Connector

- d. Assembly instructions for 3M connectors using a 3M assembly press. Figure 7 depicts termination of a flat cable with a 3M connector. Explanation and illustration of each step of the assembly process are shown.

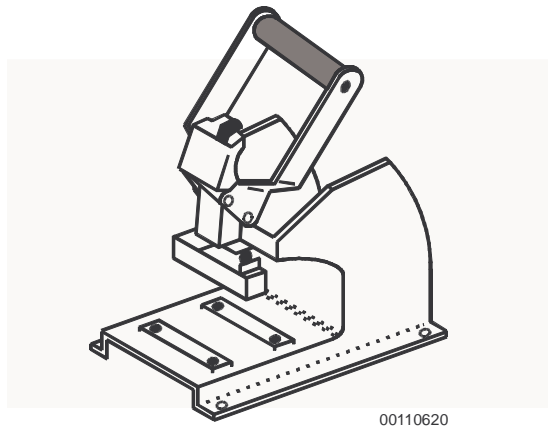


Figure 6 3m Connector Assembly Press

NOTE

It is recommended that a 3M assembly press, similar to that shown in Figure 6, be used to assemble the 3M flat cable connectors.

- (1) Step 1. A paper liner on the connector cover protects a nonconductive, transfer adhesive. Before removing the protective liner from adhesive, press thumb along length of liner. This will insure good adhesive transfer to the cover.

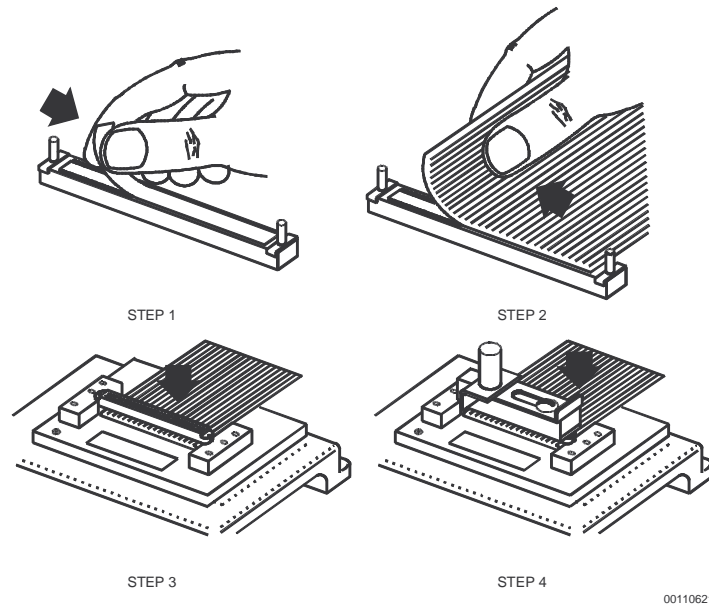
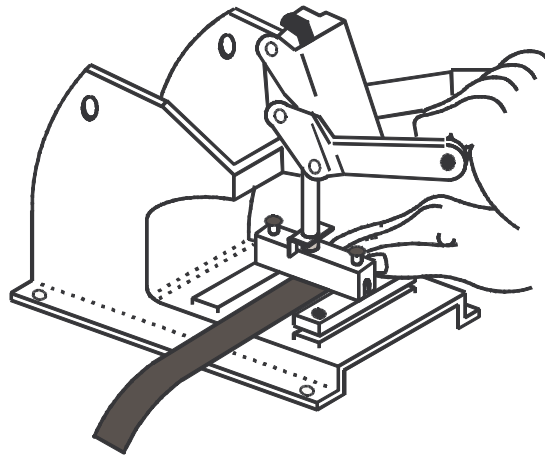


Figure 7 Assembly of 3m Flat Ribbon Connectors

- (2) Step 2. Cut cable to length using a cable shear or equivalent shearing action cutting device. Do not cut cable with a scissors-type device or trim cable flush with the connector after assembly. These actions can dislodge or smear the ends of the conductors, resulting in poor connections. Position the trimmed cable on the connector cover, matching the ridged contour of the cable to the grooved contour of the cover. The adhesive holds the cable to the cover during subsequent handling.
- (3) Step 3. This step may be approached from two positions. The connection body or the connector cover may be placed in the locator plate. The choice is made by the operator depending upon visibility and connector position on the cable. In either case, the ribbon cable must enter the connector from the pin 1 side and be flush with the pin 2 side. (Figure 7 depicts the cover placed in the connector plate and the connector body over the cover.) Posts on the cover mate with holes in the body to align the connector parts during termination.

- (4) Step 4. Lower handle of assembly press to complete connection. The handle of the press should be lowered until the arm of the press strikes the casting. (See Figure 8.) Raise the handle of the press and remove assembled connector by lifting it out of the locator plate slot.

NOTE: DO NOT REMOVE BY PULLING ON CABLE

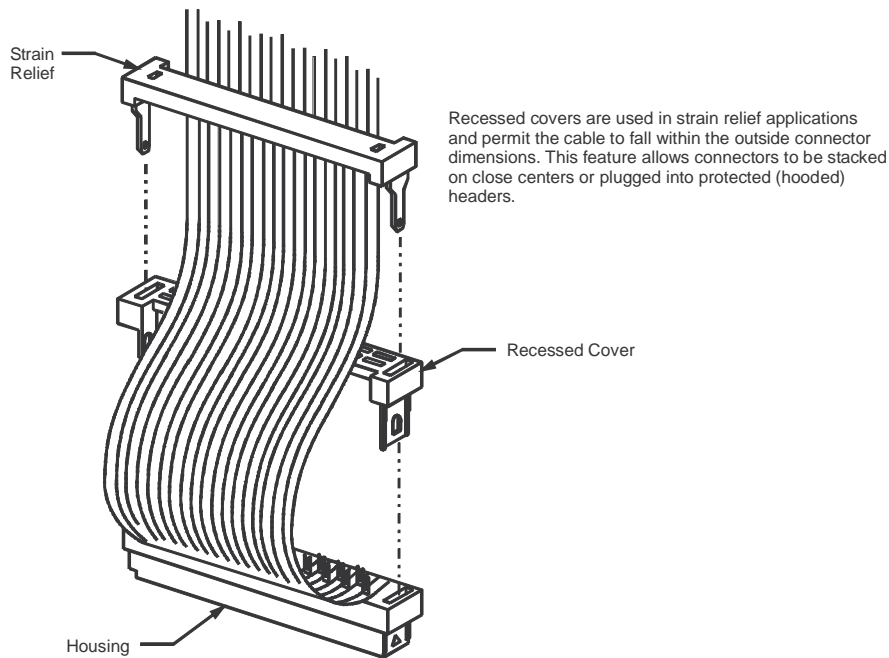


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Figure 8 Compressing Cable and Connector

- (5) Visually inspect the completed assembly for the following:
 - (a) Cover is fully seated and is parallel with body.
 - (b) Wires are in alignment with grooves.
 - (c) Cable or wire is flush with the edge of the connector if it is being used to terminate.
- e. The connector is now ready for a strain relief, if necessary.
- f. Strain relief. Strain relief covers and clips, when specified on the drawing, are assembled as follows:
 - (1) Bend cable back over cover and hold in this position.
 - (2) Start strain relief locking legs into slots provided in cover.

- (3) Push locking legs through cover and into connector until they lock in place. (See Figure 9.)



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Figure 9 Installation of Strain Relief

- g. Assembly instructions for AMP connectors using the AMP latch manual applicator. The AMP Latch Pneumatic Applicator (Figure 10) is designed to install flat cable in 10- through 60-position AMP connectors. The press ram is actuated by a foot pedal. The press ram remains in a loaded position as long as the foot pedal is depressed. The termination procedure for the flat cable is as follows:
- (1) Slide lower tooling away from press.

NOTE

Connectors can be flush-mounted and/or through-mounted (with .50-inch [1.27-cm] minimum centers), as indicated in Figure 11.

- (2) If making a through-mount termination, remove the cable stop. If making flush mount terminations, the cable stop must remain secured to the crimping insert.
- (3) Loosen adjustable cable guide screw and slide cable guide to extreme outside. Open cable clamp. This allows the applicator to be used for different sizes of flat cable.

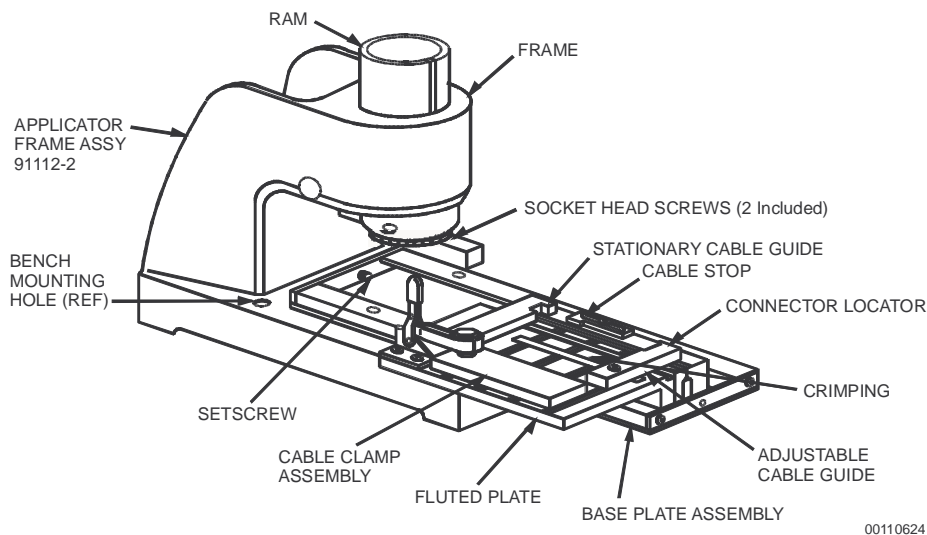


Figure 10 Amp Latch Manual Applicator

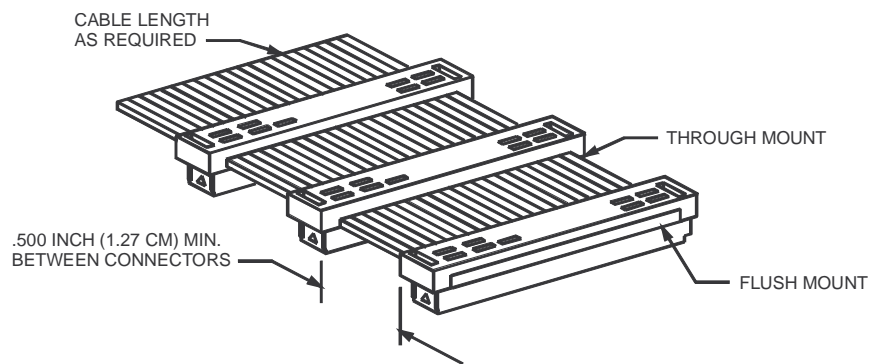


Figure 11 Amp Connector Spacing

- h. Cable installation. Refer to Figure 12.

- (1) Place cable on fluted plate with side of cable butted against stationary guide.
- (2) Slide cable along guide until it butts against cable stop or, if cable stop is not used (as in through-mounting), slide cable through tooling until desired location is centered on crimping inserts.
- (3) If flush mounting, loosen screw and center cable stop on cable; tighten screw to hold cable stop in position.
- (4) Close cable clamp to secure cable to fluted plate.

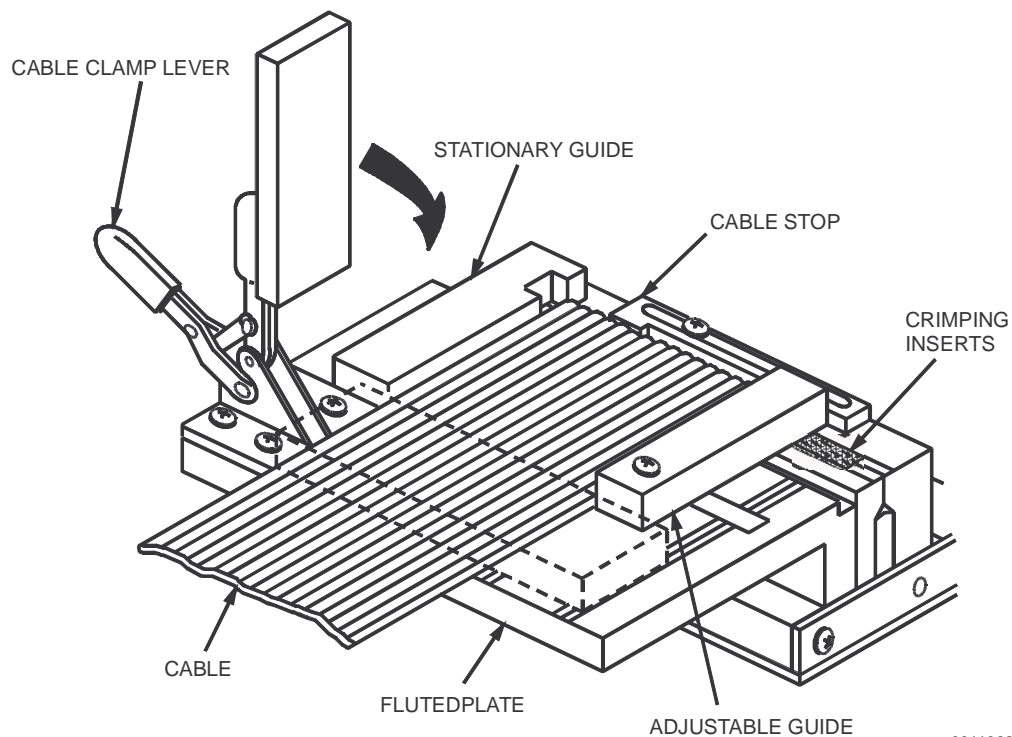
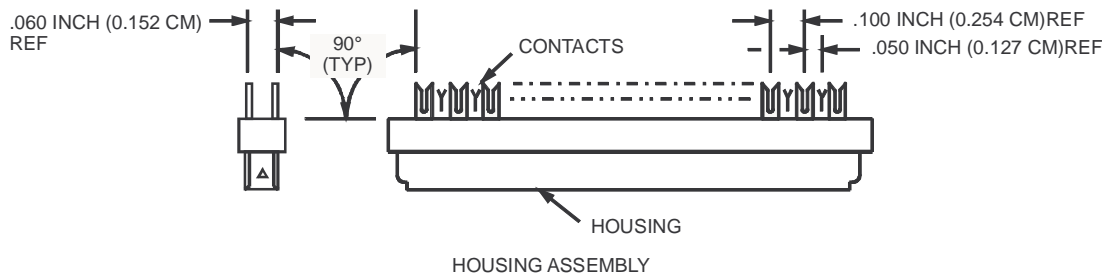


Figure 12 Installing Cable Into Applicator

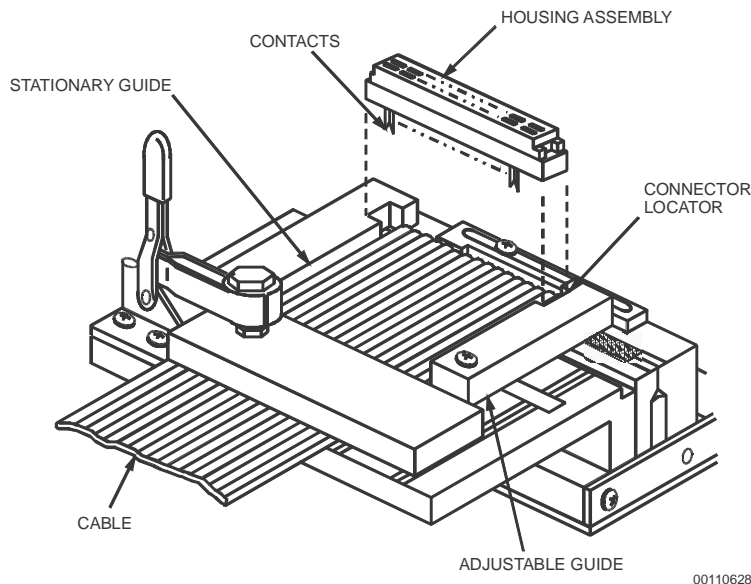
- i. Connector/Cover Installation.
 - (1) Check to be sure contacts in connector have not been deformed or misaligned during handling. (See Figure 13.)

- (2) Insert connector, with contacts facing cable, into locator slot in stationary guide. Slide adjustable guide toward stationary guide until locator slot butts against connector. Tighten screw to hold guide in position. (See Figure 14.)



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Figure 13 Contact Alignment



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Figure 14 Insertion of Connector Into Applicator

- (3) Slide lower tooling into press until it locks in place.
- (4) Press foot until connector bottoms on cable.
- (5) Slide lower tooling away from press. Open cable clamp and lift connector out of locator slots. Make sure connector is bottomed

on cable and contacts are not bent, twisted, or deformed in any manner.

- (6) Insert cover, with locking legs facing upward, into slots provided in connector. (See Figure 15.)

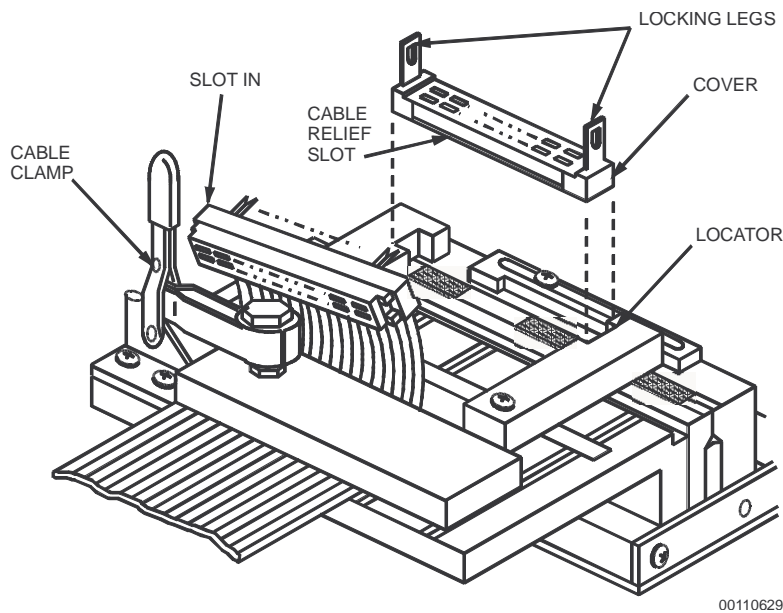
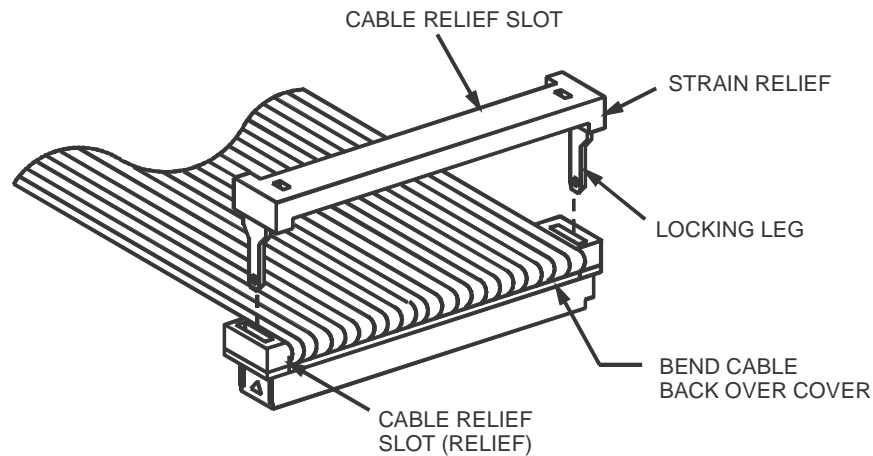


Figure 15 Inserting Connector Cover

- (7) Place connector into locator slots. Start cover locking legs into slots provided in connector.
- (8) Slide lower tooling into press until it locks in place.
- (9) Press foot pedal until connector bottoms on cover.
- (10) Slide lower tooling away from press. Lift connector out of locator and visually inspect cover installation. Make sure cover is bottomed on cable and locking legs are secured in connector. (See Figure 16.)
- (11) The connector is ready for strain relief, if specified. Refer to paragraph 1.6f.



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Figure 16 Completed Connector Assembly

2. Quality Assurance Provisions
 - 2.1 The Quality Assurance Organization shall be responsible for assuring that the workmanship meets the minimum requirements specified herein.
3. Preparation For Delivery (Not Applicable)