

NOTE



All numerical values are in metric units [with U.S. customary units in brackets]. Dimensions are in millimeters. Unless otherwise specified, dimensions have a tolerance of ± 0.13 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 application of Low Power Sealed Lighting Connectors for printed circuit (pc) board and free-hanging applications. Connectors are available in 2 through 4 contact positions. Cavities are marked with numbers to provide circuit identification. The pin header is available, for wire-to-board applications, in vertical or right angle configurations for through hole mount application or surface mount technology (SMT). The plug housings are available for free-hanging wire-to-wire applications. The plug locking latch ensures positive mating of the connectors.

The pin header contains pre-installed solder type contacts with precision formed solder tines. The pin header is available with boardlocks to provide stability for connector placement on the pc board. The connectors are placed on the pc board by hand application tooling or electrically-powered machines.

The receptacle housing accepts only Low Power Sealed Lighting Connector tab contacts sizes for 18-26 AWG wire. To ensure proper placement, the contact orientation barrel aligns with an orientation feature on the housing cavity. The contact contains locking lances designed to engage the housing contact retention shoulder and prevent backing out during mating of the connector.

The contacts are available in loose-piece for terminating with manual hand-held tools, and in strip form for terminating with semi-automatic or automatic electrically-powered machines.

The plug housing accepts only Low Power Sealed Lighting Connector receptacle contacts sizes for 18-26 AWG wire. To ensure proper placement, the contact orientation barrel aligns with an orientation feature on the housing cavity. The contact contains locking lances that will engage the housing contact retention shoulder to prevent backing out during mating of the connector.

When corresponding with personnel, use the terminology provided in this specification to facilitate your inquiries for information. Basic terms and features of this product are provided in Figure 1.

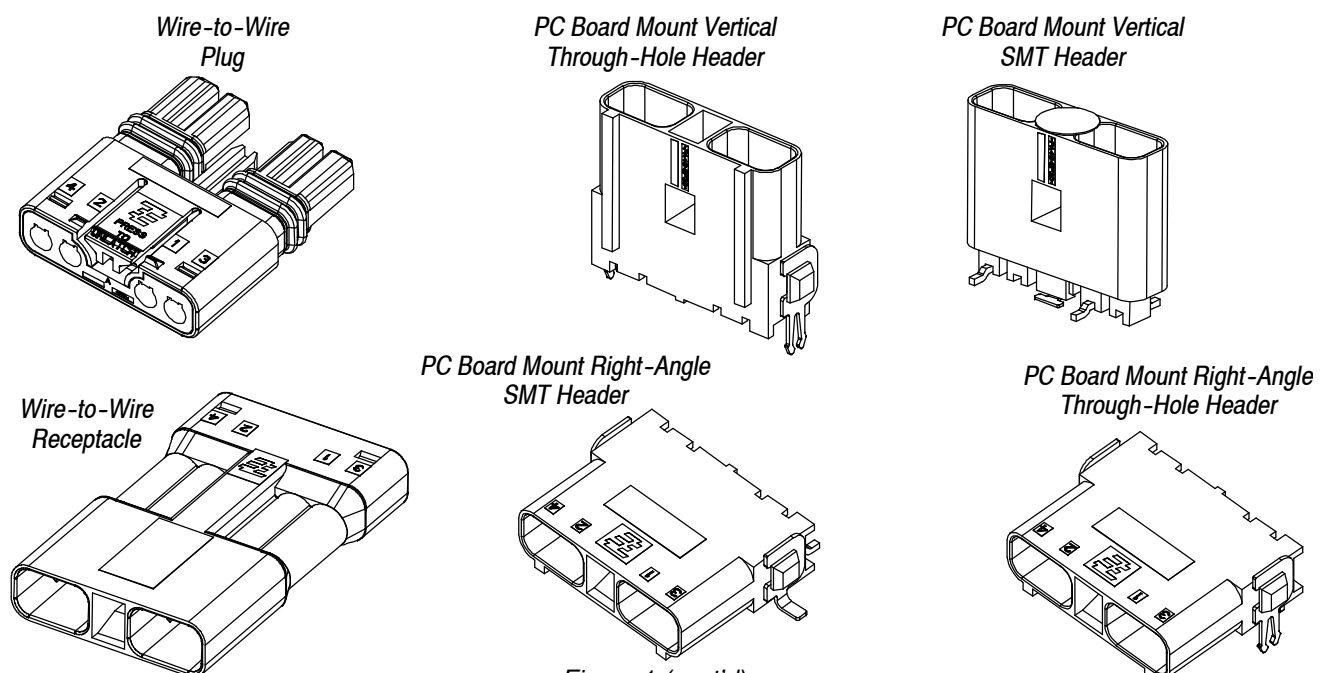


Figure 1 (cont'd)

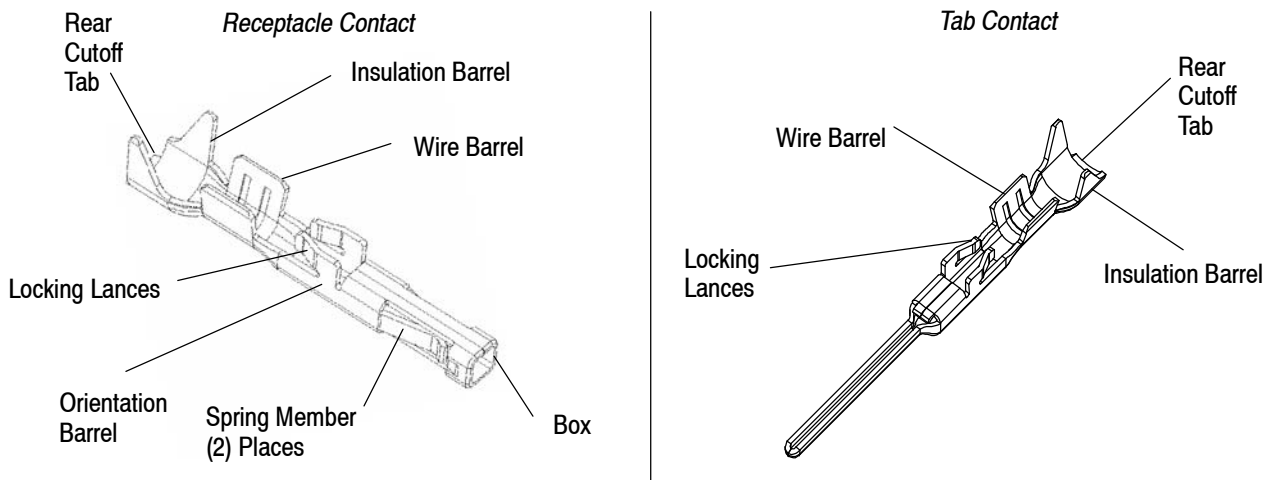


Figure 1 (end)

2. REFERENCE MATERIAL

2.1. Revision Summary

- Initial release of document

2.2. Customer Assistance

Reference Base Product Part Numbers 2106135 and 2106136 and Product Code L012 are representative of Low Power Sealed Lighting Connectors. 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 Tyco Electronics Representative or, after purchase, by calling the Product Information Center at the number at the bottom of page 1.

2.3. Drawings

Customer Drawings for specific products 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 Tyco Electronics.

2.4. 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 provide setup, operation, and maintenance procedures of machines.

<u>Document Number</u>	<u>Document Title</u>
408-3295	Preparing Reel of Contacts for Applicator Tooling
408-7424	Checking Terminal Crimp Height
408-8040	Heavy Duty Miniature Quick-Change Applicators (Side-Feed Type)
408-8053	Conversion Guide for Miniature Quick Change Applicators
408-8059	General Preventive Maintenance for Miniature Quick-Change Applicators
408-8547	CERTI-CRIMP* II Straight Action Hand Tools
408-9816	Handling of Reeled Products
408-9453	Extraction Reset Tool 843996-[]
409-5128	AMP-O-ELECTRIC* Model "K" Terminating Machine 565435-5
409-5842	AMP-O-ELECTRIC Model "G" Terminating Machine 354500-[]
409-5852	AMPOMATOR* CLS III-G Lead-Making Machine 122500-[]
409-5866	AMPOMATOR CLS IV Lead-Making Machine 217500-[]
409-5878	AMPOMATOR CLS IV+ Lead-Making Machine 356500-[]
409-10016	Entry Level Terminator (ELT) Machine 1338600-[]
409-10027	Stripping Modules 1490500 and 1490502
409-10029	Stripping Modules 1490501 and 1490503

2.5. Specifications

Design Objective 108-2391 provides expected product performance and test information.

2.6. Manuals

Manual 402-40 is available upon request and can be used as a guide to soldering. This manual provides information on various flux types and characteristics with the commercial designation and flux removal procedures. A checklist is included in the manual as a guide for information on soldering problems.

3. REQUIREMENTS

3.1. Safety

Do not stack component packages so high that the shipping containers buckle or deform.

3.2. Material

The housings are made of flame-retardant black thermoplastic, and the contacts are made of copper alloy. The wire-to-wire plug and receptacle housings are made of material having an F1 rating per UL746C.

3.3. Storage

A. Shelf Life

The contacts should remain in the shipping containers until ready for use to prevent deformation of the contacts. The contacts should be used on a first in, first out basis to avoid storage contamination that could adversely affect performance.

B. Reeled Contacts

When using reeled contacts, store coil wound reels horizontally and traverse wound reels vertically.

3.4. Chemical Exposure

Do not store connectors or contacts near any chemical listed below as they may cause stress corrosion cracking in the connectors or contacts.

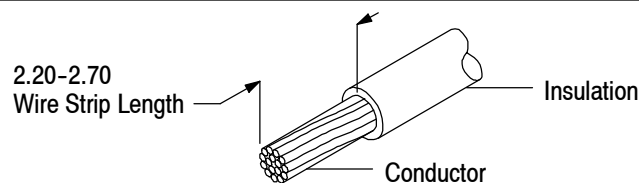
Alkalies	Ammonia	Citrates	Phosphates	Citrates	Sulfur Compounds
Amines	Carbonates	Nitrites	Sulfur Nitrites		Tartrates

3.5. Wire Selection and Preparation

The contacts will accept stranded wire sizes 18 through 26 AWG with an insulation diameter range of 1.3 to 2.1 mm. Proper strip length is necessary to properly insert the wire into the contact. The strip length of the wire is shown in Figure 2.



Reasonable care must be taken not to nick, scrape, or cut any strands during the stripping operation.



WIRE (STRANDED ONLY)			WIRE BARREL CRIMP		INSULATION BARREL CRIMP	
SIZE (AWG)	INSULATION DIAMETER	STRIP LENGTH	HEIGHT ± 0.05	WIDTH	HEIGHT (REF)	WIDTH (REF)
18	1.7-2.1	2.2-2.7	1.05	1.40	2.20	1.80 (Hand Tool)
20			0.87		1.95	2.00 (Applicator)
22	1.3-1.6	2.2-2.7	0.79	1.07	1.5	1.80 (Hand Tool)
24						1.57 (Applicator)
26						

Figure 2

3.6. Crimp Requirements



Wire insulation must NOT be cut or broken during the crimping operation. Reasonable care should be taken to provide undamaged wire terminations.

The contact must be crimped to the wire according to instructions packaged with applicable tooling.

A. Cutoff Tab and Burr

Cutoff tabs are the remaining portion of the carrier strip after the contact is cut from the strip. The following dimensional requirements will ensure proper application for these contacts.

1. The rear cutoff tab must not extend beyond the insulation barrel more than the limits shown in Figure 3.
2. The burr resulting from the cutoff tab shearing must not exceed the dimension shown in Figure 3.

B. Locking Lance

The locking lances must be free of damage as shown in Figure 3.

C. Spring Members

There must be no damage or distortion to the spring members of the receptacle contacts or the tab end of the tab contact. See Figure 3.

D. Orientation Barrel

There must be no damage or distortion to the orientation barrel. See Figure 3.

E. Wire Barrel Crimp

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 wire barrel must be crimped in the "F" crimp where the tips of the wire barrel turn inward and capture the wire strands. The wire barrel crimp height and width must be within the dimensions provided in Figure 2.

F. Effective Crimp Length

Effective crimp length is defined as that portion of the wire barrel, excluding bellmouths, fully formed by the crimping tool. For optimum crimp effectiveness, the crimp must be within the limits shown in Figure 3.

G. Wire Barrel Seam

The seam between the two sides of the wire barrel must be completely closed and there must be no evidence of loose wire strands or wire strands visible in the seam. Refer to Figure 3.

H. Bellmouths

The front and rear bellmouths caused by extrusion of the contact material during crimping must be within the limits shown in Figure 3.

I. Wire Barrel Flash

Wire barrel flash is the formation that may appear on both sides of the wire barrel as the result of crimping. It must not exceed the dimension provided in Figure 3.

J. Insulation Barrel Crimp

The insulation barrel crimp is crimped to form a support for the insulation. The insulation barrel must be crimped where the tips of the insulation barrel wrap around and capture the wire insulation. The insulation barrel crimp width is shown in Figure 2.

K. Insulation Barrel Seam

The two legs of the insulation barrel must completely grasp the wire insulation. The two legs of the insulation barrel must not overlap on top of one another. Refer to Figure 3.

L. Conductor Location

The wire insulation and conductor must be visible within the transition area (between the contact insulation barrel and wire barrel). The insulation must not enter the wire barrel. The wire conductor ends must be flush to or extend slightly beyond the wire barrel to the limit provided in Figure 3.

NOTE: Receptacle contact shown. Tab contact has same dimensions for crimp requirements.

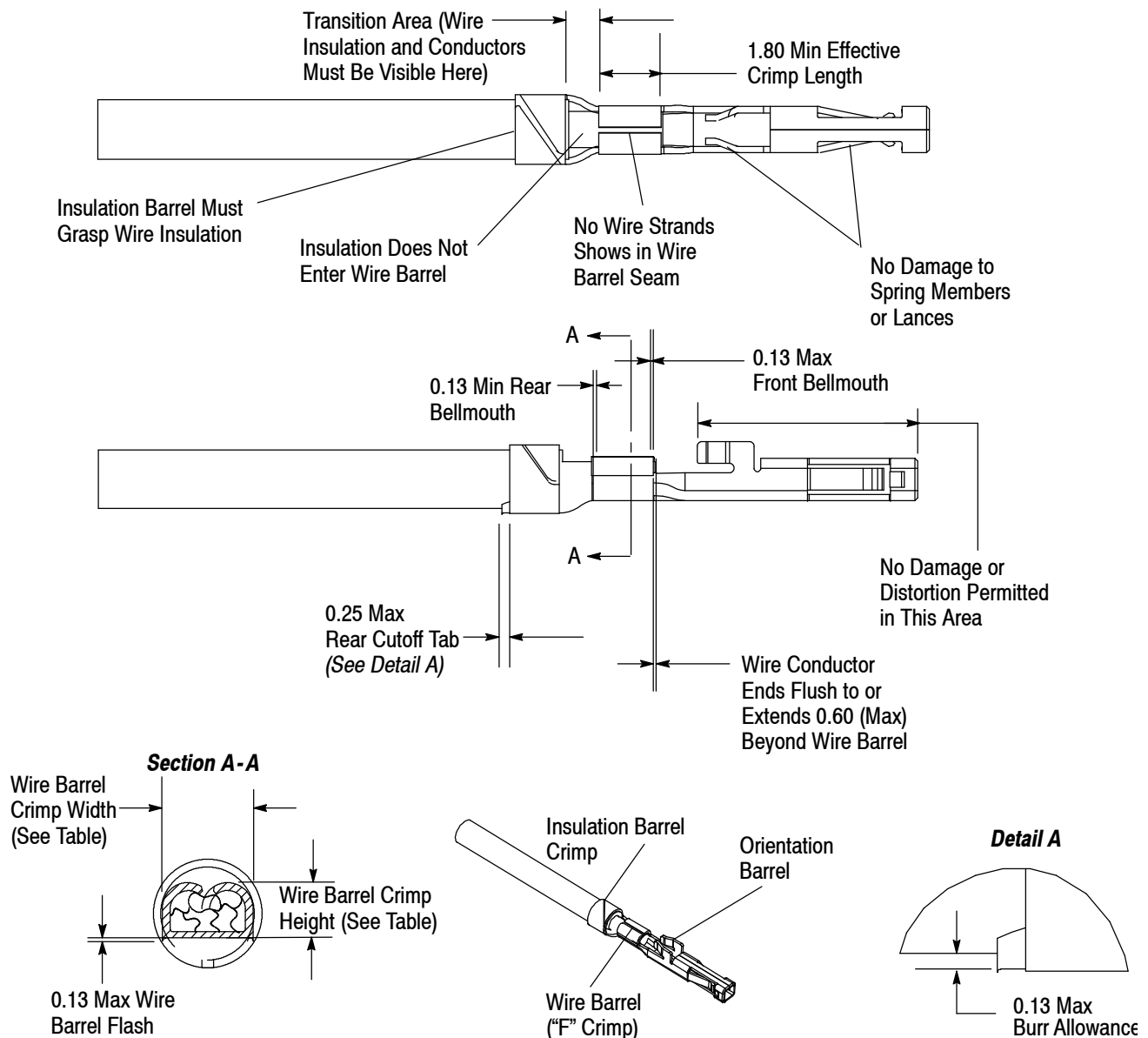


Figure 3

NOTE

The developed crimp configurations result from using the specific tooling described in Section 5, TOOLING.



M. Straightness

The force applied during crimping may cause some bending between the wire barrel and the mating portion of the contact. Such deformation is acceptable within the following limits.

1. Up and Down

The crimped portion, including cutoff tab and burr, must not be bent beyond the limits shown in Figure 4.

2. Side-to-Side

The crimped portion must not be bent from one side to the other beyond the limits shown in Figure 4.

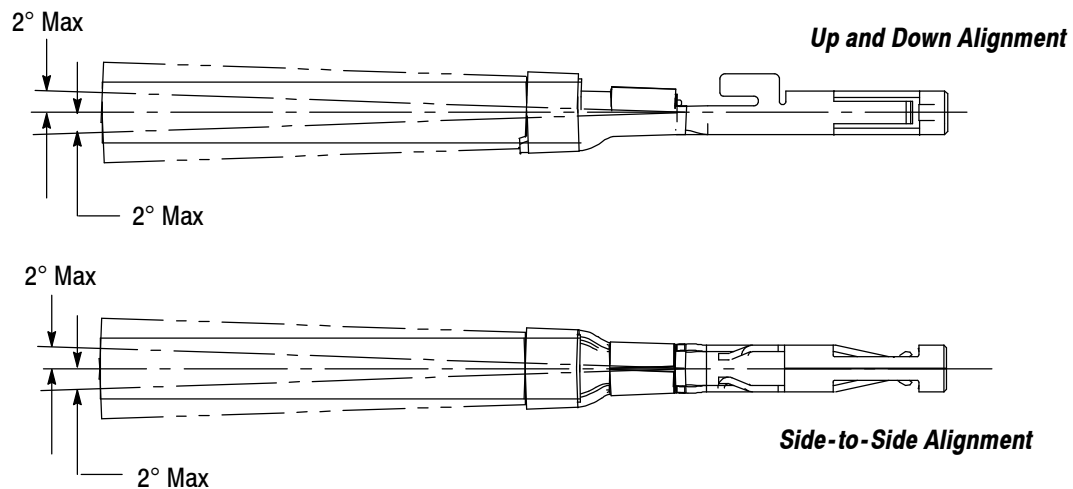


Figure 4

N. Twist and Roll

There should be no twist or roll of the wire barrel or mating portion of the crimped contact beyond the limits shown in Figure 5.

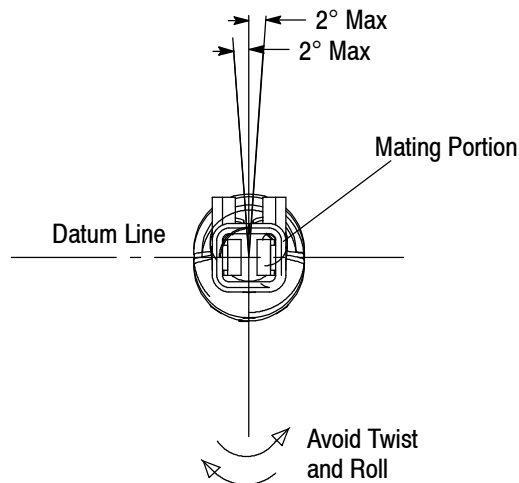


Figure 5

3.7. Placement of Crimped Contacts

A. Receptacle Housing

The contact orientation barrel must be aligned with the contact cavity orientation feature (located on the back of the receptacle). In order to prevent damage to the wire seal, the contact must be inserted slowly through the seal and into the housing. The contact should be properly oriented before insertion through the seal and not turned as it passes through the seal. The contact must be inserted into the housing contact cavity and snapped into place. When fully inserted, the contact locking lances will engage the contact retention shoulder and prevent backing out during mating of the connectors. After inserting contact into housing, pull back lightly on the wire to ensure contact is fully seated. See Figure 6.

NOTE

An insertion tool is not required to insert contacts into receptacles.



CAUTION

Tab contacts are for use with receptacle housings only. Do not insert tab contacts into plug housings.

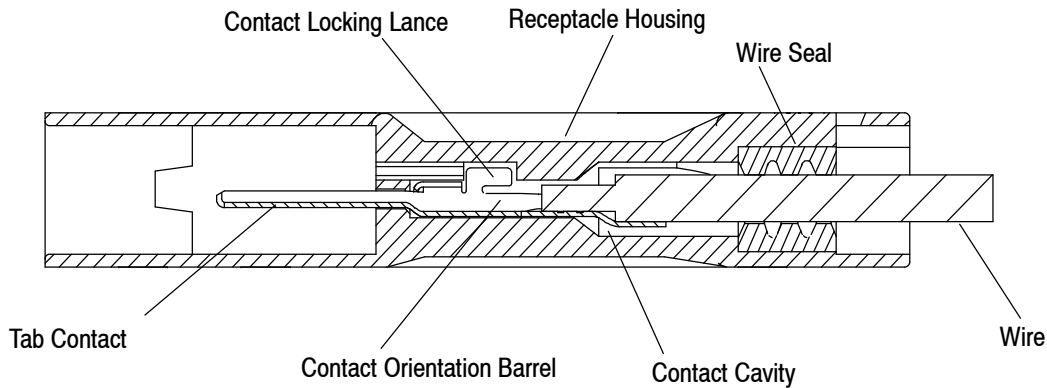


Figure 6

B. Plug Housing

The contact orientation barrel must be aligned with the contact cavity orientation feature (located on the back of the plug housing). In order to prevent damage to the wire seal, the contact must be inserted slowly through the seal and into the housing. The contact should be properly oriented before insertion through the seal and not turned as it passes through the seal. The contact must be inserted into the housing contact cavity and snapped into place. When fully inserted, the contact locking lances will engage the contact retention shoulder and prevent backing out during mating of the connectors. After inserting contact into housing, pull back lightly on the wire to ensure contact is fully seated. See Figure 7.

CAUTION

Receptacle contacts are for use with plug housings only. Do not insert receptacle contacts into receptacle housings. Care must be taken to keep the seals clean and protected from damage. A damaged seal will not function properly.

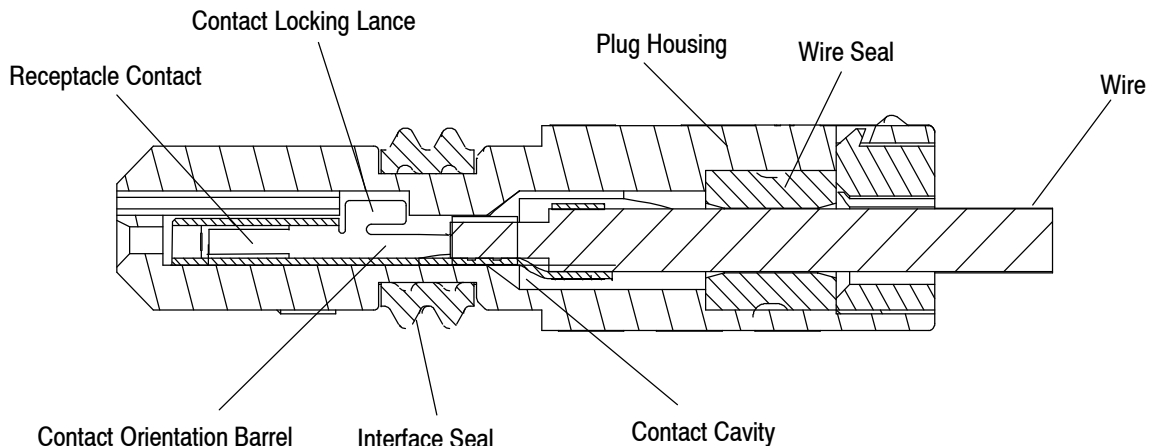


Figure 7

3.8. PC Board

A. Material and Thickness

The pc board material shall be glass epoxy (FR-4 or G-10). The pc board thickness shall be 1.57 mm.

NOTE

Contact the Product Information Center at the number listed at the bottom of page 1 for suitability of other board materials and thicknesses.

B. Tolerance

Maximum allowable bow of the pc board shall be 0.03 mm over the length of the pin header.

C. Layout for Through Hole Mount Connectors

1. The pc board and lead wires must be solderable in accordance with Test Specification 109-11.
2. The pc board holes for the contact solder tines and holddowns must be drilled and plated through to specific dimensions to prevent stubbing during placement of the connector on the pc board and to ensure optimum continuity for circuits after soldering. The drilled hole size, plating types, and plating thickness will depend on application requirements. The finished hole size must be as stated to provide unrestricted insertion and ensure adequate application of solder to the solder tines. See Figure 8.

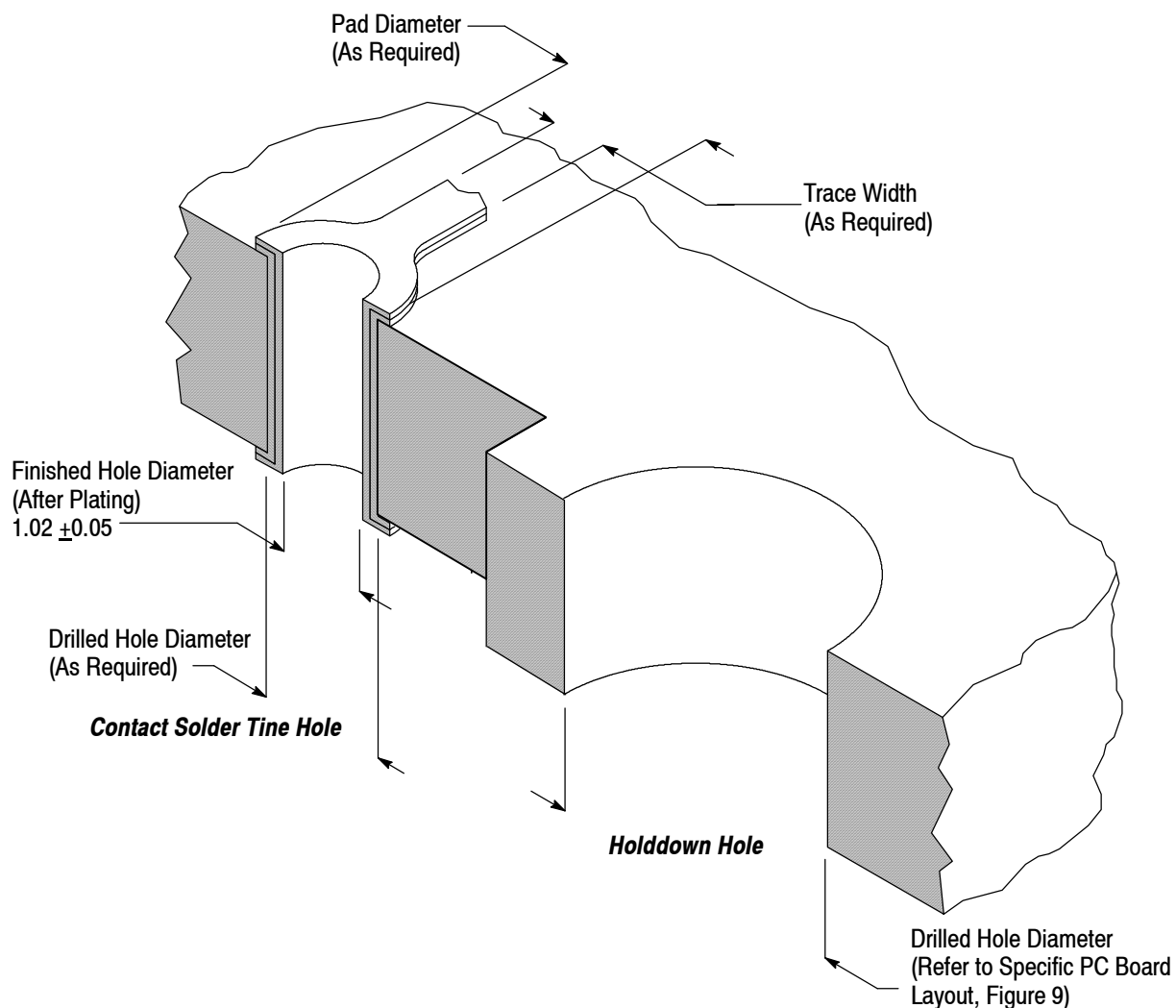
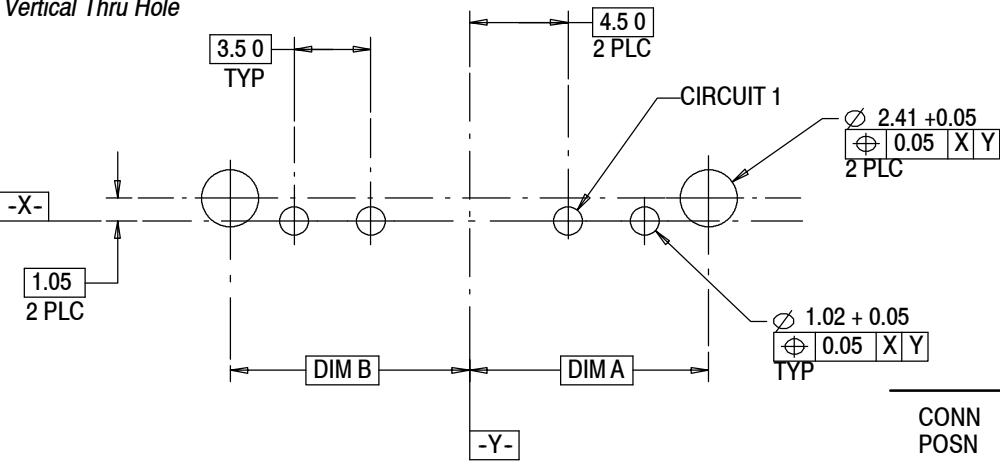


Figure 8

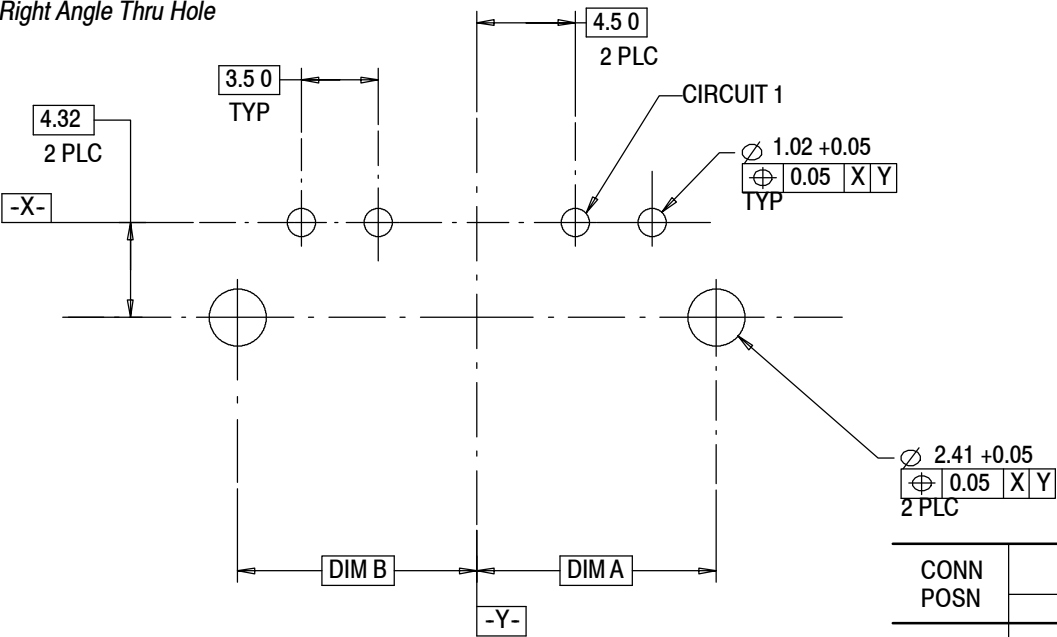
3. The contact holes and boardlock holes in the pc board must be precisely located to ensure proper placement and optimum performance of the connector. Design the pc board using the dimensions provided in Figure 9.

Vertical Thru Hole



CONN POSN	DIMENSION	
	B	A
2	7.42	7.42
3	7.42	10.92
4	10.92	10.92

Right Angle Thru Hole



CONN POSN	DIMENSION	
	B	A
2	7.42	7.42
3	7.42	10.92
4	10.92	10.92

Figure 9

D. Layout for Surface Mount Connectors

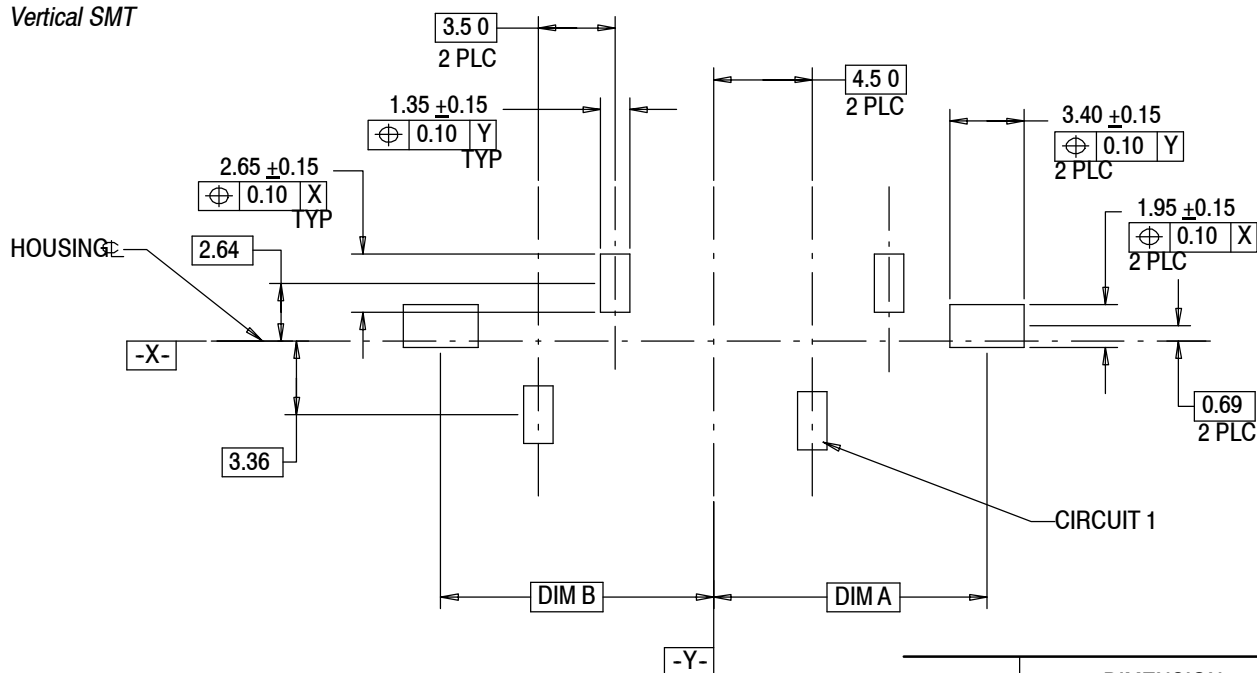
The pc board pads must be solderable in accordance with EIA-638 (Electronic Industries Alliance).

NOTE



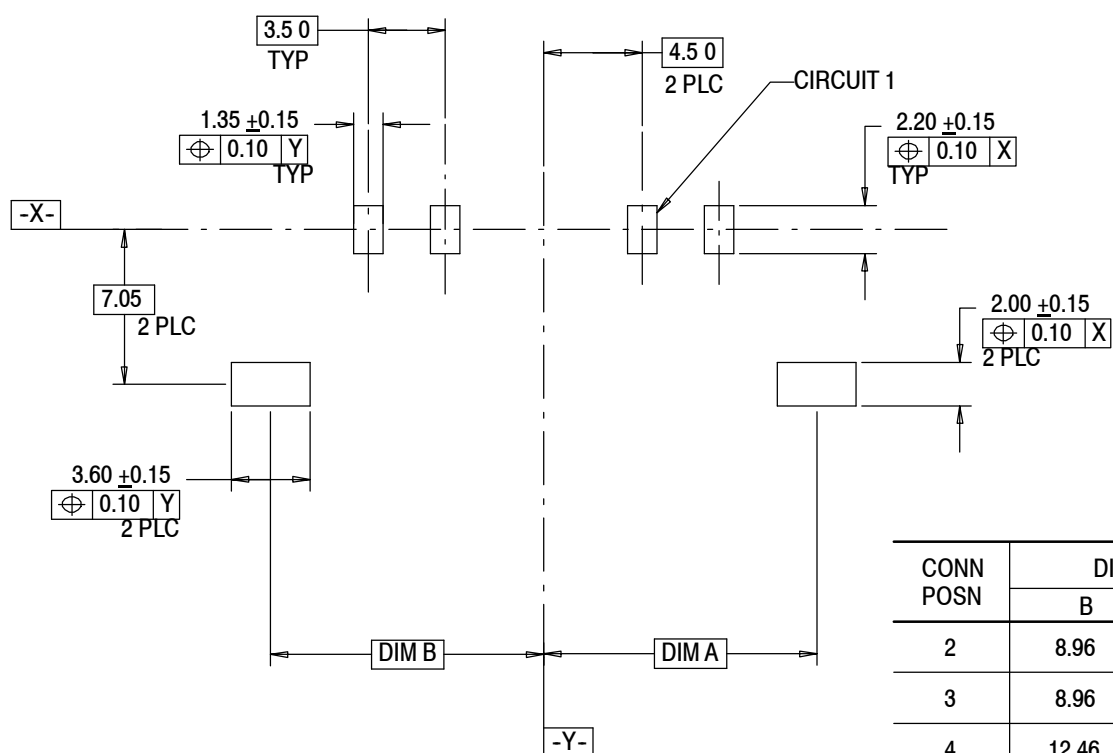
Two representative examples of recommended pc board patterns, dimensions, and tolerances are shown in Figure 10. Consult the customer drawings for specific pc board layouts or part numbers not listed in this document. Component side shown. See Paragraph 2.3.

Vertical SMT



CONN POSN	DIMENSION	
	B	A
2	8.96	8.96
3	8.96	12.46
4	12.46	12.46

Right Angle SMT



CONN POSN	DIMENSION	
	B	A
2	8.96	8.96
3	8.96	12.46
4	12.46	12.46

Figure 10

3.9. Soldering Process

NOTE

After the connector is seated onto the pc board, the mechanical holddowns must be soldered along with the contacts during the soldering process.

Observe guidelines and procedures when soldering contacts. Solder, clean, and dry all contacts according to the following:

A. Solder Paste Characteristics

1. Alloy type shall be SAC 305; Sn 96.5/Ag 3.0/Cu 0.5.
2. Flux incorporated in the paste shall be rosin, mildly active (RMA) type.
3. Paste will be at least 80% solids by volume.
4. Mesh designation -200 to +325 (74 to 44 square micron openings, respectively).
5. Minimum viscosity of screen print must be $5 \times 10\%$ cp (centipoise).
6. Minimum viscosity of stencil print must be $7.5 \times 10\%$ cp (centipoise).

B. Stencil or Screen

The stencil aperture is determined by the size of the circuit pad and thickness of the stencil. It may be any shape as long as it prevents solder bridging and maintains the correct volume of solder paste.

CAUTION

All traces must be covered by solder mask in the solder deposit area. Exposed traces could cause bridging and create a short, or wick solder away, producing a weak solder joint.

CAUTION

If a hold-down aperture is used, the design must ensure that the connector housing will not sit on the solder deposit.

C. Solder Volume

Recommended solder volume deposit (wet paste per solder pad) must be:

- 1.59 mm³ per contact solder tine for vertical pin header connectors
- 1.59 mm³ per contact solder tine for right angle pin header connectors
- 1.08 mm³ per holddown

NOTE

Solder volume may vary depending on solder paste composition. Values provided are based on 90% solids by volume.

D. Solder Mask

Solder mask is recommended between all pads. If a trace is run between adjacent pads on the solder side of the pc board, a solder mask must be applied over the trace to prevent bridging and wicking of solder away from the contact solder tines. Additionally, there should be solder mask covering any traces in the area of the holddown (if applicable) solder deposit. Liquid photo imageable or dry film solder masks are recommended.

E. Flux Selection

Contact solder tines must be fluxed prior to soldering with a mildly active, rosin base flux. Selection of the flux will depend on the type of pc board and other components mounted on the board. Additionally, the flux must be compatible with the wave solder line, manufacturing, health, and safety requirements. Call Product Information Center at the number at the bottom of page 1 for consideration of other types of flux.

F. Connector Placement

Machine placement of connectors is recommended due to the inherent difficulty of manual placement of fine-pitch connectors and to minimize possible damage that could result from improper handling. The top

of vertical pin headers has an adhesive-backed pad to facilitate vacuum pick-up and handling, and right angle pin headers can be picked up by the housing. To avoid damage, connectors should be picked up by the machine directly from the connector embossed-tape package.

CAUTION

If connectors are placed on the board manually, the connector should be handled only by the housing to avoid deformation, contamination, or damage to the contact solder tines and holdowns.

1. Surface Mount Connectors

Optimally, the contact solder tines should be centered on the pc board circuit pads. However, slight misalignment is permissible as shown in Figure 11.

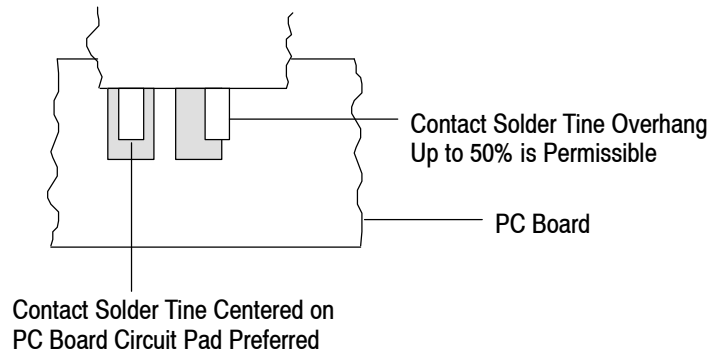


Figure 11

2. Through Hole Mount Connectors

When placing through hole mount connectors on the pc board, make sure that the contact solder tines are aligned and started into the matching holes before seating the connector onto the pc board.

G. Technique

The connectors can be soldered using wave, non-focused infrared (IR) reflow soldering, or equivalent soldering technique. The temperatures and exposure time must be as specified in Figure 12.

SOLDERING PROCESS	TEMPERATURE (Max)	TIME (Max)
Wave	245° C [473° F]	5 Seconds
IR	225° C [437° F]	90 Seconds

Figure 12

H. Cleaning

After soldering, removal of fluxes, residues, and activators is necessary. Consult with the supplier of the solder and flux for recommended cleaning solvents. Cleaners must be free of dissolved flux and other contaminants.

CAUTION

Even when using "no clean" solder paste, it is imperative that the contact interface be kept clean of flux and residue, since it acts as an insulator. Flux may migrate under certain conditions with elevated temperatures and, therefore, cleaning is necessary.

DANGER

Consideration must be given to toxicity and other safety requirements recommended by the solvent manufacturer. Refer to the manufacturer's Material Safety Data Sheet (MSDS) for characteristics and handling of cleaners. It is not recommended using Trichloroethylene and Methylene Chloride because of harmful occupational and environmental effects. Both are carcinogenic (cancer-causing).

I. Drying

When drying cleaned assemblies, make certain that temperature limitations are not exceeded: -40° to 105° C [-40° to 221° F]. Excessive temperatures may cause housing degradation or plating deterioration.

3.10. Checking Installed Connector

All solder joints should conform to the requirements specified in this document and those specified in the following: Workmanship Specification 101-21 for surface mount connectors
Test Specification 109-11 for through hole mount connectors

Solder must be evenly distributed and not cracked. The connector standoffs must be seated on the pc board, and the housing not exceeding the dimension shown in Figure 13.

3.11. Polarization

The design of each contact cavity assures polarization for mating connectors.

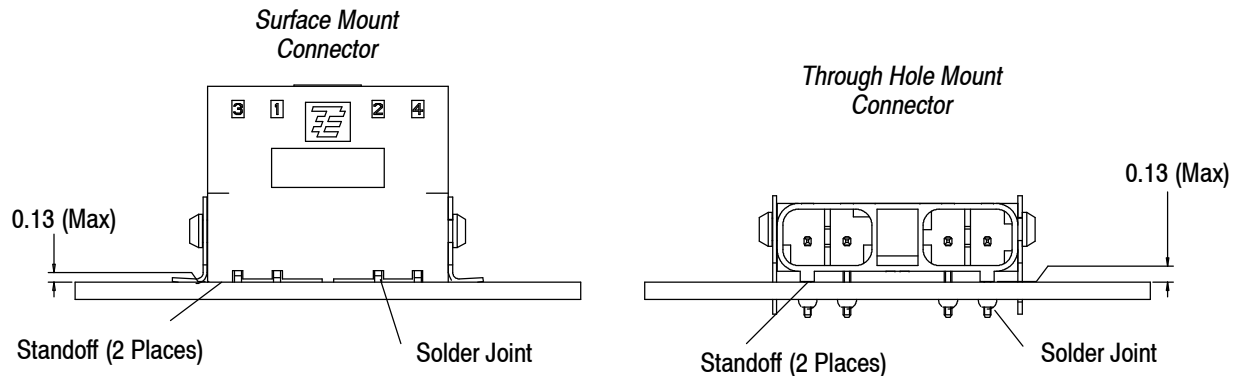


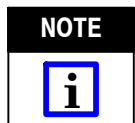
Figure 13

3.12. Mating Connectors

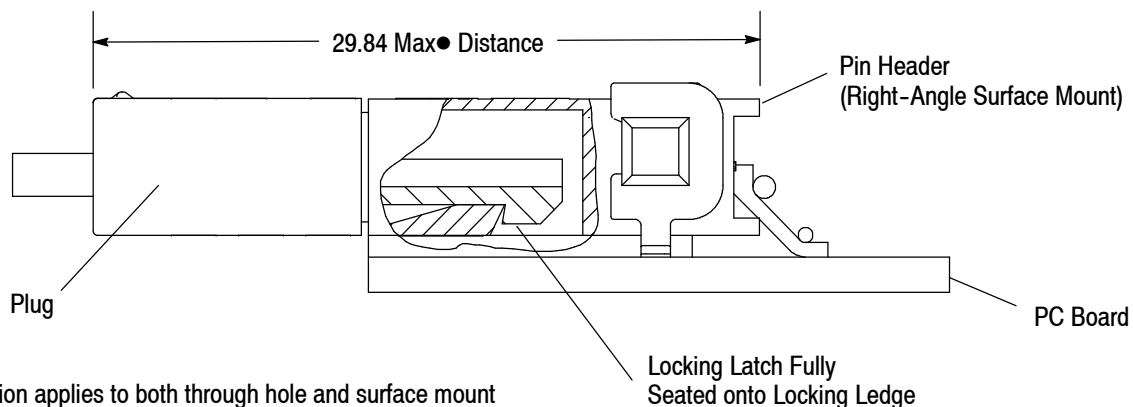


Connectors should be handled only by the housing to avoid deformation, contamination, or damage to the contact solder tines.

The plug has an integral locking latch that should be fully seated and latched to the pin header locking ledge after mating. The locking latch and locking ledge ensure positive mating of connectors. The distance between mating connectors must be considered when determining location of connectors to ensure full mating. The mated dimension of the plug housing to the pin header housing is provided in Figure 14.



Plugs will mate only with the appropriate pin headers or receptacle housings; the plug and pin header or receptacle housing must have identical number of circuit positions and rows.



●Dimension applies to both through hole and surface mount and right-angle and vertical headers when mated.

Figure 14

3.13. Repair

Damaged connectors must be removed, discarded, and replaced.

1. The connectors must be unmated by releasing the locking latch on the plug from the locking ledge on the pin header and pulling the plug straight out.
2. Damaged or worn crimp type contacts may be replaced provided there is sufficient slack, after restripping the wire, to insert the new contact into the housing. An extraction tool must be used to remove individual contacts from the housing.
3. Pin headers will require standard de-soldering of all contact solder tines. Individual solder type contacts cannot be replaced.

4. QUALIFICATION

Low Power Sealed Lighting Connectors have not yet been sent for agency evaluation.

5. TOOLING

Tooling part numbers and instructional material packaged (if available) with the tooling are shown in Figure 15.

5.1. Extraction Tool

The extraction tool is designed to remove contacts from the housings by releasing the contact locking lances from the housing without overstressing the contact.

5.2. Hand Crimping Tool

The hand crimping tools accommodate the full wire size range for terminating crimp type contacts. These tools are designed for prototype and low-volume application of loose piece form contacts.

5.3. Robotic Equipment

For automatic machine placement, a pc board support must be used to prevent bowing of the pc board during the placement of contacts and holddowns on the board. It should have flat surfaces with holes or a channel large enough and deep enough to receive the contacts and holddowns. The robotic equipment must have a true position accuracy tolerance to properly locate the contacts. This includes gripper and fixture tolerances as well as equipment repeatability. It must use the contact datum surfaces detailed on the customer drawing to ensure reliable placement.

5.4. Power Unit

NOTE



Modified designs and additional tooling concepts may be available to meet other application requirements. Machines have been designed for a variety of application requirements. For assistance in setting up prototype and production line equipment, call the Tooling Assistance Center at the number at the bottom of page 1.

A. Applicator

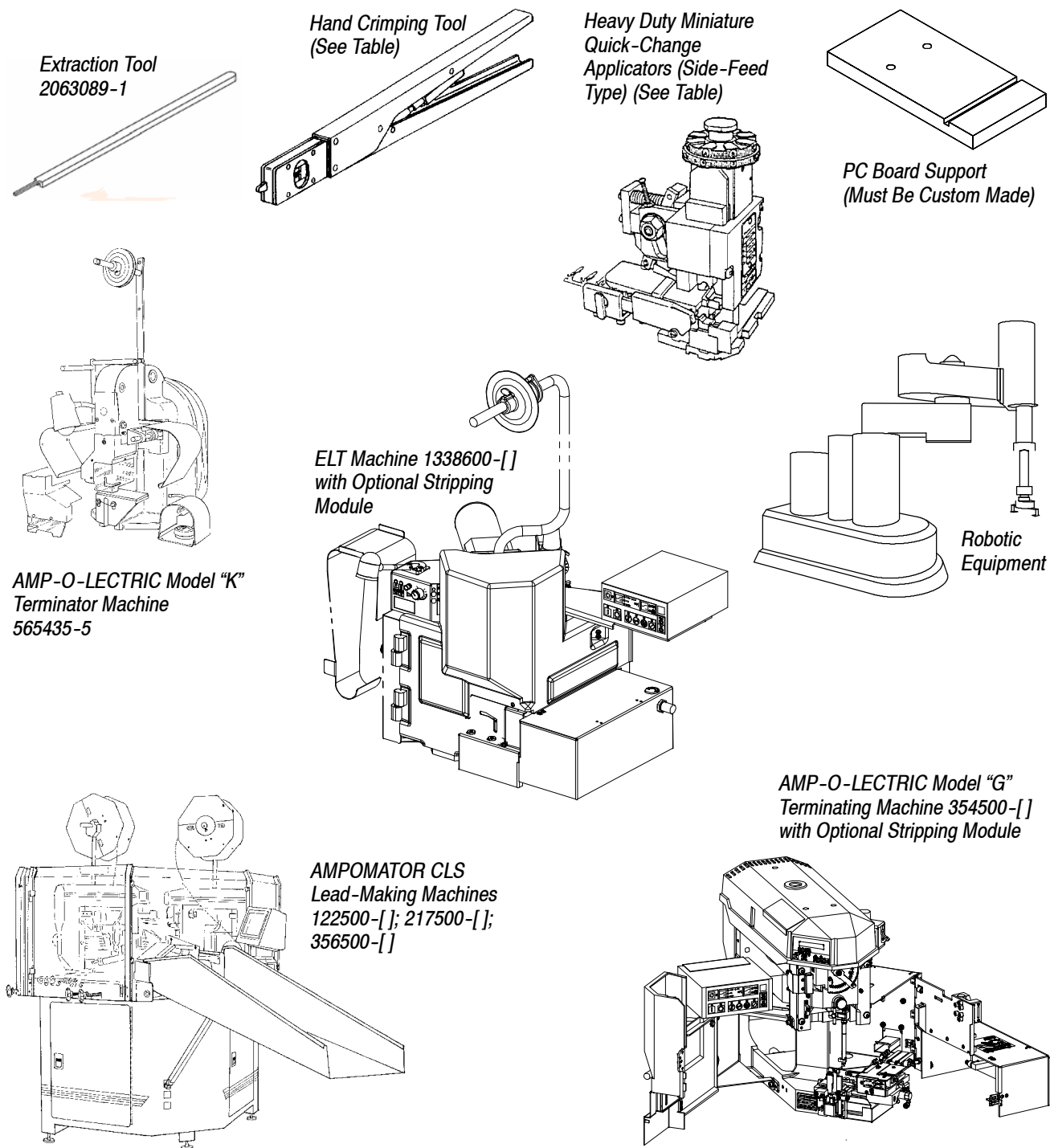
The applicators are designed to crimp strip form contacts onto pre-stripped wire, and provides for high volume, heavy duty production requirements. These applicators accept interchangeable crimping dies and must be installed onto a power unit.

B. Semi-Automatic Machine

The AMP-O-ELECTRIC machine is an electrical power unit designed for terminating pre-stripped wires to reel-fed contacts. It is designed to be bench mounted and used for high volume applications.

C. Automatic Machine

These power units provide the force required to drive applicators for crimping tape-mounted contacts. They can be set up to automatically measure, cut, strip, and terminate wire. They provide for high volume, heavy duty production requirements. The AMPOMATOR CLS IV+ machine is an electrical power unit designed to be floor standing.



TOOLING PART NUMBERS				
WIRE SIZE RANGE (AWG)	HAND TOOL	APPLICATOR FOR		
		MODEL "K"	MODEL "G"	LEAD-MAKER
18-20	2063957-1	1530177-2	1530177-3	1530177-1
22-26	2063956-1	1530178-2	1530178-3	1530178-1

Figure 15

6. VISUAL AID

Figure 16 shows a typical application of Low Power Sealed Lighting Connectors. 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.

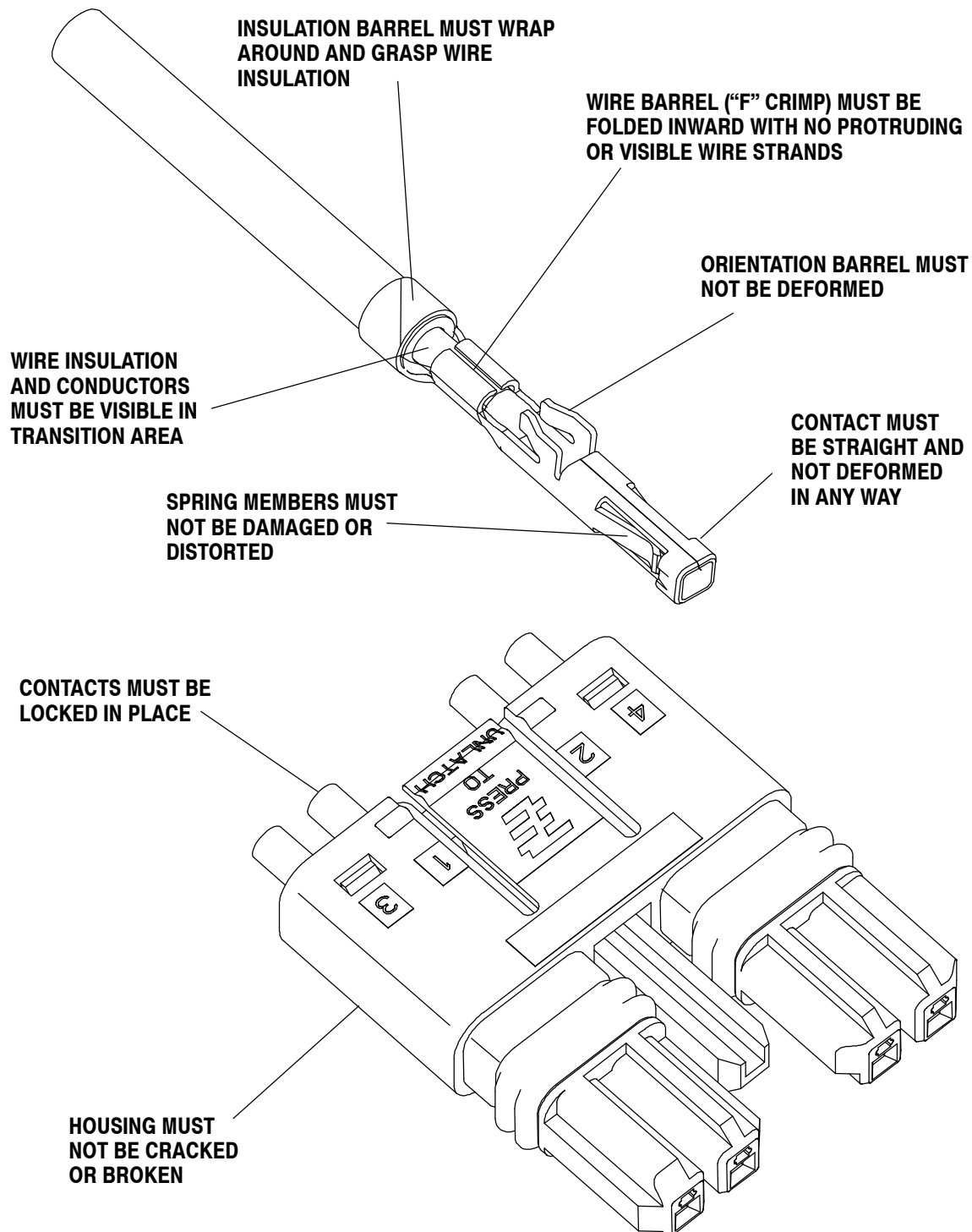


FIGURE 16. VISUAL AID