

NOTE



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 ± 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 application of standard and shielded Circular DIN Receptacle and Plug Connectors. The connectors are available in four- through eight-position configurations meeting all dimensional and functional DIN standards. For three-position applications, it is recommended that the five-position connectors be used.

Also covered are requirements for pin contacts used in the plugs. The contacts are of the crimp snap-in type and are generally tin plated. They are available in two sizes; one fits 28-22 AWG wire sizes, and the other fits 24-20 AWG wire sizes.

When corresponding with TE Representatives, use the terminology provided in this specification to facilitate your inquiry for information. Basic terms and features of the connectors and contacts are provided in Figure 1.

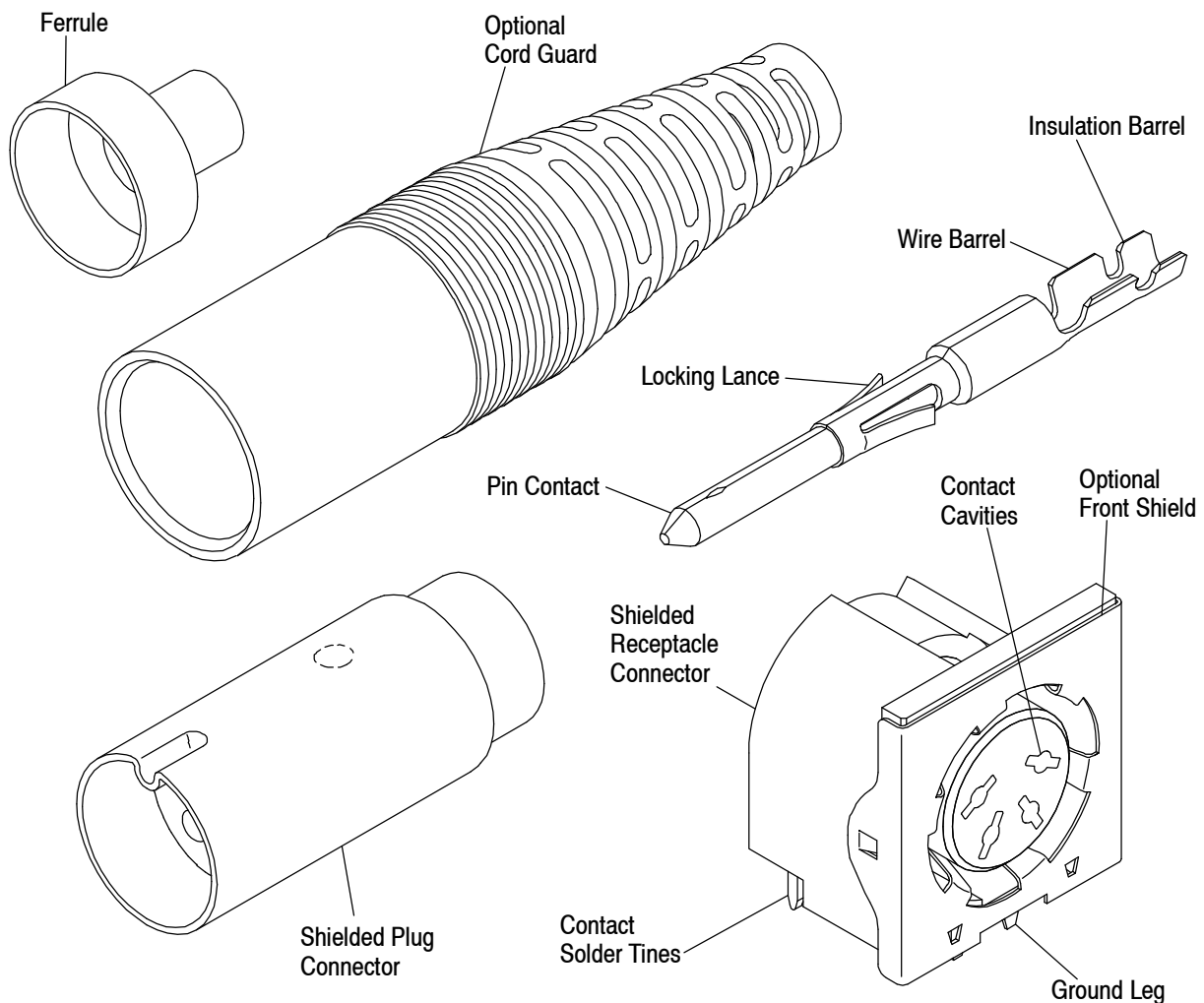


Figure 1

2. REFERENCE MATERIALS

2.1. Revision Summary

This paragraph is reserved for a revision summary covering the most recent additions and changes made to this specification which include the following:

- Updated document to corporate requirements

2.2. Customer Assistance

Reference Part Number 212437 and Product Code 4904 are representative numbers that identify the Circular DIN Standard and Shielded Connectors and Contacts. These numbers are used in a customer service network to access tooling and product application information. This service is provided by your local TE Representative or, after purchase, by calling the Tooling Assistance Center number at the bottom of page 1.

2.3. Drawings

Customer Drawings for specific products are available from the responsible TE Engineering Department via the service network. The information contained in the 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 Specification 108-10047 is available to provide test and performance results.

2.5. Manuals

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

2.6. 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 of machines.

<u>Document Number</u>	<u>Document Title</u>
408-2095	Hand Crimping Tools 69710 and 69710-1
408-3295	Preparing Reel Of Contacts for Application Tooling
408-6773	Hand Crimping Tool 90407-1
408-7347	Insertion Tools 91002-1 and -2
408-7424	Checking Terminal Crimp Height or Gaging Die Closure
408-7921	Extraction Tool 91144-1
408-8040	Heavy Duty Miniature Quick Change Applicators (Side-Feed Type)
408-8053	Conversion Guide for Miniature Quick-Change Applicators
408-9201	Crimping Dies 58215-1 through -6 for Circular DIN Connector Ferrules
408-9816	Handling Of Reeled Products
409-5128	Basic AMP-O-LECTRIC* Model "K" Terminating Machine 565435-5
409-5842	AMP-O-LECTRIC Model "G" Terminating Machine 354500-[]
409-10012	AMP-O-MATIC* Side Feed Stripper-Crimper III Machine 1320895-[]

3. REQUIREMENTS

3.1. Storage

A. Ultraviolet Light

Prolonged exposure to ultraviolet light may deteriorate the chemical composition used in the receptacle connector material.

B. Reel Storage

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

C. Shelf Life

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

D. Chemical Exposure

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

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

3.2. Cable Preparation

NOTE Ferrule and optional cord guard must be placed over the cable before the cable stripping operation.



The cable outside diameter shall range from a minimum of 3.81 mm [.150 in.] to a maximum of 7.62 mm [.300 in.]. Strip length for the outer cable jacket shall be as indicated in Figure 2. The cable shall contain four to eight individually insulated wires, each with an outside diameter ranging from a minimum of 0.91 mm [.036 in.] to a maximum of 1.37 mm [.054 in.]. Each wire shall have a stranded or solid conductor, size AWG 28 through AWG 20. The cable and wire shall be stripped as shown in Figure 2.

CAUTION DO NOT nick, scrape or cut foil or braided shield when stripping cable insulation; wire insulation when stripping the shield.

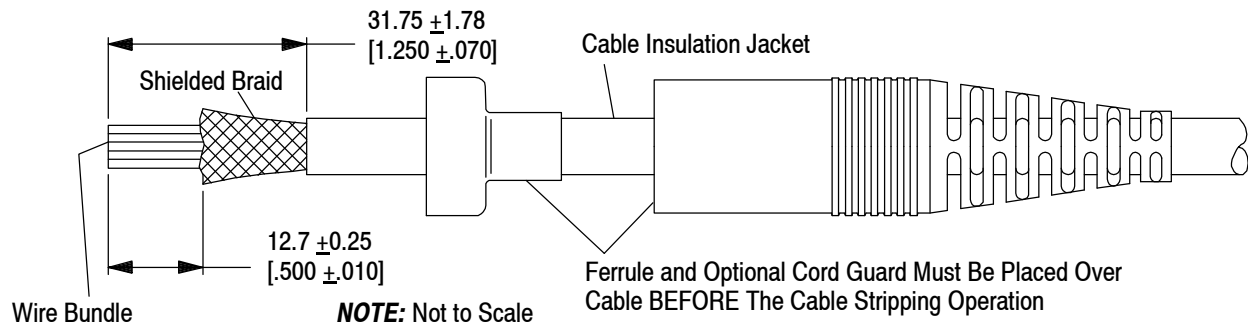


Figure 2

After the stripping procedures, fold the braid back over the cable insulation as shown in Figure 3. If foil shielding is also present, trim any foil in the wire area as shown.

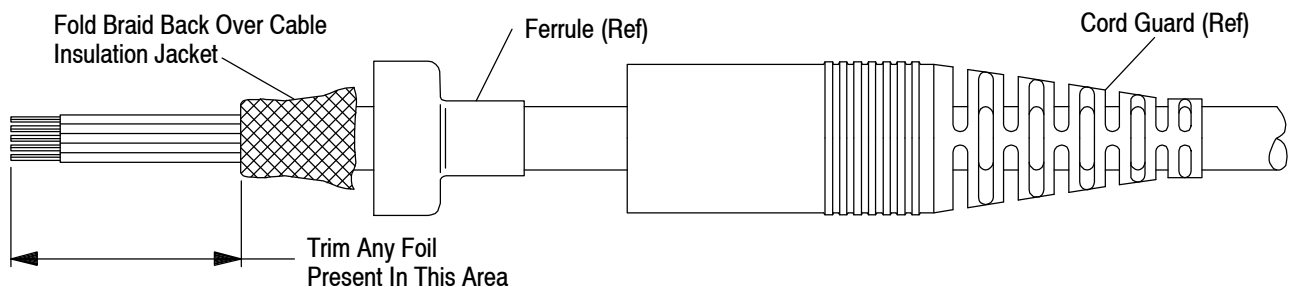




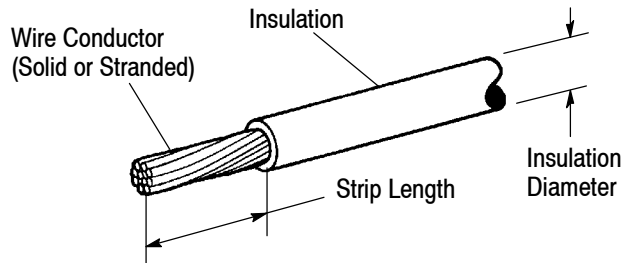
Figure 3

3.3. Discrete Wire Preparation

The pin contacts accept a wire size range of 28 to 20 AWG and may be terminated to solid or stranded wire. Figure 4 lists the insulation diameter range and strip length as determined by the wire size range used.

CAUTION  When stripping the wire, care must be taken to avoid scraping, nicking, or cutting the conductor. Care must also be used when handling the wire during stripping and crimping to prevent cracking or breaking of the conductor and insulation.

NOTE  Each crimp dimension represents the functional range of a wire/contact combination. There are tool designs available to meet various application requirements. The developed crimp configuration is unique for each tool design and is acceptable provided the crimp height is within the functional range. For crimp dimensions of a specific tool, refer to instruction sheet packaged with manual tools and applicator log packaged with power tools.




Note: Not to Scale

WIRE SIZE, AWG	INSULATION DIA RANGE	WIRE STRIP LENGTH	WIRE BARREL CRIMP		INSULATION BARREL CRIMP
			HEIGHT	WIDTH (NOMINAL)	WIDTH (NOMINAL)
28	0.91-1.37 [.036-.054]	3.96 [.156]	0.51-0.61 [.020-.024]	1.40 [.055]	1.57 [.062]
26	0.91-1.37 [.036-.054]	3.96 [.156]	0.51-0.61 [.020-.024]	1.40 [.055]	1.57 [.062]
24	0.91-1.37 [.036-.054]	3.96 [.156]	0.51-0.76 [.020-.030]	1.40 [.055]	1.57 [.062]
22	0.66-0.86 [.026-.034]	3.96 [.156]	0.66-0.81 [.026-.032]	1.40 [.055]	1.57 [.062]
20	0.91-1.37 [.036-.054]	3.96 [.156]	0.84-0.94 [.033-.037]	1.40 [.055]	1.57 [.062]

Figure 4

3.4. Crimped Receptacle Contact Requirements

The contact shall be located in desired tooling and crimped according to the instructions packaged with that tooling. See Section 5, TOOLING, of this document for details on tooling options and instructional materials.

CAUTION  Wire insulation shall NOT be cut or broken during the crimping operation, nor shall the insulation be crimped into the contact wire barrel. Reasonable care should be taken by tooling operators to provide undamaged wire terminations.

A. Contact Crimp Features

Figure 5 shows a typical contact as it should appear after crimping.

1. Crimp Location

For optimum crimp effectiveness, the crimp must be within the area shown and must meet the crimp requirements provided in Figure 5.

2. 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 terminated contact. The contact wire barrel crimp height must be within the dimension provided in Figure 4.

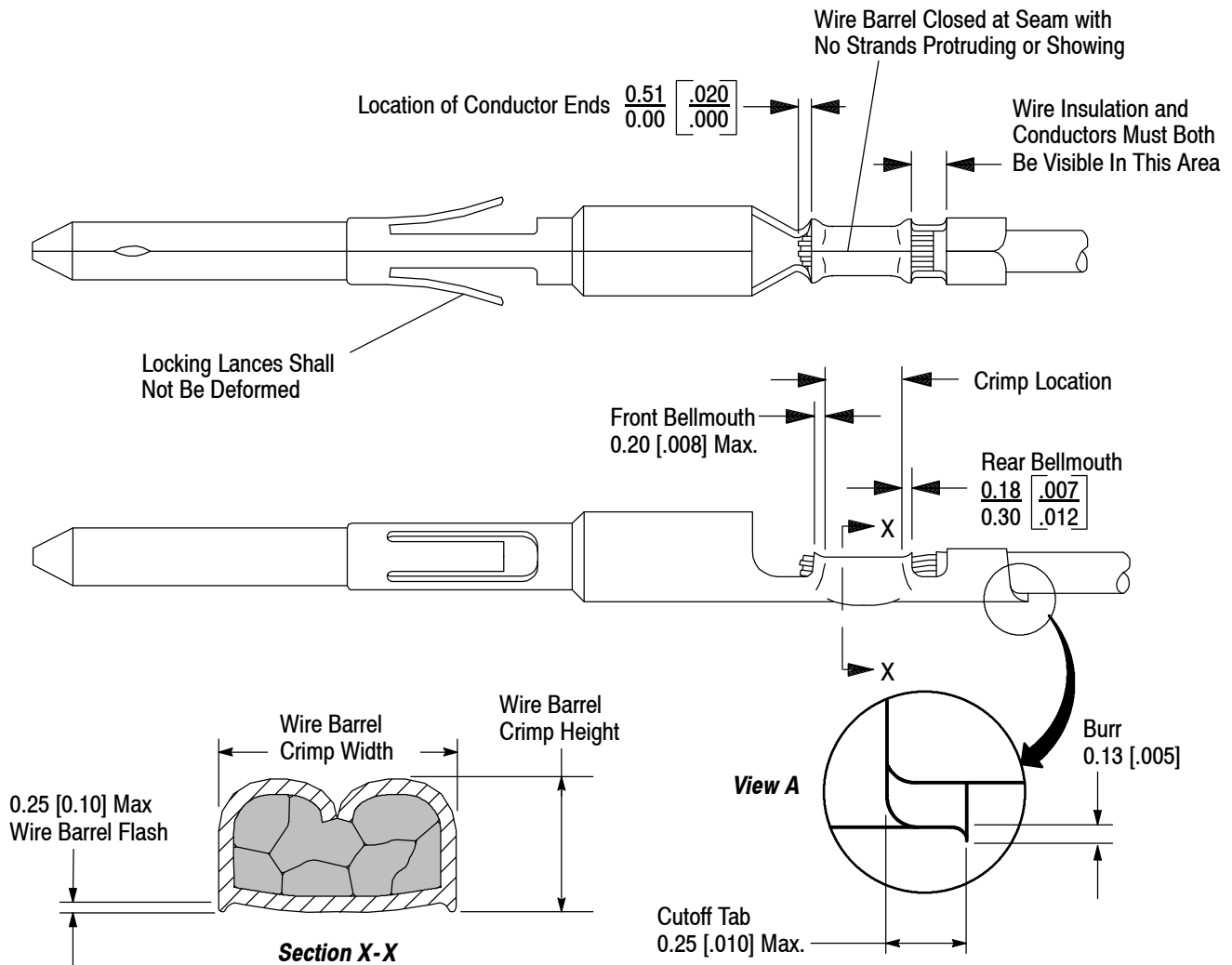


Figure 5

3. Effective Crimp Length

Effective crimp length shall be defined as that portion of the wire barrel, excluding bellmouth(s), fully formed by the crimping tool. See Figure 5.

4. Conductor Extension

The conductor may extend beyond the wire barrel to the maximum shown in Figure 5.

5. Wire Barrel Seam

The wire barrel seam must be closed with no evidence of loose wire strands visible in the seam.

6. Conductor/Insulation

The conductor and insulation must both be visible in the area between the insulation barrel and the wire barrel.

7. Bellmouth

The front and rear bellmouths are caused by the extrusion of metal during crimping and must be within the range specified in Figure 5.

8. Cutoff Tab and Burr

The cutoff tab and burr resulting from the contact being cut from the carrier strip must be within limits to allow the contact to be fully inserted and seated in the housing. See Figure 5.

9. 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 Section X-X of Figure 5.

B. Twist and Roll

There shall be no twist, roll, deformation, or other damage to the mating portion of the crimped contact that will prevent proper mating. See Figure 6.

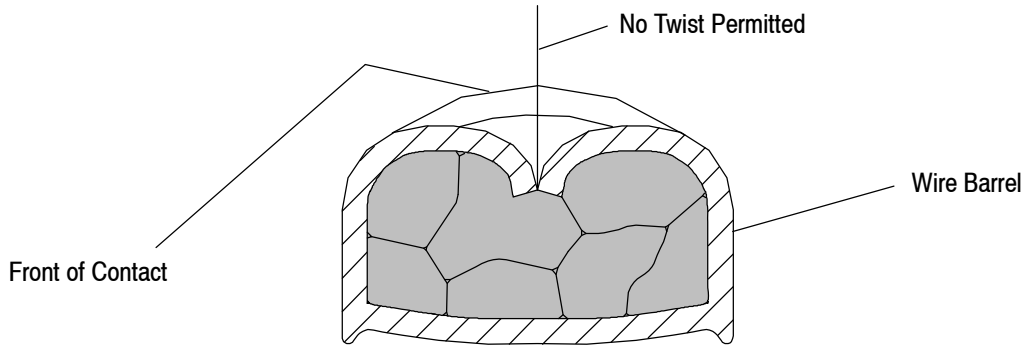


Figure 6

C. Straightness

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

1. *Up and Down*

The crimped contact, including cutoff tab and burr, shall not be bent above or below the datum line more than the amount shown in Figure 7.

2. *Side to Side*

The side-to-side bending of the contact may not exceed the limits provided in Figure 7.

NOTE

Periodic inspections must be made to ensure crimped contact formation is consistent as referenced.

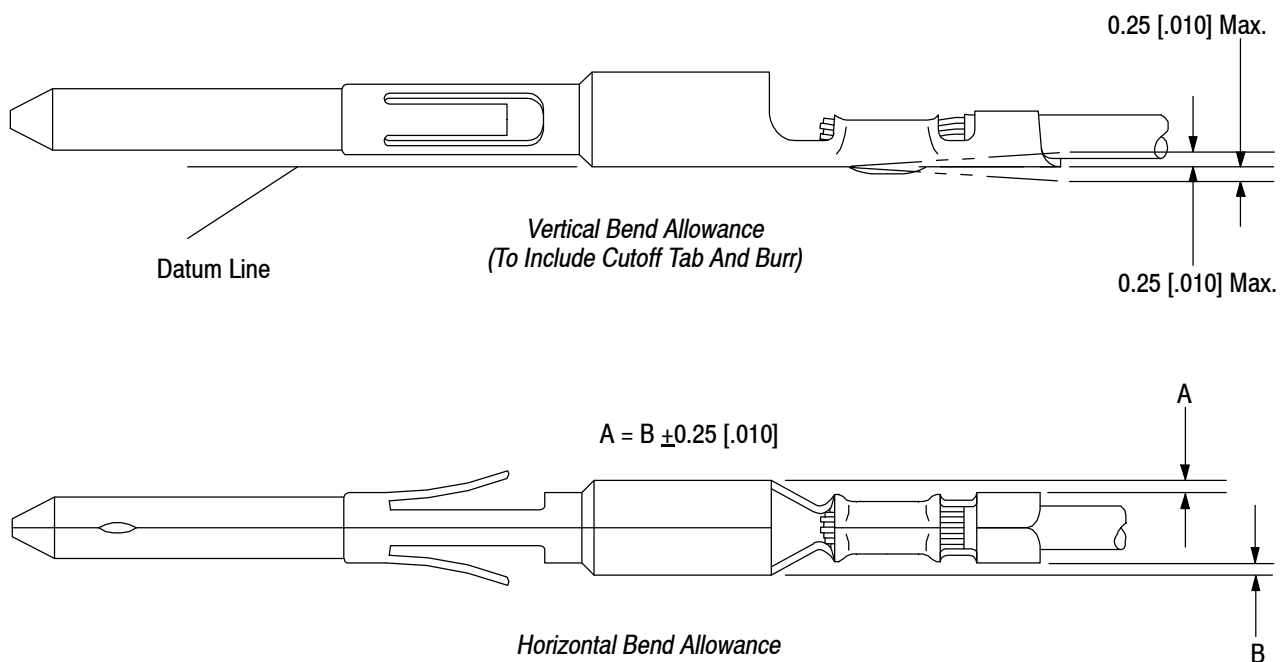


Figure 7

3.5. Placement of Crimped Contact in Housing

The contact must be inserted in the back of the plug housing and snapped into place. When fully inserted, the locking lances will engage the housing and prevent backing out during mating of the connector. After inserting contact into housing, pull back lightly on the wire to ensure contact is fully seated. See Figure 8.

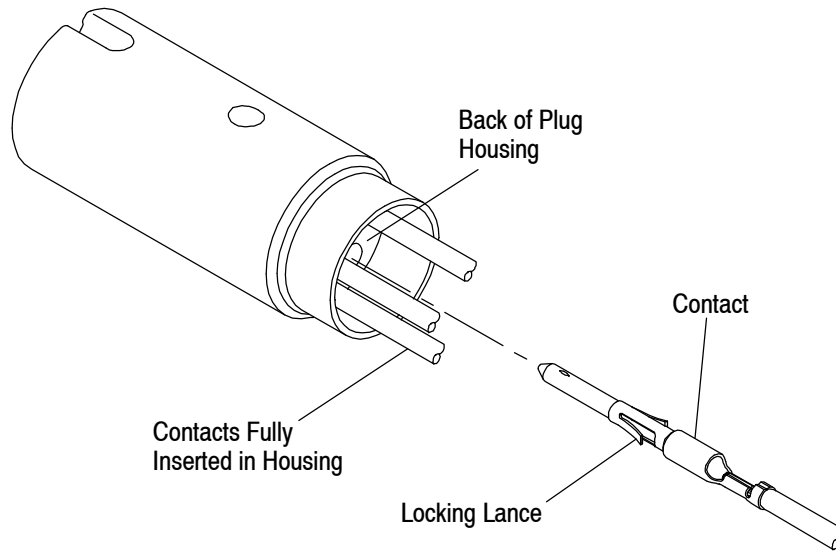
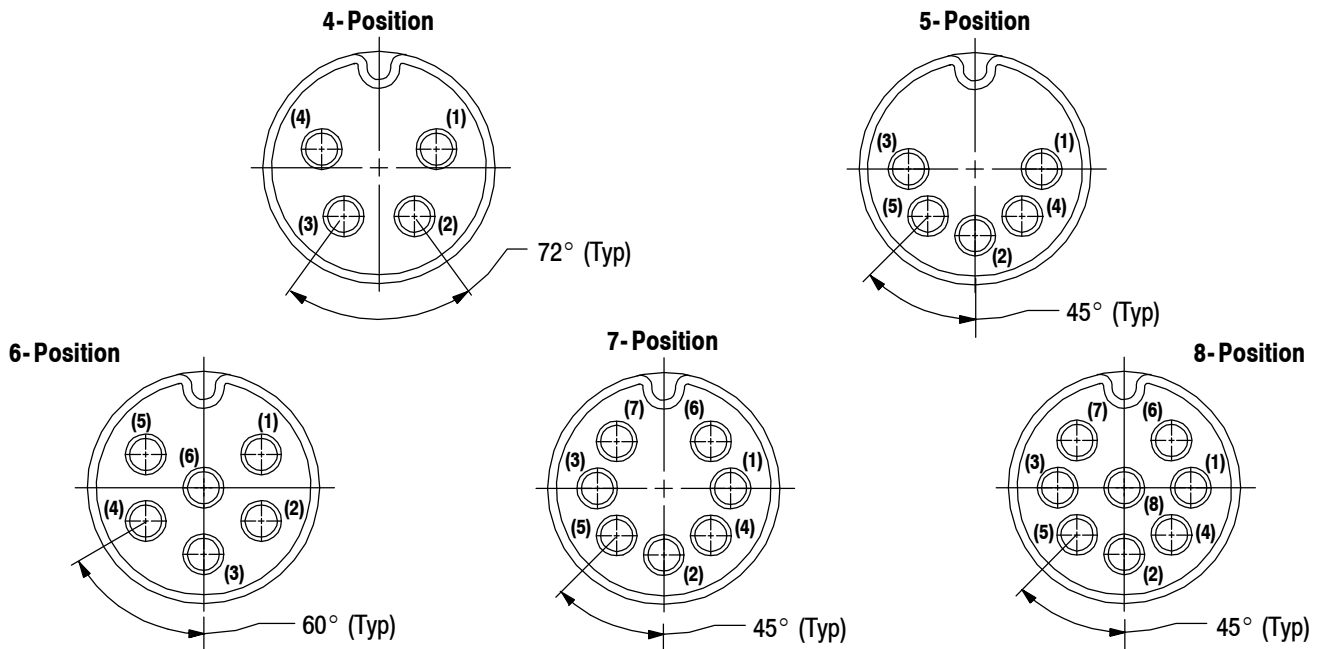


Figure 8

3.6. Mating Face Circuits

The contact insertion pattern will be determined by circuitry. Figure 9 shows the receptacle mating faces for the available Circular DIN receptacle connector sizes. The circuits are identified by the numbers in parentheses. The plug circuits will be a mirror image.



NOTE: If a required pattern is not shown, contact TE Engineering.

Figure 9

3.7. Connector Repair/Replacement

The Circular DIN contacts may be removed from the plug connector housing if they are damaged, or if they are to be relocated. Use Contact Extraction Tool 91144-1 to accomplish contact removal. Refer to Instruction Sheet 408-7921 for removal procedures. If the removed contact is to be re-used, it must conform to the requirements of this specification. See Figure 10.

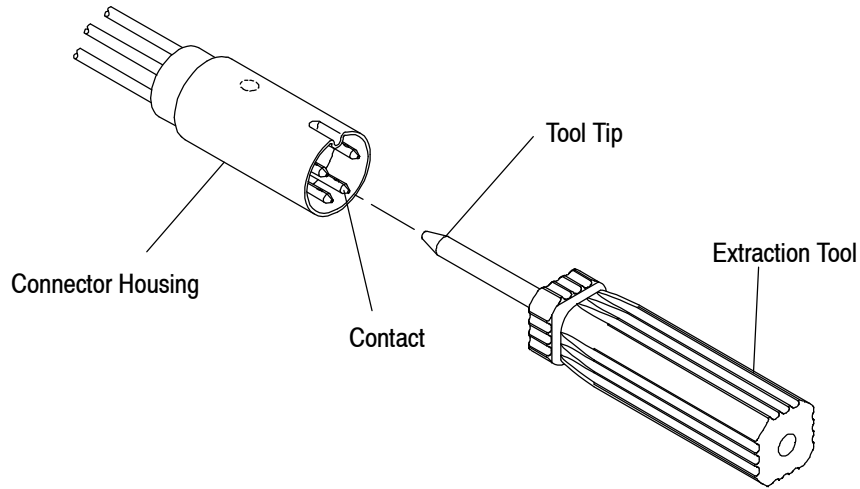
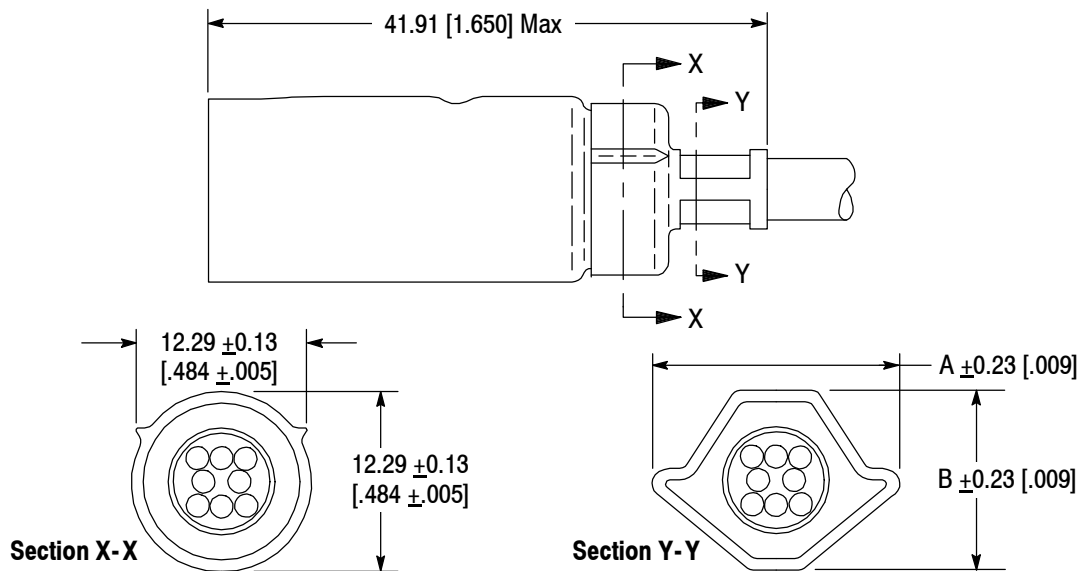


Figure 10

3.8. Ferrule Crimping

The cable braid must be folded *evenly* around the cable outlet of the connector, and the ferrule moved forward into position, before the ferrule crimping operation is performed. Then crimp the ferrule according to the instructions given in Instruction Sheet 408-9201. Refer to Figure 11 for proper braid and ferrule positioning, and for crimp section measurements.



CABLE OUTSIDE DIAMETER	4.44 [.175]	5.08 [.200]	5.72 [.225]	6.35 [.250]	6.98 [.275]	7.62 [.300]
	3.81 [.150]	4.44 [.175]	5.08 [.200]	5.72 [.225]	6.35 [.250]	6.98 [.275]
DIMENSION A	8.51 [.335]	8.26 [.325]	10.16 [.400]	9.78 [.385]	11.56 [.455]	11.30 [.445]
DIMENSION B	3.81 [.150]	4.44 [.175]	5.08 [.200]	5.72 [.225]	6.35 [.250]	6.98 [.275]

Figure 11

3.9. Cord Guard Positioning

If a cord guard is used, it should be positioned over the connector so that it provides complete connector coverage. The pre-molded type (pre-positioned on cable) should slide as far forward as possible. Another optional type of cord guard can be molded over the assembled connector when specified or desirable due to limited space or other peculiarities. Here it is important to ensure adequate cable strain relief.

3.10. Wire Bend Radius

TE Engineering recommends that individual cables should be dressed to a bend radius of *at least* ten times the cable outside diameter. Likewise, cable bundles should be dressed to a bend radius of *at least* ten times the diameter of the bundle.

3.11. PC Board

A. Material and Thickness

1. Board material will be glass epoxy (FR-4, G-10).
2. Board thickness shall be 3.18 mm [.125 in.] Max.

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

B. Tolerance

Maximum allowable bow of the pc board shall be 0.03 mm [.001 in.] over the length of the receptacle connector.

C. PC Board Layout

The mounting and contact holes in the pc board must be precisely located to ensure proper placement and optimum performance of the receptacle connector. Design the pc board using the dimensions provided in Figure 12. The layout shows the top (component) side of the board.

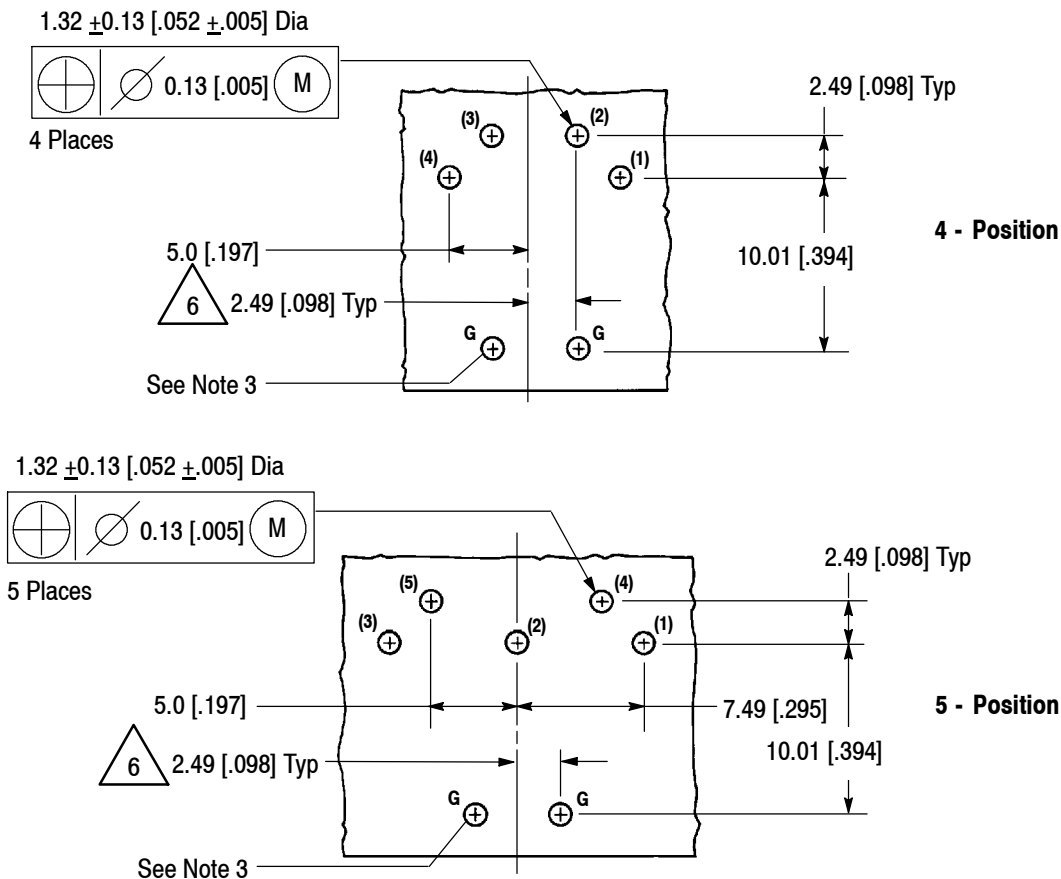
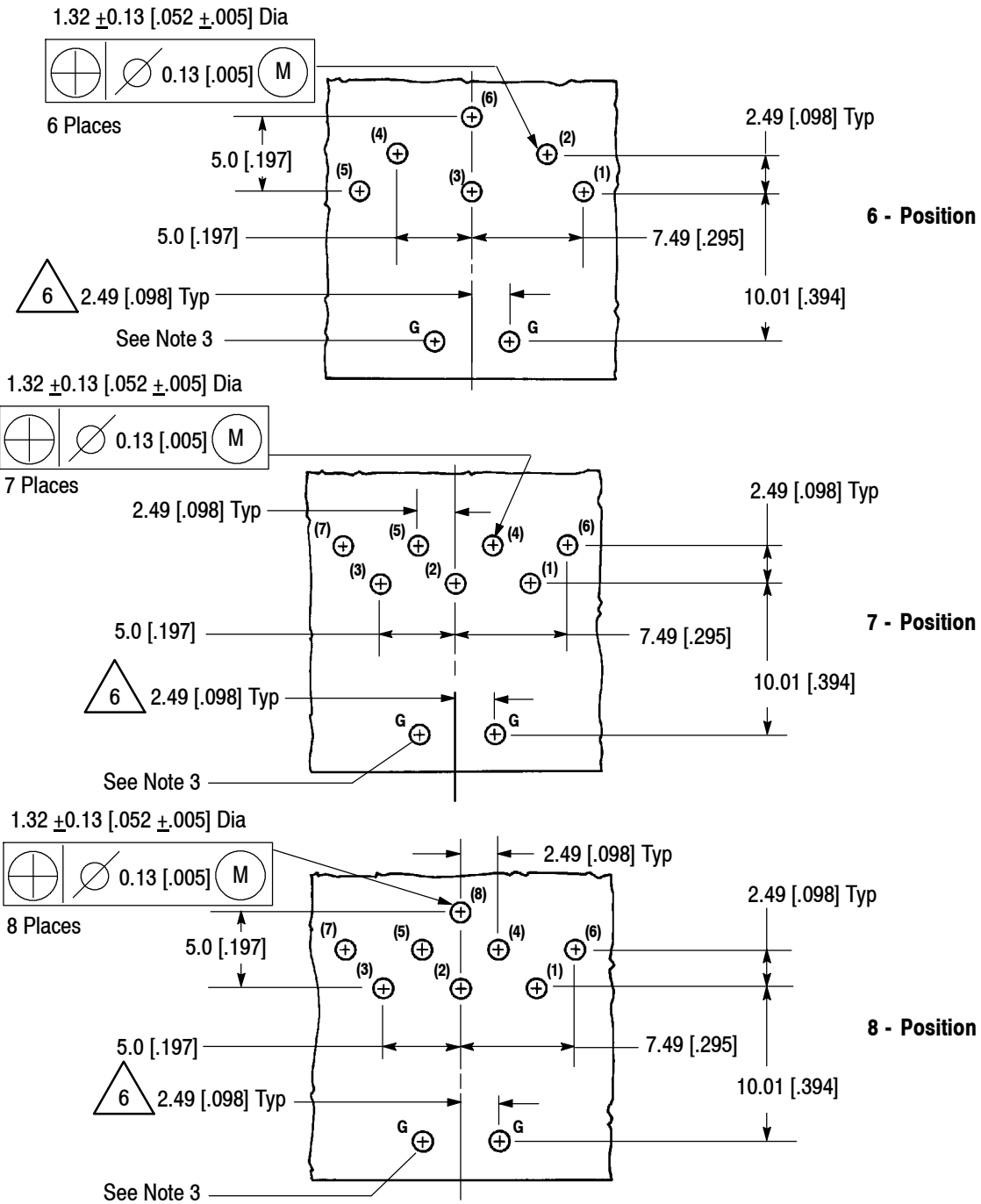


Figure 12 (cont'd)



- NOTES:**
- (1.) Horizontal hole-spacing dimensions are typical both directions from the centerline of the pattern.
 - (2.) G = Ground Leg Holes.
 - (3.) $1.32 \pm 0.13 [.052 \pm .005]$ for standard receptacles with 5 mm [.197] grounding pattern;

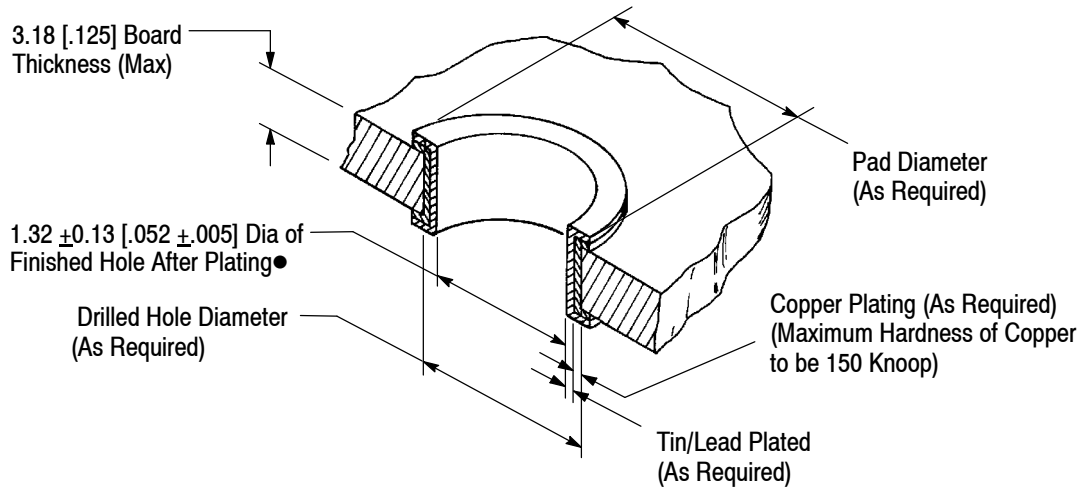
1.50 ± 0.13 [.059 ± .005] for all shielded receptacles and for standard receptacles with 10 mm [.394] grounding pattern (2 places, each receptacle).
 - (4.) Numbers in parentheses identify circuitry.
 - (5.) Hole location dimensions are basic.

On 10 mm [.394] grounding pattern, this dimension is 5.0 [.197].

Figure 12 (end)

3.12. PC Board Solder Tine Holes

The holes in the pc board for the solder tines must be drilled and plated through to specific dimensions. See Figure 13.



- 1.50 ±0.13 mm [.059 ±.005 in.] for all shielded receptacles and for standard receptacles with 10 mm [.394 in.] grounding pattern (2 places, each receptacle).

Figure 13

3.13. PC Board Receptacle Connector Placement



The receptacle connectors should be handled only by the housing to prevent deformation or other damage to the solder tines.

A. Manual Placement

Align the receptacle connector solder tines with the appropriate holes in the pc board. Start all solder tines into the board, then press on the receptacle connector until it seats on the pc board.

B. Robotic Placement

The robotic equipment must be adjusted to feed, pick up, and place the receptacle connectors on the pc board with an accuracy of 0.25 mm [.010 in.]. The receptacle connector datum surfaces detailed on the customer drawing will ensure correct placement of the receptacle connector. For information on robotic equipment, see Section 5, TOOLING.

3.14. Soldering

A. 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 the Product Information phone number at the bottom of page 1 for consideration of other types of flux. Some fluxes that are compatible with these receptacle connectors are provided in Figure 14.

FLUX TYPE	ACTIVITY	RESIDUE	COMMERCIAL DESIGNATION	
			KESTER	ALPHA
Type RMA (Mildly Activated)	Mild	Noncorrosive	186	611

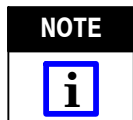
Figure 14

B. Cleaning

After soldering, removal of fluxes, residues, and activators is necessary. Consult with the supplier of the solder and flux for recommended cleaning solvents. The following is a listing of common cleaning solvents that will not affect the receptacle connectors for the time and temperature specified. See Figure 15.



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. Trichloroethylene and Methylene Chloride can be used with no harmful affect to the receptacle assemblies; however TE does not recommend them because of the harmful occupational and environmental effects. Both are carcinogenic (cancer-causing) and Trichloroethylene is harmful to the earth's ozone layer.



If you have a particular solvent that is not listed, contact the Tooling Assistance Center or Product Information number at the bottom of page 1.

CLEANER		TIME (Minutes)	TEMPERATURES (Maximum)	
NAME	TYPE		CELSIUS	FAHRENHEIT
ALPHA 2110	Aqueous	1	132	270
BIOACT EC-7	Solvent	5	100	212
Butyl CARBITOL	Solvent	1	Room Ambient	
Isopropyl Alcohol	Solvent	5	100	212
KESTER 5778	Aqueous	5	100	212
KESTER 5779	Aqueous	5	100	212
LONCOTERGE 520	Aqueous	5	100	212
LONCOTERGE 530	Aqueous	5	100	212
Terpene Solvent	Solvent	5	100	212

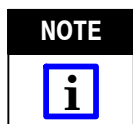
Figure 15

C. Drying

When drying cleaned connectors and printed circuit boards, make certain that temperature limitations are not exceeded: -55° to 105°C [-67° to 221°F] for standard temperature products. Excessive temperatures may cause receptacle degradation.

D. Soldering Guidelines

The receptacle connectors can be soldered using wave or equivalent soldering techniques. The temperatures and exposure time shall be within the ranges specified in Figure 16. We recommend using SN60 or SN62 solder for these receptacle connectors.



Manual 402-40 provides some guidelines for establishing soldering practices. Refer to Paragraph 2.5, Manuals.

SOLDERING PROCESS	TEMPERATURE		TIME (At Max Temperature)
	CELSIUS	FAHRENHEIT	
WAVE SOLDERING	260**	500**	5 Seconds

** Wave Temperature

Figure 16

3.15. Checking Installed Receptacle Connectors

The receptacle connectors must be seated on the pc board to the dimensions shown in Figure 17.

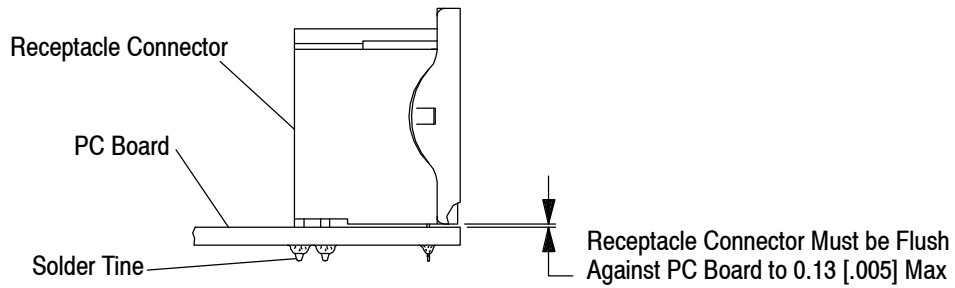


Figure 17

3.16. Polarization/Mating of Connectors

The configuration of the Circular DIN Standard and Shielded Connector mating face prevents accidental inversion when mating the two components. To ensure a proper circuit connection, the receptacle and plug connectors must be bottomed as shown in Figure 18.

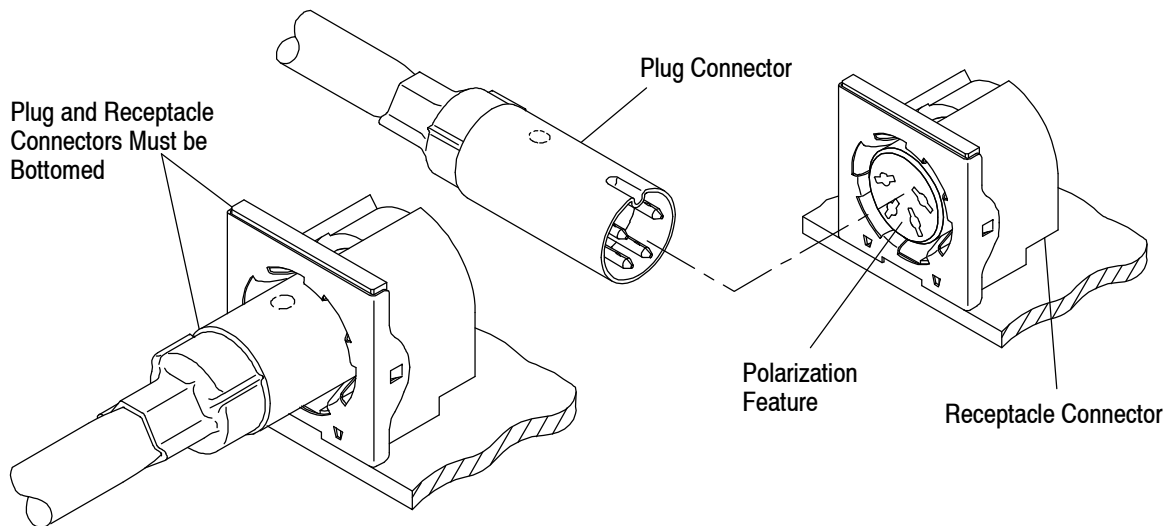
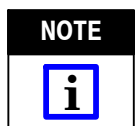


Figure 18

3.17. Receptacle Connector Spacing

Care must be used to avoid interference between adjacent receptacle connectors and/or other components. The information provided in Figure 19 is to ensure proper application.



The information provided is for manual placement of receptacle connectors. If robotic equipment is used, other space allowances will be required for the grippers.

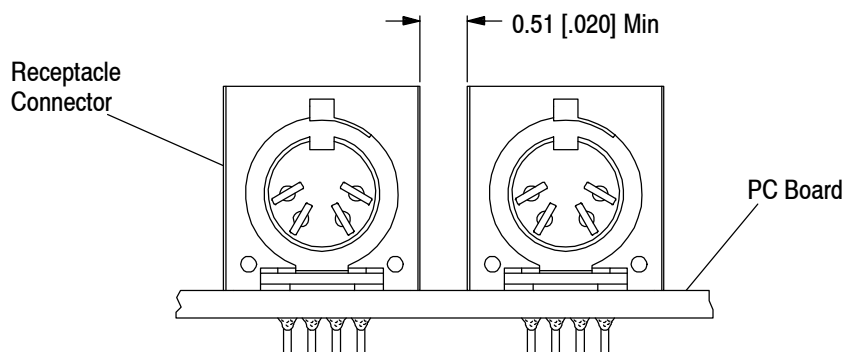


Figure 19

3.18. Receptacle Connector Repair/Replacement

Damaged pc board receptacle connectors may be removed from the pc board by standard de-soldering methods.

4. QUALIFICATIONS

Circular DIN Standard and Shielded Connectors are recognized under the Component Program of Underwriters Laboratories Inc. (UL) in File Number E28476 and certified by CSA International in File Number LR35510.

5. TOOLING

A listing of tooling recommendations covering the full wire size range is provided in Figure 20. The listing includes hand tools for manual application of loose piece contacts, and semi-automatic and automatic machines for power assisted application of strip form contacts. Modified designs and additional tooling concepts may be available to meet other application requirements. For additional information, contact one of the service groups at the bottom of page 1.

NOTE



TE Tool Engineers have designed machines for a variety of application requirements. For assistance in setting up prototype and production line equipment, contact TE Tool Engineering through your local TE Representative or call the Tooling Assistance Center number at the bottom of page 1.

- **Hand Crimping Tools**

Hand crimping tools that accommodate the full wire size range are designed for prototype and low-volume applications such as repair of damaged contacts.

- **Crimping Die Assemblies**

Crimping die assemblies for crimping the contacts are available for the full wire size range. They are designed for easy installation and removal in hand crimping tool frame assemblies or applicators.

- **Applicators**

Applicators are designed for the full wire size range of strip-fed, precision formed contacts, and provide for high volume, heavy duty production requirements. The applicators can be used in bench or floor model power units.

NOTE



Each applicator is shipped with a metal identification tag attached. DO NOT remove this tag or disregard the information on it. Also, a packet of associated paperwork is included in each applicator shipment. This information should be read before using the applicator; then it should be stored in a clean, dry area near the applicator for future reference. Some changes may have to be made to the applicators to run in all related power units. Contact the Tooling Assistance Center number at the bottom of page 1 for specific changes.

- **Power Units**

A power unit is an automatic or semi-automatic device used to assist in the application of a product. Power unit includes the power source used to supply the force or power to an applicator.

NOTE



The Model "K" AMP-O-ELECTRIC Terminating Machine PN 565435-5 (Customer Manual 409-5128) has been superseded by the Model "G" Terminating Machine PN 354500-1 (Customer Manual 409-5842) for new applications. For existing applications, the Model "K" is still recommended because of the large number of installed machines.

- **Robotic Equipment**

Robotic equipment for placement of the receptacle assemblies on a pc board must have a true position accuracy of 0.25 mm [.010 in.] to ensure proper location and insertion of the solder tines. This includes gripper and fixture tolerances as well as equipment repeatability. It must use the assembly datum surface to ensure reliable receptacle assembly placement. If you need assistance in setting up prototype or production line equipment, contact Tooling Engineering through your local TE Representative or call the Tooling Assistance Center number at the bottom of page 1.

- **PC Board Support**

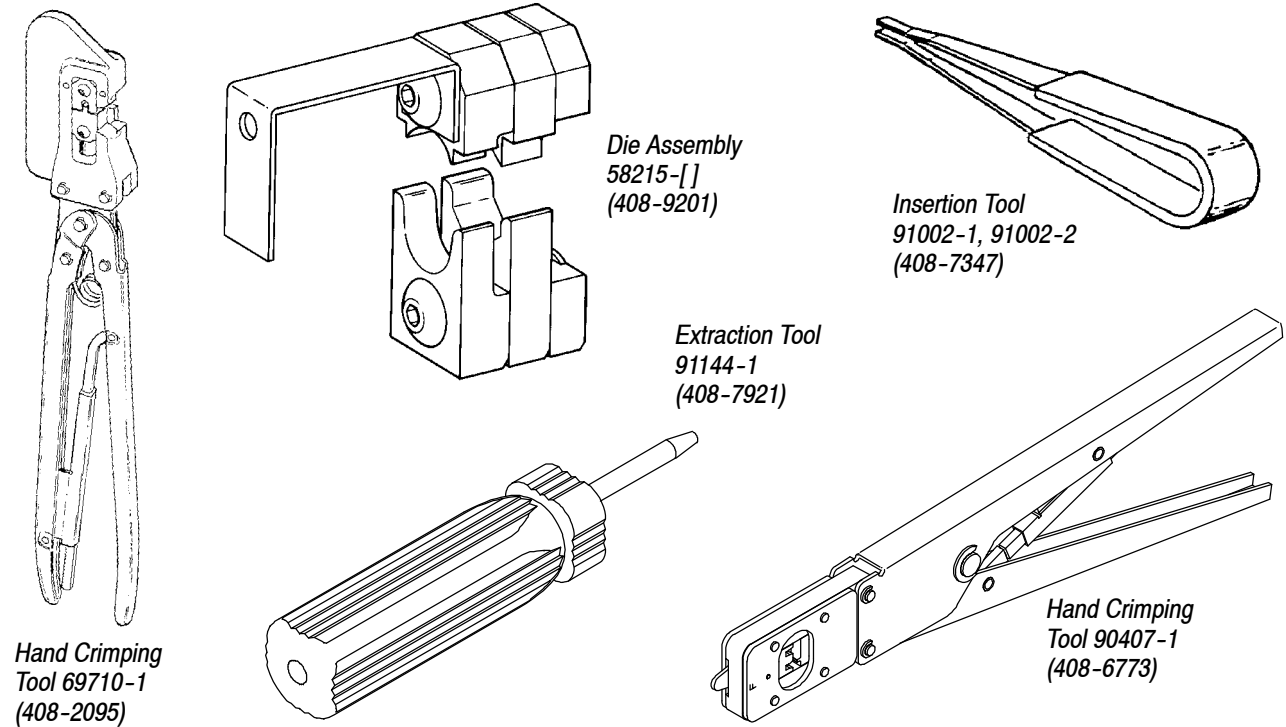
A pc board support must be used to prevent bowing of the pc board during insertion of the receptacle assembly. It should have a flat surface with holes or a channel large enough to receive the solder tines during installation. See Instruction Sheet 408-6927.

• **Insertion Tools**

Insertion tools are designed for contacts crimped to small fragile wire. They are designed to stabilize the contact during insertion.

• **Extraction Tools**

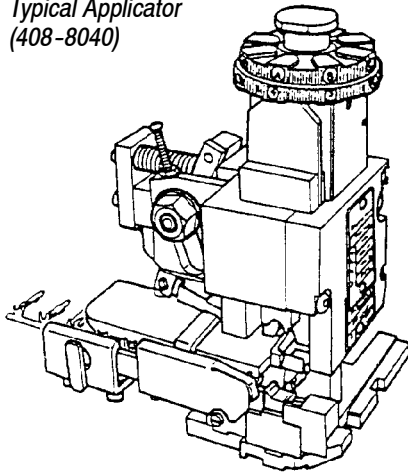
Extraction tools are designed to release the contacts inside the plug connector without damaging the housing or contacts.



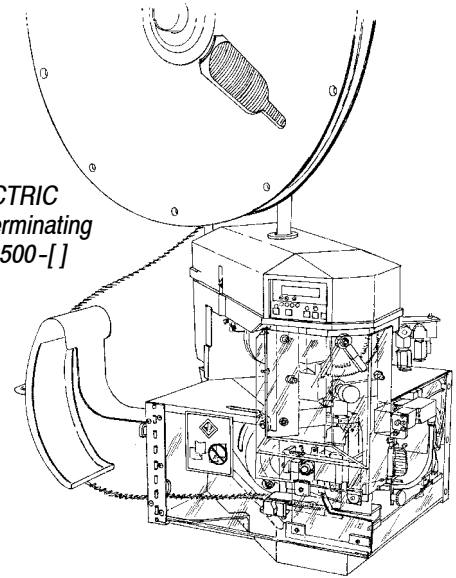
CIRCULAR DIN	WIRE SIZE RANGE (AWG) CABLE DIA	WIRE SIZE INSULATION RANGE	DIE ASSEMBLY (DOCUMENT)	HAND TOOL (DOCUMENT)	APPLICATOR (DOCUMENT)	POWER UNIT (DOCUMENT)
CONTACT	28-22	0.91-1.37 [.036-.054]	---	90407-1 (408-6773)	466966-1	1320895-1 (409-10012)
					466644-3 (408-8040)	354500-1 (409-5842)
						565435-5 (409-5128)
					466644-4 (408-8040)	354500-[] (409-5842)
	24-20	0.91-1.37 [.036-.054]	---	---	466970-1 (408-8040)	1320895-1 (409-10012)
					567392-2 (408-8040)	354500-1 (409-5842)
					565435-5 (409-5128)	
FERRULE	3.81-7.62 [.150-.300]	---	58215-[] (408-9201)	69710-1 (408-2095)	---	---

Figure 20 (cont'd)

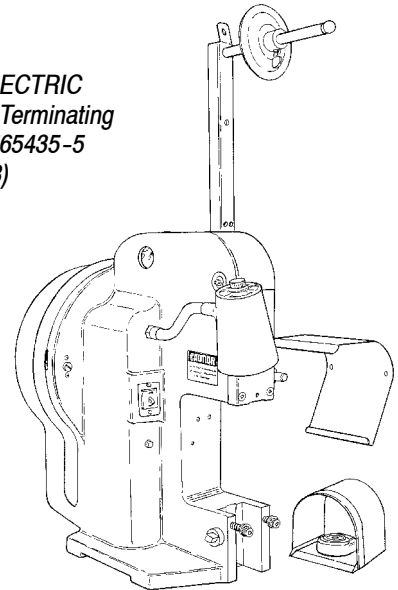
*Typical Applicator
(408-8040)*



*AMP-O-LECTRIC
Model "G" Terminating
Machine 354500-[]
(409-5842)*



*AMP-O-LECTRIC
Model "K" Terminating
Machine 565435-5
(409-5128)*



*AMP-O-MATIC Side Feed
Stripper-Crimper III Machine
1320895-[]*

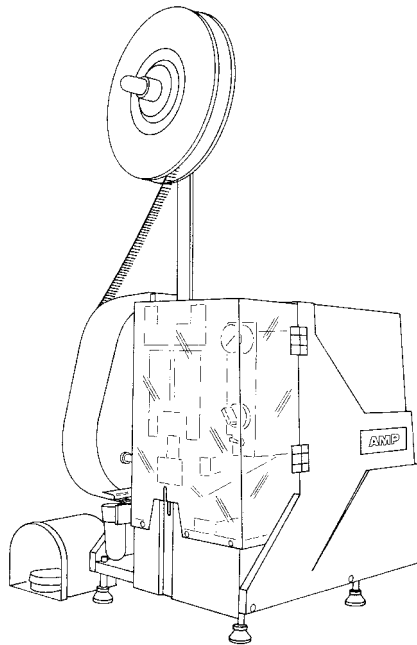


Figure 20 (end)

6. VISUAL AID

Figure 21 shows a typical application of a Circular DIN Standard and Shielded Connector with Contacts. 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.

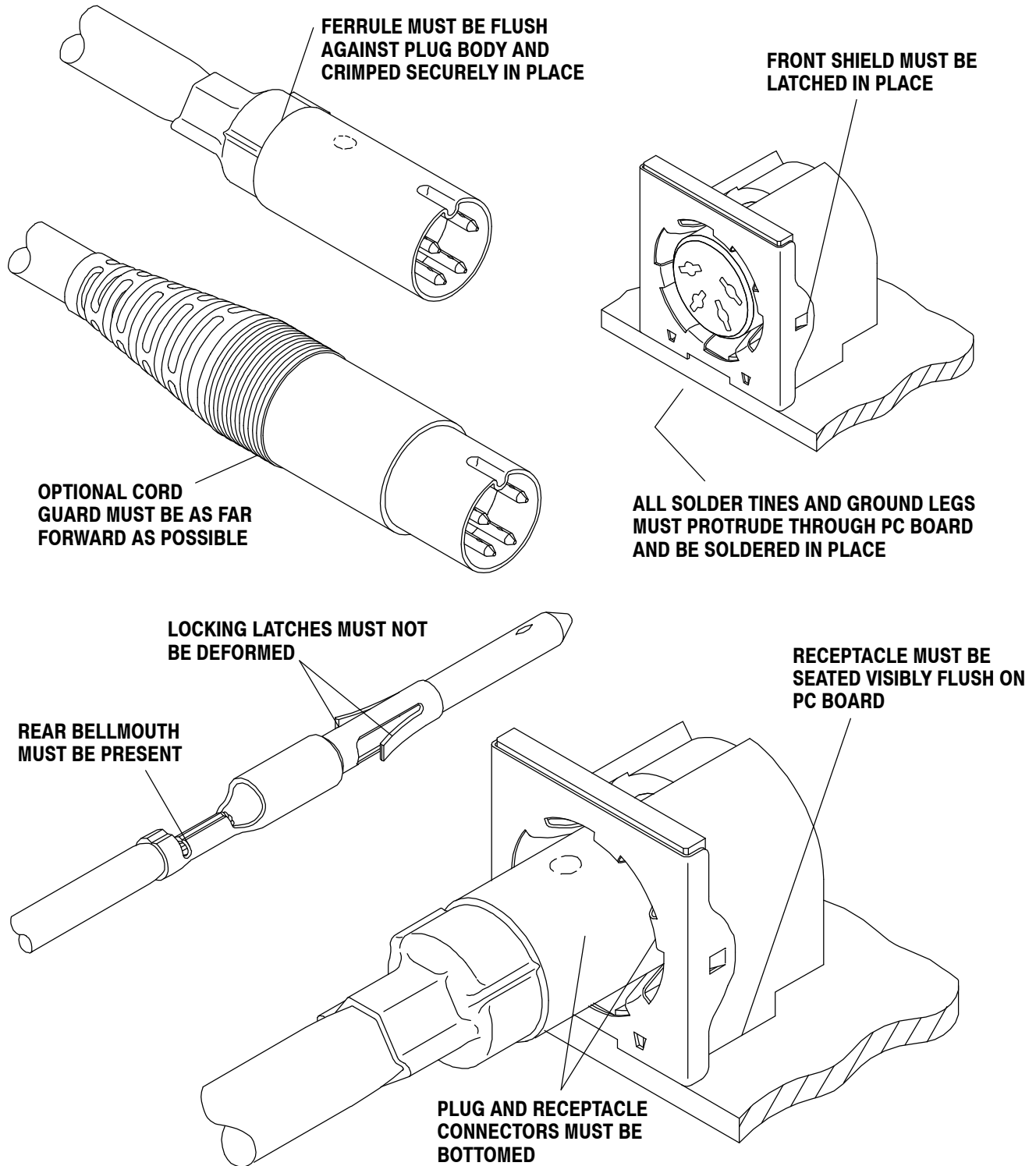


FIGURE 21. VISUAL AID