



STANDARD OVERHAUL PRACTICES MANUAL

REPAIR OF ELECTRICAL CONNECTORS

**PART NUMBER
NONE**

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STANDARD OVERHAUL PRACTICES MANUAL

Revision No. 22
Jul 01/2009

To: All holders of REPAIR OF ELECTRICAL CONNECTORS 20-11-02.

Attached is the current revision to this STANDARD OVERHAUL PRACTICES MANUAL

The STANDARD OVERHAUL PRACTICES MANUAL is furnished either as a printed manual, on microfilm, or digital products, or any combination of the three. This revision replaces all previous microfilm cartridges or digital products. All microfilm and digital products are reissued with all obsolete data deleted and all updated pages added.

For printed manuals, changes are indicated on the List of Effective Pages (LEP). The pages which are revised will be identified on the LEP by an R (Revised), A (Added), O (Overflow, i.e. changes to the document structure and/or page layout), or D (Deleted). Each page in the LEP is identified by Chapter-Section-Subject number, page number and page date.

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Description of Change

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REVISION RECORD

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INTRODUCTION

1. General

- A. The instructions in this manual tell how to do standard shop procedures during maintenance functions from simple checks and replacement to complete shop-type repair.
- B. This manual is divided into separate sections:
 - (1) Title Page
 - (2) Transmittal Letter
 - (3) Highlights
 - (4) Effective Pages
 - (5) Contents
 - (6) Revision Record
 - (7) Record of Temporary Revisions
 - (8) Introduction
 - (9) Procedures
- C. Refer to SOPM 20-00-00 for a definition of standard industry practices, vendor names and addresses, and an explanation of the True Position Dimensioning symbols used.
- D. The data is general. It is not about all situations or specific installations. Use it as a guide to help you write minimum standards.
- E. If the component overhaul instructions are different from the data in this subject, use the component overhaul instructions.

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INTRODUCTION

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REPAIR OF ELECTRICAL CONNECTORS

1. INTRODUCTION

- A. The following information is based on Boeing process specification BAC 5162 for assembly of electrical connectors. Several supplementary specifications supply additional information about specific connectors.
- B. This information is intended to be general in nature. It does not necessarily cover all situations or specific installations, but is to be used as a guide in establishing minimum standards for assembly of electrical connectors.
- C. Refer to SOPM 20-00-00 for a list of all the vendor names and addresses.

2. DEFINITIONS OF TERMS

- A. Adapter Ring - An adapter which screws onto the threaded portion of some connectors when a potting mold is used. It supports potting mold and provides a bearing surface for coupling ring to physically disengage mating parts when the coupling ring is loosened.
- B. Cable Clamp - The clamp at the rear of a connector endbell or a separate clamp adapter that screws onto the endbell. The cable clamp grips the wire bundle, providing strain relief to connector terminations.
- C. Clocking - A term used to describe the assembly of angle type plug connectors to set a desired direction of "take off" for the wire bundle relative to the polarizing keyway (Figure 1).
- D. Connector - A mechanical device used to interconnect wiring in an electrical circuit, providing a manual disconnect at electrical equipment or other points determined by circuit design. The interconnection consists of an engaged "plug" and "receptacle" connector.
- E. Endbell - An outside case which attaches to the connector shell and covers the terminations and rear end of connector.
- F. Grommet - A compressible insulator, used with environment resisting connectors, which provides environmental sealing at the rear of the connector and supports individual wires.
- G. Grommet Follower - A sleeve which compresses the grommet in the assembled connector.
- H. Insert - An insulator which holds the connector contacts in their proper arrangement and electrically insulates them from each other and the shell.
- I. Pin - A male contact. It is normally connected to side of a circuit that is "dead" when plug and receptacle are disengaged.
- J. Plug - The connector which mates with a receptacle in the engaged assembly and is normally removable from the assembly after disengagement. A plug may have either pin or socket contacts.
- K. Polarization - The proper positioning of a plug with its receptacle by means of mating key and keyways, guide pins and sockets, pin and socket jack screws, or shell configuration.
- L. Positioning - A term which refers to connector insert position relative to key or keyway in the shell. Standard positions are established as "normal" and alternate positions are indicated by letters or numbers.
- M. Receptacle - The connector which receives the mating "plug" in the engaged assembly. The receptacle is usually wall or box mounted, but may be a floating (unmounted) connector. A receptacle may have either pin or socket contacts.
- N. Shell - The outside case of a connector into which inserts and contacts are assembled.

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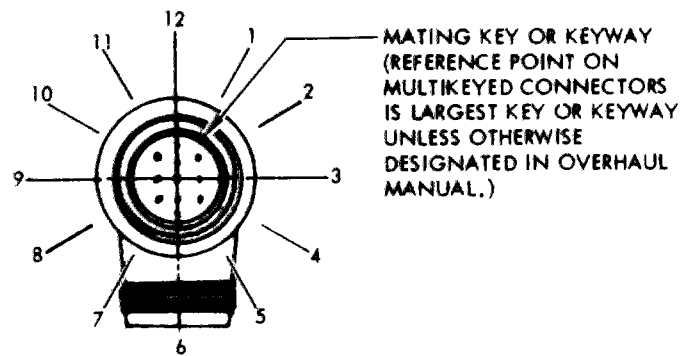


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- O. Socket - A female contact. It is normally connected to the side of a circuit that is "live" when a plug and receptacle are disengaged.
- P. Spare Wire Stub - A length of insulated wire attached to a contact in a potted connector with its opposite end protruding from the connector and unattached. The spare wire stub is provided to allow later modification to connector wiring by splicing to the spare wire stub without replacement of the potting material or connector.
- Q. Sealing Rod - Tapered plastic rod used to fill holes through unwired contacts.

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Front Face View of Angle Type Connector Plug Clocked at 1 O'Clock
Figure 1

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3. GENERAL REPAIR REQUIREMENTS

A. Attaching Wires to Solderless Contacts

- (1) Attach wires to solderless connector contacts in accordance with the following:
 - (a) For some connectors with separable grommets or rear inserts, it may be desirable to insert wires through the insert or grommet holes prior to attaching contacts. Use this method in connectors with separate grommets when contacts have rugged or sharp protrusions which could damage the grommet if inserted through it.
 - (b) Insert wire conductor into contact barrel until wire is visible in the inspection hole. Exercise care to ensure that all conductor strands are inserted in the conductor crimp barrel.
 - (c) Bottom wire insulation in the insulation barrel of insulation gripping, or supporting contacts, as shown in Figure 2.
 - (d) Butt wire insulation against end of contact in noninsulation supporting contacts as shown in Figure 3. The maximum allowable gap between contact and wire insulation is 1/16 inch.
 - (e) Crimp contacts with tools specified for the particular connector being assembled.
 - (f) When crimping size 22 wire in a size 16 contact, strip wire to provide doubling back of conductor per Figure 4. The conductor must be visible through inspection hole of contact. The cut end of folded back conductor must be visible but must not extend 1/32 inch beyond the back edge of contact crimp barrel (Figure 4).

B. Installing Solderless Contacts in Connectors

- (1) Assemble solderless contacts in connectors according to Paragraph 4., Paragraph 5. or Paragraph 6. and the following:

CAUTION: DO NOT USE INSERTION TOOLS THAT HAVE BENT, SPREAD, FLARED, OR OTHERWISE DAMAGED INSERTION BITS OR TOOLS WITH SHARP EDGES.

- (a) Insert contacts into resilient inserts of solderless contact connectors using appropriate insertion tool for specific contact-connector series, where applicable.
 - 1) Exercise care to properly grip or hold contacts in insertion tool since damage to contact, connector or tool may result from improper use. Avoid scraping wire insulation behind contact with insertion tool.
 - 2) Insert contacts into a fully seated position in connector insert. When inserting contacts through a connector grommet, exercise care to avoid an abrupt insertion which does not allow sufficient time for grommet material to flow or stretch around contact and insertion tool. Always insert contacts straight and aligned with contact hole. Where lubrication is required to facilitate contact insertion through grommet, use a light application of alcohol.

NOTE: Lubricate only with alcohol when grommet is made of silicone or neoprene rubber.

CAUTION: DO NOT JERK ON WIRE OR INDENT WIRE INSULATION WITH FINGERNAILS.

- (b) Check for proper seating of contact by grasping wire between thumb and forefinger and pulling slowly until thumb and forefinger slip on wire.

C. Completing Connector Assembly

- (1) General Requirements

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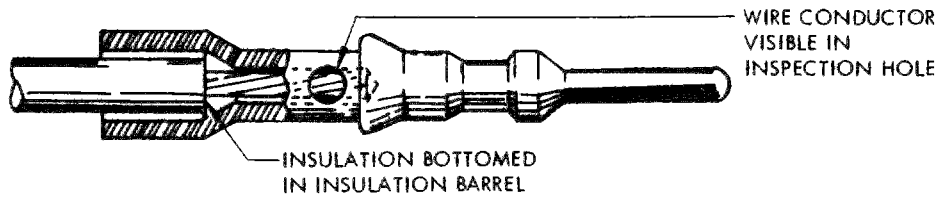


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- (a) Exercise care and minimize handling of connectors and wiring at all times to reduce possibility of connector damage and to avoid bend fatigue and breakage of wire conductors. Wire with damaged insulation must be rejected.
- (b) Connectors internally contaminated with metal particles, water, dirt, grease, oil, carbon, adhesives, etc., are unacceptable.
- (c) Connectors with bent or corroded contacts are unacceptable. Straightening of bent connector contacts is not permissible; however, correction of slight mating misalignment may be made when acceptable to Quality Control. Tarnished finish on silver, gold or rhodium plated contacts is not cause for rejection.

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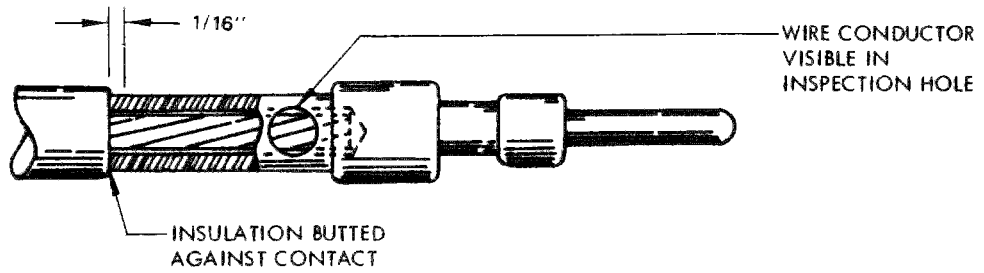
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Typical Solderless Contact With Insulation Grip or Support
Figure 2

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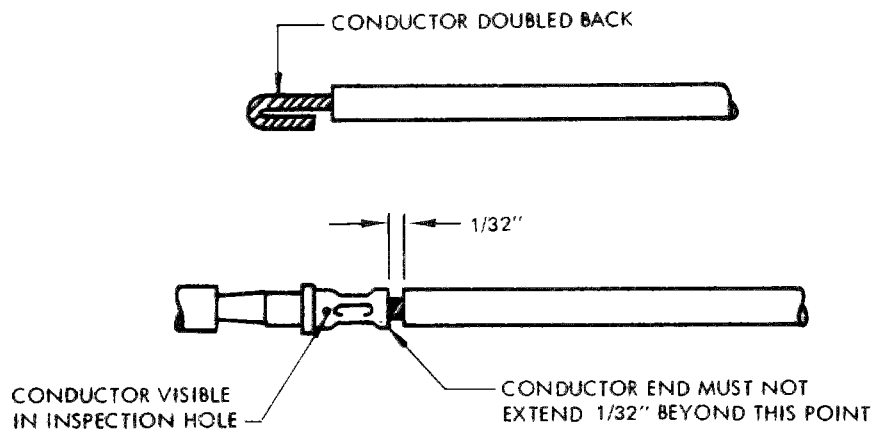
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Typical Solderless Contact Without Insulation Support
Figure 3

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Attaching Undersize Wires to Solderless Contacts
Figure 4

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4. PROTECTION OF CONNECTORS

A. Every effort must be made to protect connectors from mechanical damage or contamination from foreign matter. Requirements for accomplishing this are as follows:

- (1) Use standard snug fitting plastic dust caps to protect uncoupled ends of connectors against mechanical damage and contamination, except when necessary to work directly upon them.
- (2) Protect connectors from contamination by falling or flying metal particles, water, dirt, grease, oil, carbon, etc., using polyethylene (or equivalent) bags. Use bags made of 0.006 to 0.012 inch thick material. All unsealed connectors (unpotted or without sealing grommet), whether coupled or uncoupled, require protection if exposure to contamination is expected, or can occur.

NOTE: If it is physically impossible to enclose connector in a bag, coverage may be provided by splitting bags and tying them in place.

- (3) Protect uninstalled connectors and installed uncoupled connectors by stowing or storing in a manner where contaminants will not fall or drain into protective cover.

5. SOLDERING WIRES TO SOLDER TYPE CONTACTS

A. Soldering Connections

- (1) Place connector and wire bundle in an assembly holding fixture, when practical, during soldering operation. For soldering miniature connectors which have nylon inserts, engage connector with appropriate mating connector and secure in holding fixture.
- (2) Solder conductors to contact solder cups per SOPM 20-12-01.
- (3) Where thermocouple contacts are removed from connectors for assembly, check for proper contact coding per Table 1 to make sure contacts are attached to correct thermocouple wires and replaced in correct insert location.

B. Adapting Oversize Wire to Solder Cup

- (1) Attach oversize wire to connector solder cups using BACA14AB wire adapters only when required by overhaul manual. Assemble adapters in accordance with the following:
 - (a) Provide a snug-fitting insulating sleeve for crimped assembly per Paragraph 7., and slide back on wire. The sleeve length must be such that it will cover finished termination and extend $5/8 \pm 1/8$ inch beyond the end of crimped adapter barrel on the finished termination. Omit sleeve if connector is to be potted.
 - (b) Bottom wire conductor in adapter barrel and crimp adapter using tooling indicated in Table 2.
 - (c) Solder the adapter pin in connector solder cup per SOPM 20-12-01 (Figure 5).
 - (d) Butt sleeve against insert and secure in place per Paragraph 7..
- (2) Adaptation of an oversize wire to a connector solder cup may be made using a BACC34B copper sleeve only when required by Overhaul Manual or when BACA14AB wire adapters are not available in required size. Solder and insulate sleeves as required for BACA14AB adapters, above, except as follows:

Table 1: Thermocouple Contact Coding

Vendor	Chromel	Alumel	Iron	Constantan
Amphenol	Green	Orange	White	Red
Bendix	White	Green	Black	Yellow
ITT Cannon	CH	AL	IR	CO

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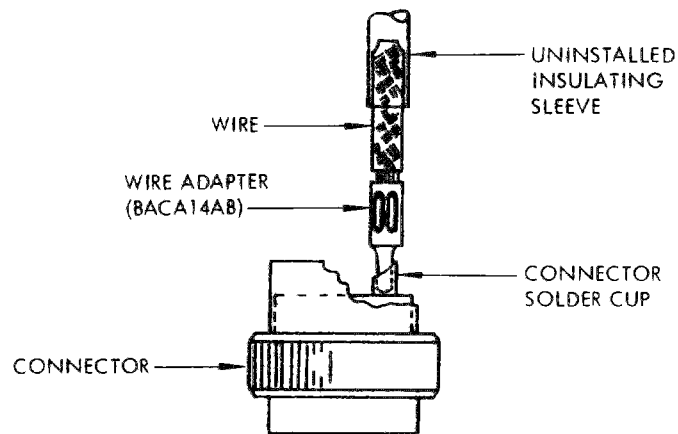
Table 2: Crimping Tools

Adapter No. BACA14AB-	Contact Solder Cup Size	Wire Size	Crimping Tool P/N
-161	16	14	AMP 49900
-162	16	10 or 12	or AMP 49935
-121	12	10	or T&B WT130

- (a) Make two loops and an overhand tie at the base of the solder cup with tying material per BAC5157. This will be used as a gasket in the next step.
- (b) Put a tight-fitting BACC34B sleeve over the solder cup and push it down against the tie you made in step (a).
- (c) Melt Type R rosin core solder between the sleeve and the solder cup. Fill the cup slightly over the top, then let the solder become solid.
- (d) Put the wire into the copper sleeve until it pushes on the hardened solder. Heat the wire and the sleeve to the flow point of the solder, push the wire down to the bottom, and then remove the heat. Hold the assembly firmly in position until the solder becomes solid again (Figure 6).

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Connecting Oversize Wire with Wire Adapter
Figure 5

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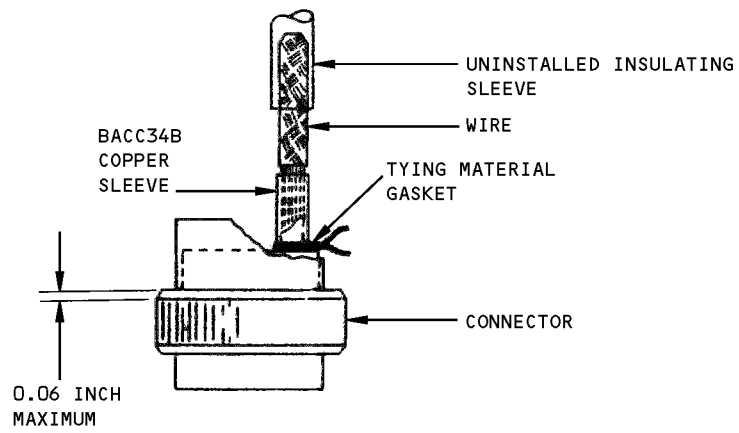
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6. QUALITY CONTROL REQUIREMENTS

- A. During assembly and before you attach endbells or install potting compound, make sure the inserts, contacts, grommets, and wires are clean and have no defects.
- B. Be sure that crimping tools, stripping tools and insertion-extraction assembly tools are certified.
- C. Make sure that stripping tools do not damage conductors. Refer to Paragraph 8.E. for details.
- D. Make sure the contacts are correctly crimped, and that you can see the conductors through the inspection hole of contact wire barrel.
- E. Reject connectors if there are cuts, cracks, gouges, chips, or tears on the front or the rear face of resilient connector grommets.
- F. For MIL-C-26500 (BACC45F) connectors, you can make a check of the completed connector with the applicable ST8756 alignment gage if you think the contacts are not aligned.

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Connecting Oversize Wire with Copper Sleeve
Figure 6

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7. INSULATING TERMINATIONS

- A. Use an insulating sleeve to cover contacts installed in connectors that do not have connector sealing grommets or a rear insulator.
 - (1) Preferred Method – Installation of heat shrinkable tubing
 - (a) Use a sleeve size that fits easily over the termination before it is shrunk, and fits tightly and does not move after it is shrunk.
 - (b) Make the sleeve extend over the conductor insulation 0.37-0.63 inch. Make the gap between the sleeve and the insert face less than 0.06 inch. Install the sleeve as near the insert face as possible.
 - (c) Shrink the sleeve in position (SOPM 20-11-03).
 - (2) Optional Method – Installation of non-shrinkable sleeve
 - (a) Use the smallest size of sleeve that fits over the termination.
 - (b) Install the sleeves with one end against the connector insert and the other end 0.37-0.63 inch out from the contact.
 - (c) Tie the sleeves in position with a wire bundle tie. Tie the sleeve to the wire, or put the tie on the wire directly behind the sleeve. Make sure the sleeve does not slip over the tie. Sleeves on a group of up to 7 adjacent contacts can be attached by one tie on the wires behind the sleeves. Be sure the installed ties do not put stress on the wire connections.

8. PREPARATION OF WIRES

- A. If possible, use an assembly holding fixture which will hold both wires and connector for the wire preparation and soldering operations.
- B. Lay the wires in the bundle support of the holding fixture in the positions in which they terminate. Move the individual wires to their contact locations and cut them to the correct length for assembly.
- C. For potted assembly of Teflon insulated wire, etch the wires or install sleeves on them, unless the wire is pretreated for potting.
- D. Strip wire insulation with a correctly-adjusted stripping tool. Be sure not to cut or nick the conductor strands. Small scrapes are permitted on wire strands, and on tinned or plated copper wires which makes some bare copper areas. Wire grips of stripping tools must not cut, extrude or otherwise damage wire insulation, but small dents or impressions are acceptable.
- E. Strip the wire to the length for the specified contact and terminating method. For assembly in solder type contacts, include sufficient length for an inspection gap between the wire insulation and the contact solder cup (SOPM 20-12-01).
- F. If the wires are too small for the grommets of environmentally sealed grommets, increase the diameter of their insulation with layers of heat shrinkable sleeving. Refer to BAC5162, or Standard Wiring Practices Manual 20-60-08, for details.

9. SPARE WIRE STUBS

- A. Make the spare wire stubs from wire of the highest temperature rating used in the bundle and of the largest size that will fit in the contact. Identify the wire stubs.
- B. Give protection to the ends of spare wire stubs with flexible sleeves or shrinkable sleeves or end caps. Make spare wire stubs in groups approximately 5 to 7 inches long, and stagger the groups of stubs as necessary to prevent excessive bundle enlargement. Do not put the ends of unused or spare wires in conduit.

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- C. Attach the spare wire stubs within or on the surface of the wire bundle. Put one bundle tie within 0.75 inch from the end of each group of spare wire stubs, and put one bundle tie midway between the connector and the end of the shortest group of stubs.

10. TIGHTENING GROMMET NUTS (Amphenol Connectors Only)

- A. On connectors with ferrules, make sure the ferrule lands are down in the shell slots, and that the ferrule insert and grommet nut are aligned. Tighten the grommet nut slightly more than hand tight.

11. REMOVING SEALING ROD FROM CONNECTOR

- A. Remove cable support (and grommet nut and ferrule of Amphenol connectors, if used).
- B. Remove sealing rods as follows:
 - (1) If a spare contact is not installed, hold the free end of the sealing rod with pliers and gently pull the rod away from the connector, along the axis of the grommet hole.
 - (2) If a spare contact is installed with the sealing rod, remove the contact first, then remove the sealing rod.

12. SECURING CONNECTOR PARTS

- A. Connector endbells, assembly nuts, and cable clamp adapters must be correctly assembled and tightened. Do not tighten parts too much, or you could damage connector threads or parts.
- B. On connectors which have standard threaded assembly nuts, endbells or separate cable clamps, tighten the parts by hand, then tighten slightly more (max. 1/8 turn) with tool ST2596G, ST2596C or AT508K (Aircraft Tools, Inc., V00784).
- C. On connectors with nuts, endbells or cable clamps to be lockwired, tighten these parts per par. B. above.
- D. On connector endbells attached with set screws, tighten the set screws approximately an equal number of turns. Do not tighten the set screws too much. You could break the connector shell.
- E. Assemble connectors with angle type cable clamps in the clocking position called out by the overhaul instructions. See Figure 1 for example docking positions. Unless otherwise specified, the allowable clocking tolerance is ± 1 hour (30°). If clocking is not specified, put the connector mating key or keyway at twelve o'clock. Put the angle type cable clamp at six o'clock.
- F. Make checks for tightness of connector parts by hand and only in the direction that tightens the part. Make checks for tightness before you install the lockwire.

13. MATERIALS AND EQUIPMENT

A. Materials

NOTE: Equivalent substitutes can be used. Also see the instructions for the specific connector.

- (1) Sealing Rod – Type I vinyl or Type IV Teflon in Type I, non-Skydrol areas. Use only Type IV Teflon in Type II and higher areas.
- (2) Sleeving, non-shrinkable – MIL-I-7444 or MIL-I-3190/6
- (3) Alcohol, isopropyl (SOPM 20-60-01)
- (4) Sleeving, heat-shrinkable – MIL-DTL-23053 or MIL-R-46846

B. Tools

NOTE: Equivalent substitutes can be used.

- (1) Insertion and Removal Tools – See the instructions for the specific connector.

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- (2) Crimp Tools and Locators – See the instructions for the specific connector.
- (3) Wire Stripping Tool – ST2346

14. REPAIR OF MIL-C-26500 SOLDERLESS CONNECTORS (BACC45F())

A. Connector Nomenclature (Figure 7)

NOTE: Early configurations could have ferrules, grommet nuts, load rings and noncaptive coupling rings. Screws supplied with early version connector cable clamps can be replaced with longer screws. For replacements, use screws of the same head and thread configuration as the old screws.

B. Part Numbering of Connectors

- (1) BAC Part Number – See Figure 8
- (2) Shell Style and Coupling Arrangements

Boeing Part No.	Shell Style	Coupling Arrangement
BACC45FM	Sq. Flange	Threaded
BACC45FN	Receptacle	Bayonet
BACC45FP	Single Hole	Threaded
BACC45FR	Mtg. Receptacle	Bayonet
BACC45FS	Straight Plug	Threaded
BACC45FT	Straight Plug	Bayonet

C. Removing Contacts from Connector

CAUTION: DO NOT ATTEMPT TO REMOVE GROMMETS FROM CONNECTORS, AS THEY ARE BONDED TO SHELL.

- (1) Select correct contact removal tool from Table 3.

Table 3: Boeing Electrical Contact Insertion and Removal Tools

Contact Size	Insertion Tool Handle	Insertion Bit	Removal Tool
20	ST2220-2	ST2220-2-1	ST2220-3-13
*[1]20		ST2220-2-11 *[2]	
		ST2220-2-11A	
*[3]20		ST2220-2-11A	
16		ST2220-2-4 *[4]	ST2220-3-14
		ST2220-2-4A	
12		ST2220-2-5	ST2220-3-15

*[1] #20 contact with #18 crimp barrel.

*[2] Use with wire that has an insulation O.D. that is larger than the O.D. of contact insulation support barrel.

*[3] #20 contact with #16 crimp barrel.

*[4] ST2220-2-4 may be used for wire with 0.088 inch maximum O.D. ST2220-2-4A may be used for wire with 0.130 inch maximum O.D.

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NOTE: Equivalent vendor tools may be used in place of above ST-tools.

- (2) Slide contact removal tool end over contact and into the insert hole. Insert tool until first mark on tool tip, for pin contacts, or until second mark, for socket contacts, coincides with insert face.

CAUTION: RETENTION CLIPS MAY BE DAMAGED IF REMOVAL TOOL IS INSERTED FARTHER THAN SPECIFIED.

- (3) With removal tool held firmly in this position, rotate tool slightly to assure that it is properly seated in retention clip. Advance internal plunger so that contact is ejected from its seated position. See Figure 9 for contact removal procedure.

CAUTION: TO MINIMIZE POSSIBLE GROMMET DAMAGE, REMOVE EACH CONTACT COMPLETELY ONE AT A TIME. DO NOT RELEASE SEVERAL CONTACTS WITH REMOVAL TOOL BEFORE COMPLETE REMOVAL FROM GROMMET. IF CONTACTS ARE DIFFICULT TO REMOVE, CHECK REMOVAL TOOL TIP FOR PROPER TAPER.

- (4) The contact may then be pulled free of grommet with hand. Do not use pliers to remove contacts.

D. Removing Wires From Solderless Contact

- (1) Cut wire at end of wire insulation, using wire cutters or similar tool.

E. Installing Contacts on Wire

- (1) Strip wire $3/16 \pm 1/32$ inch for size 20 contacts, and $9/32 \pm 1/32$ inch for size 16 and 12 contacts, using stripping tool ST2346 or equivalent. If wire is too large to enter insulation support barrel of a size 20 contact, strip wire $9/32 \pm 1/32$ inch.
- (2) Select correct contact per Figure 10.

CAUTION: MAKE CERTAIN THAT PROPER CRIMP TOOL AND PROPER LOCATOR ARE USED.

- (3) Place contact in correct locator and crimp tool per Figure 11. Insert stripped end of wire in crimp barrel of contact, making certain all conductor strands enter barrel and that they are visible through inspection hole.

NOTE: As an alternate method, the wire may be placed in contact before inserting contact in crimp tool locator.

- (4) With contact shoulder seated in locator, and wire bottomed in contact, close handles of crimp tool until ratchet releases. Remove contact wire assembly from crimp tool.

F. Inserting Contacts into Connector

- (1) With Amphenol connectors, when grommet nut and ferrule or cable support nut are used, slide these parts back over wire bundle before inserting contacts. With Pyle-National connectors, slide cable support nut back over wire bundle. This must be done to prevent damage to grommet during insertion.
- (2) Examine contacts for straightness per Paragraph 3.B.
- (3) Lubricate the rear face of the grommet per Paragraph 3.B. If more lubrication is necessary, you can use small amounts of Dow Corning DC 200 or Silastic RTV Thinner (BAC5162).

NOTE: Do not immerse connector or contact-wire assemblies in lubricant.

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- (a) Install sealing rod per Paragraph 14.G. and insert contact wire assemblies per Paragraph 14.F.(5) or Paragraph 14.F.(6) below.

NOTE: All insert holes which are not fitted with a wired contact are required to be filled with sealing rod.

- (4) Select proper insertion tool per Table 3. Observe the following:
 - (a) That correct connector parts and insertion tools are used.
 - (b) That insertion bit is not bent, spread, flared or otherwise damaged.
 - (c) That insertion bit edges that come into contact with connector insert are not sharp.
 - (d) On size 20 contacts, that the insertion tool tip is around insulation support barrel of contact, and not on rear edge.

NOTE: Lubricate the tip of insertion tool, per Paragraph 3.B., before inserting contact-wire assemblies. Dow Corning DC-200 or "Silastic RTV Thinner" may be used if additional lubrication is required.

- (5) Insert contact-wire assemblies individually as follows:
 - (a) Grasp contact (socket or pin) with insertion tool tip by sliding contact into insertion tool tip end, as shown in Figure 12.
 - (b) Guide contact-wire assembly carefully through proper grommet hole (Figure 12). Push tool straight in axially to grommet hole until contact is fully seated.
- (6) Preload all or several contacts in grommet and complete insertion as follows:
 - (a) Grasp contact-wire assembly with fingers and guide it carefully through proper grommet hole until contact insulation barrel of size 20 contact is flush to 3/32 inch from rear grommet surface. For size 16 and 12 contacts, shoulder of contact shall rest on rear surface of grommet (Figure 13).
 - (b) Hold connector in one hand and with other hand slide tip of insertion tool over end of contact-wire assembly and push tool straight in axially to grommet hole until contact is fully seated.

CAUTION: KEEP CONTACT AND INSERTION TOOL ALIGNED AXIALLY TO GROMMET HOLE DURING INSERTION.

- (7) A slight snap and increased resistance to further motion will be felt when contact seats.
- (8) Withdraw insertion tool carefully from insert.

CAUTION: DO NOT JERK ON WIRE OR INDENT WIRE INSULATION WITH FINGERNAILS.

- (9) Check for proper contact seating by grasping each wire between thumb and forefinger and pulling slowly until thumb and forefinger slip on wire.
- (10) If contact is not properly inserted, it must be removed per Paragraph 14.C. and reinserted as specified above.

G. Sealing Unused Grommet Holes

CAUTION: WHEN A CONNECTOR WITH A FERRULE IS USED, CHECK TO ENSURE THAT GROMMET NUT AND FERRULE ARE LOOSENED BEFORE SEALING RODS ARE INSTALLED.

- (1) Use Type I vinyl or Type IV Teflon sealing rod in Type I, non-Skydrol areas.

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- (a) Use only Type IV Teflon sealing rod in Type II and higher areas and in Skydrol areas.
 (2) Install vinyl or Teflon sealing rod per Table 4 and Figure 14.

CAUTION: DO NOT USE SCRATCHED OR DAMAGED SEALING ROD. DO NOT PUSH SEALING ROD ALL THE WAY INTO GROMMET HOLES.

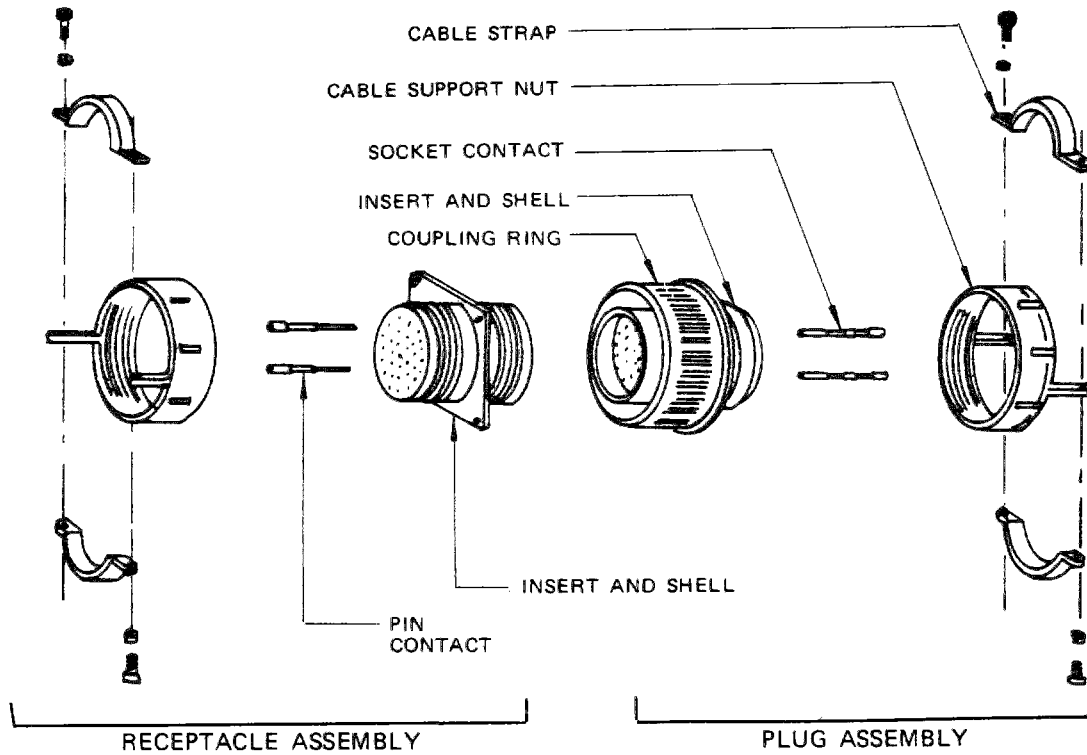
- (a) If spare contacts are installed in connector, bottom sealing rod against ends of spare contacts and trim rod so it extends 1/16 to 3/16 inch above grommet surface.
 (b) If spare contacts are not installed in connector, cut rod to length shown in Table 4 and install rod so it extends 1/16 to 3/16 inch above grommet surface.

Table 4: Installation of Sealing Rod

CONTACT SIZE	TEFLON SEALING ROD (DIAMETER)	VINYL ROD (BENDIX P/N)	DIAMETER	LENGTH INCH (+/- 1/16)
20	1/16	10-36750-7	5/64	5/8
16	3/32	10-36750-6	3/32	3/4
12	1/8	10-36750-2	5/32	3/4

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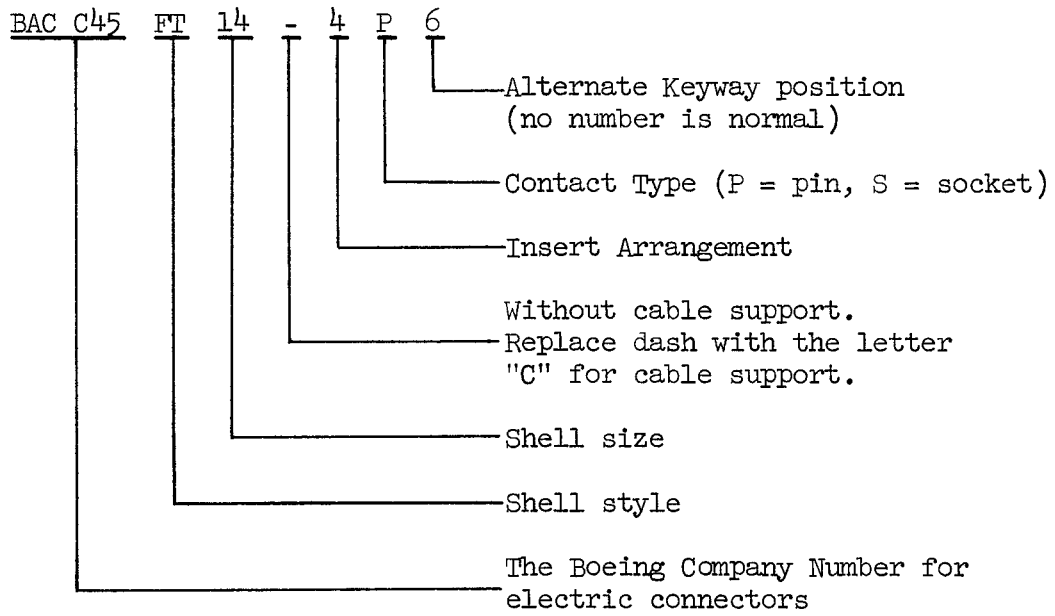


Typical Nomenclature For MIL-C-26500 Connectors (BACC45F)
Figure 7

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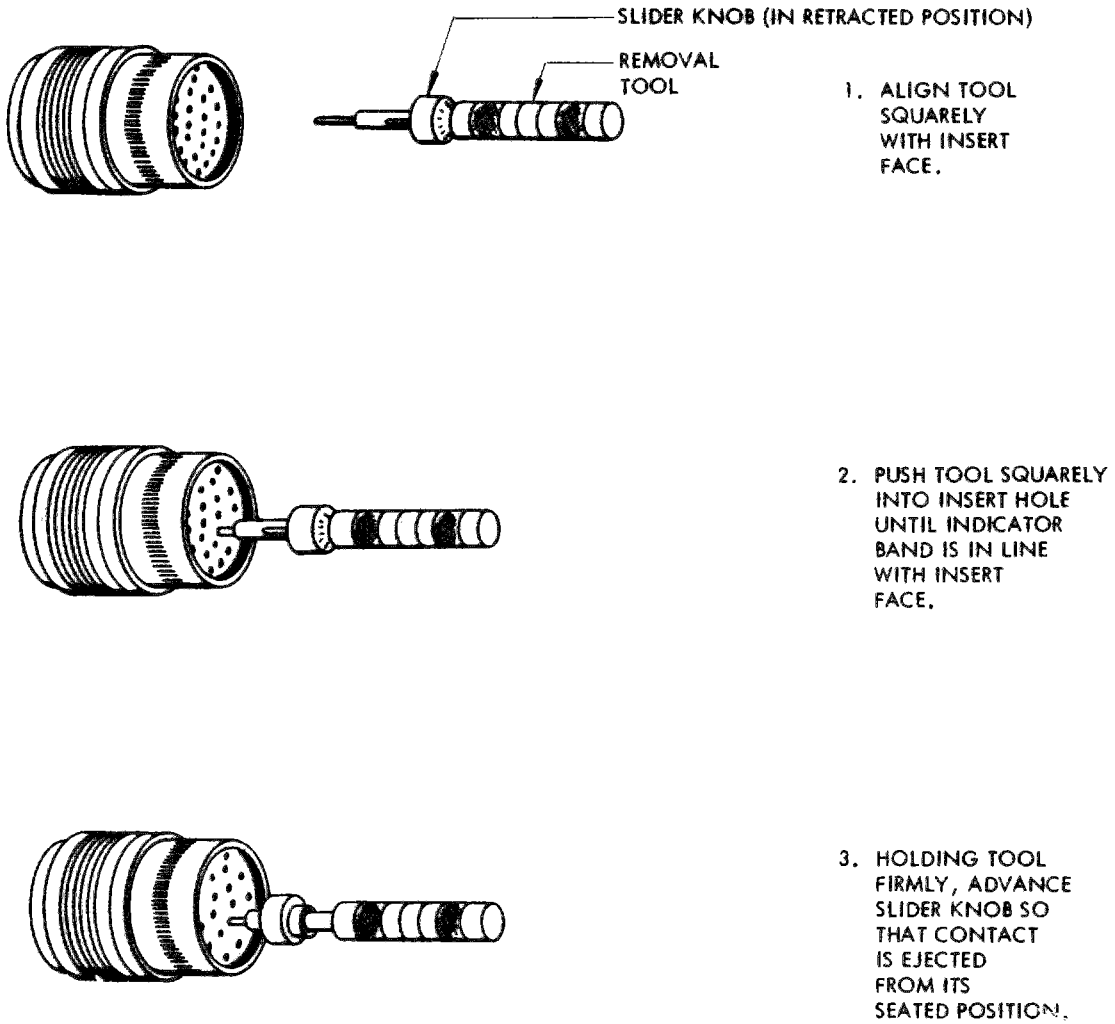
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BACC45FT Connector Part Number Coding
Figure 8

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Typical Contact Removal Procedure
Figure 9

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Contact Size and Type ▾	Part Number				
	MS	Boeing	Amphenol ▾	Burndy ▾	Pyle National
20P	MS24254-20P	BACC47CN1	48-2335-02	LRM 20W-5F74	ZZL-4020-36LT
20S	MS24255-20S	BACC47CP1	48-1824-02	LRC 20W-14F74	-
▾ 20P	-	-	48-100-5012P-02	-	-
▾ 20P	-	-	48-100-5014P-02	-	-
▾ 20S	-	-	48-100-5007S-02	-	-
▾ 20S	-	-	48-100-5008S-02 ▾	-	-
16P	MS24254-16P	BACC47CN2	48-1825-02	LRM 16M-5F74	-
16S	MS24255-16S	BACC47CP2	48-1026-02	LRM 16M-5F74	-
12P	MS24254-12P	BACC47CN3	48-1827-02	LRM 12Z-5F74	-
12S	MS24255-12S	BACC47CP3	48-1215-02	LRC 12Z-5F74	-
▾ 12P			48-2185		
▾ 12S			48-2186		

▾ P - Pin S - Socket

- ▾ #20 Contact with #16 Crimp Barrel
- ▾ #20 Contact with #18 Crimp Barrel
- ▾ Constantan
- ▾ Part Number with -2000 suffix means 22000 contacts installed in a belt on a reel.
- ▾ Prefix J indicates contacts furnished in a belt on a reel.
- ▾ 48-100-5008S-02 will be replaced by Amphenol 48-100-5018S-02 on procurement.
Use 48-100-5008S-02 only until existing stock is depleted.

NOTE: Contacts are interchangeable for all connectors.



NO. 16 AND 12 CONTACT



NO. 20 CONTACT

Selection of Contacts
Figure 10

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Wire Size	Contact Size	Crimp Tool	Contact Locator	
1 ▷ 24	20		ST2220-1-1	
22			ST2220-1-1A	
20				
18			5 ▷ 20	
16			4 ▷ 20	ST2220-1-45
2 ▷ 24	16	ST2220-1 ST2220-1Y	ST2220-1-2	
2 ▷ 22				
20				
18				
16				
18	12		ST2220-1-3	
16				
14				
12				
15 Constantan	12 Constantan	ST2220-1 3 ▷ ST2220-1Y	ST2220-1-31	

1 ▷ Strip wire $7/16 \pm 1/32$ inch and double conductor back before inserting in contact. BMS 13-30 AWG 24 wire need not be doubled back.

2 ▷ Strip wire $9/16 \pm 1/32$ inch and double conductor back before inserting in contact.

3 ▷ Use with handle extension ST2220-100

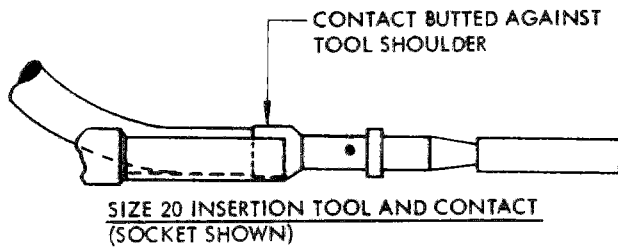
4 ▷ #20 contact with #16 crimp barrel.

5 ▷ #20 contact with #18 crimp barrel.

Boeing Crimp Tools and Locators
Figure 11

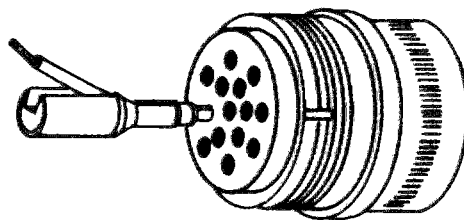
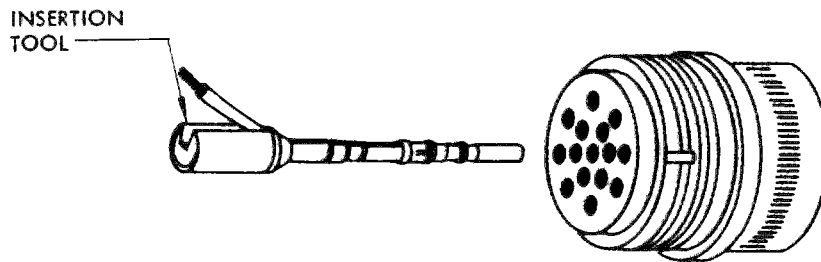
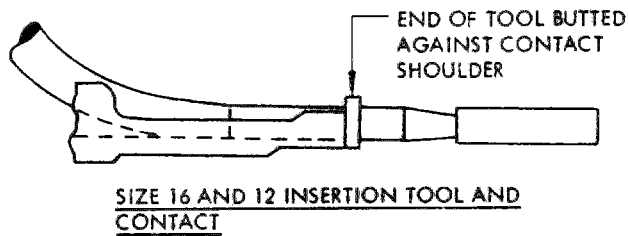
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1. (a) PLACE SIZE 20 CONTACTS INTO INSERTION TOOL TIP BY SLIDING CONTACT INTO INSERTION TOOL TIP END.

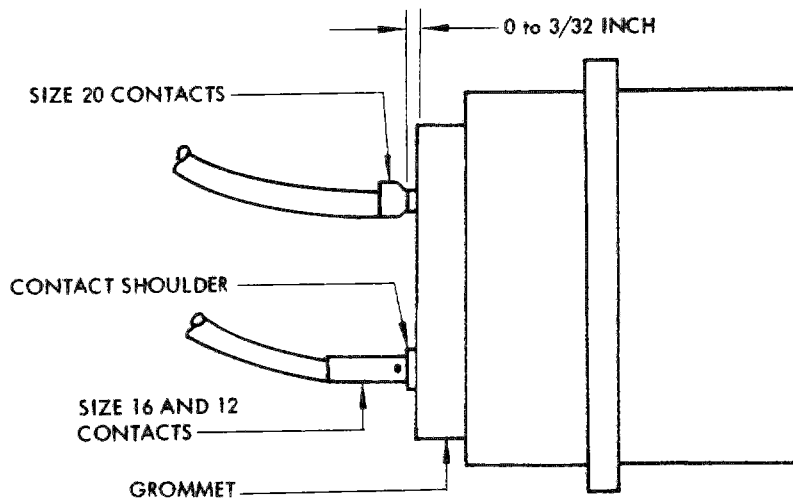
(b) BUTT END OF INSERTION TOOL TIP AGAINST SIZE 16 AND 12 CONTACT SHOULDERS.



Contact Insertion Procedure
Figure 12

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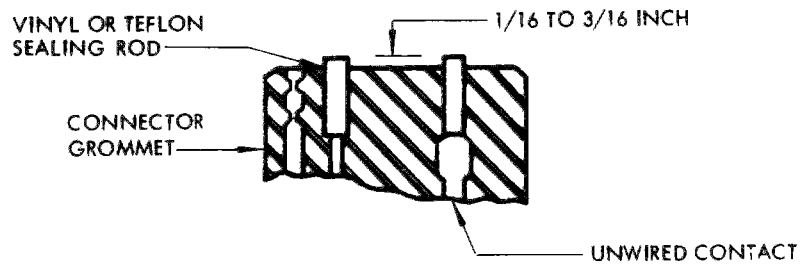
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Preloading Contacts in Grommet
Figure 13

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Installation of Sealing Rod
Figure 14

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15. REPAIR OF ITT CANNON, DPA, DPD AND DPX (MA AND MB) SERIES SOLDERLESS

- A. Connector Nomenclature (See Figure 15).
- B. Part Numbering of Connectors
 - (1) Typical DPA Series Part Number (See Figure 16)
 - (2) Typical DPD Series Part Numbers
 - (a) Single Gang Configuration (See Figure 17)
 - (b) Two Gang Configuration (See Figure 18)
 - (3) Typical DPX Series Part Numbers
 - (a) Single Gang Configuration (See Figure 19)
 - (b) Two Gang Configuration (See Figure 20)
- C. Removing Contacts from Connector
 - (1) Select proper removal tool from Table 5.

Table 5: Boeing Removal Tools

Contact Size	Contact Removal Tool	
	Manufacturer	Part Number
20	Boeing	ST2220-3-6
16	Boeing	ST2220-3-7
12	Boeing	ST2220-3-28

NOTE: Equivalent vendor tool may be used in place of above ST tools. One plastic removal tool is normally furnished for each contact size included with a new connector. Tool numbers are applicable for both pin and socket contacts.

- (2) Place removal tool on wire by sliding wire into back part of tool per Figure 22 and then snapping wire into front portion of tool per Figure 1 and Figure 24.

NOTE: To facilitate contact removal, remove bundle ties to provide a length of free wire adjacent to rear surface of connector not less than two inches.

NOTE: When two wires terminate in a common contact, removal tool may be altered by removing a narrow section of plastic as shown in Figure 25.

- (3) Slide tool along wire straight into insert cavity until tool bottoms (Figure 26 and Figure 27).
- (4) Grasp wire and simultaneously remove contact and removal tool from insert cavity (Figure 28).

D. Removing Wires from Solderless Contact

- (1) Cut wire at end of contact barrel using wire cutters or similar tool.

E. Installing Contacts on Wire

- (1) Strip wire $3/16 \pm 1/32$ inch for size 20 contacts and $1/4 \pm 1/32$ inch for size 16 and 12 contacts.
- (2) Crimp wires in contacts with tooling per Figure 29.

NOTE: Assemble DPA, DPD and DPX may contain coaxial contacts.

F. Installing Contacts in Connector

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CAUTION: KEEP CONTACT ALIGNED PERPENDICULAR TO FACE OF CONNECTOR DURING INSERTION TO PREVENT DAMAGE TO WIRE SEPARATOR.

- (1) Insert contact into contact cavity from rear of connector by gripping crimp portion of contact with finger tips and insert contact until contact shoulder has passed the resilient wire separator. After contact shoulder has passed wire separator, grip wire and carefully complete insertion until contact is locked in connector (Figure 30).

NOTE: Contact insertion can usually be installed by hand without the use of a tool.

- G. Polarization key position clocking chart, Figure 21 for two-gang DPX2 connectors. Dark, shaded position 1 thru 6 indicates the solid portion of a post or key. White, unshaded area indicates the open portion.

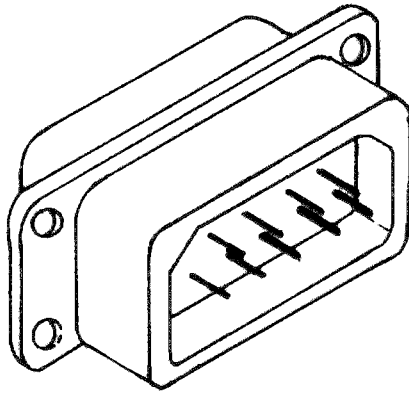
CAUTION: DO NOT INDENT WIRE WITH FINGERNAIL(S).

- (1) Check for proper seating of contact by grasping wire between thumb and forefinger only and pulling gently until thumb and forefinger slip on the wire.

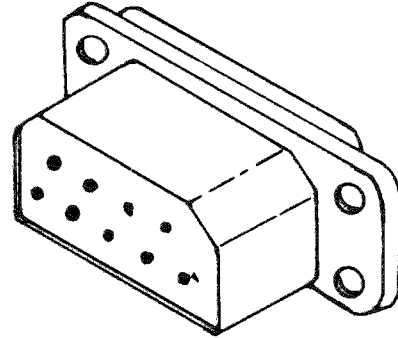
NOTE: Contact insertion can be accomplished by hand and usually does not require any tools. If necessary, plastic removal tool can double as an insertion tool.

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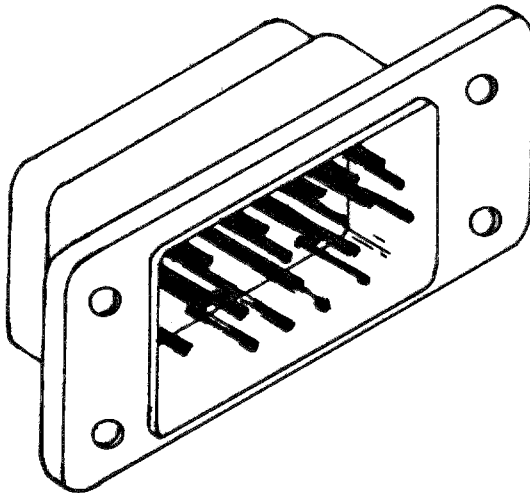


RECEPTACLE

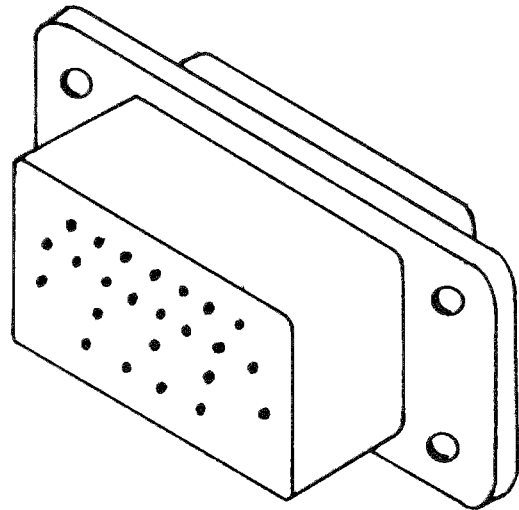


PLUG

DPA() AND DPX() SERIES
SINGLE GANG CONFIGURATION



RECEPTACLE



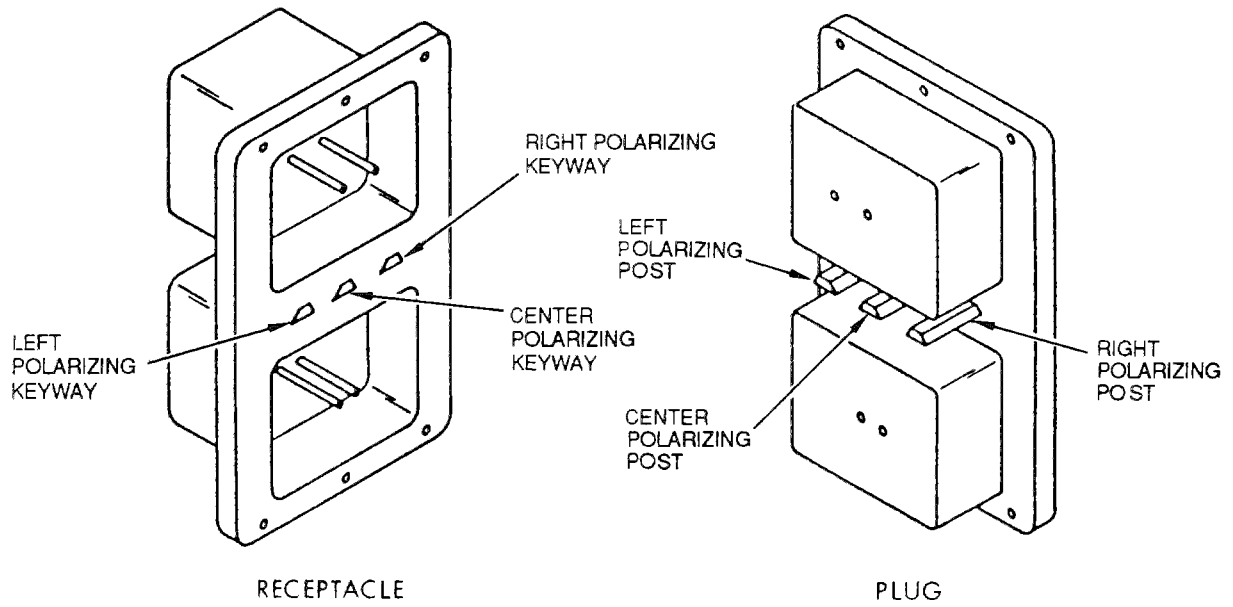
PLUG

DPD() SERIES, SINGLE GANG CONFIGURATION

ITT Cannon Connector
Figure 15 (Sheet 1 of 2)

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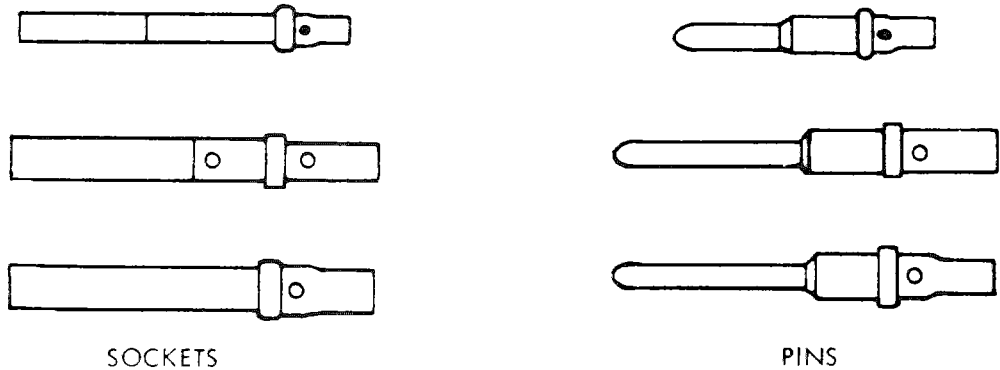
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TWO GANG CONFIGURATION

CONTACT PART NUMBERS

<u>SIZE</u>	<u>TYPE</u>	<u>PART NUMBERS</u>
20	PIN	S-2020PH-A01
20	SOCKET	S-2020SH-E21
16	PIN	S-1616PH-A00
16	SOCKET	S-1616SH-A00
16	PIN	S-1616PC-J00
16	SOCKET	S-1616SC-H56
12	PIN	S-1212PH-A01
12	SOCKET	S-1212SH-A01

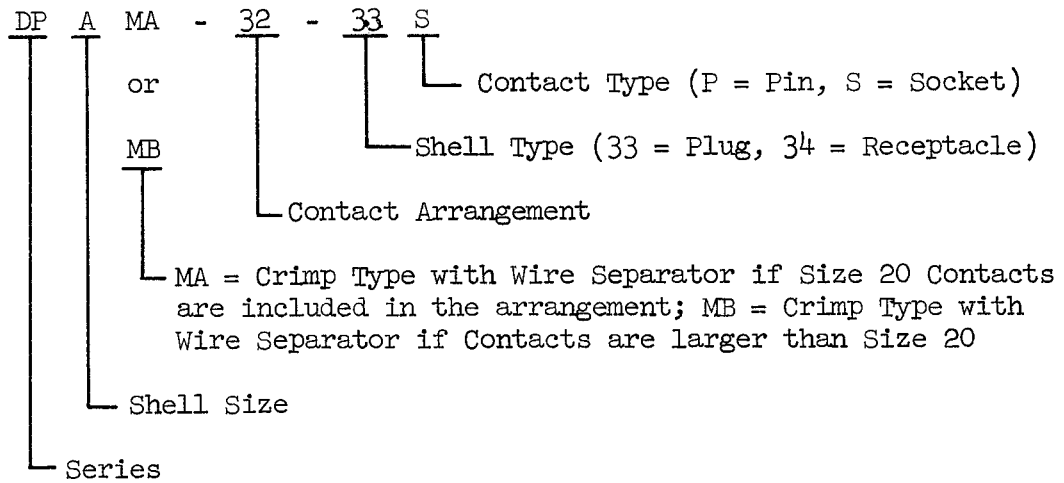


ITT Cannon Connector
Figure 15 (Sheet 2 of 2)

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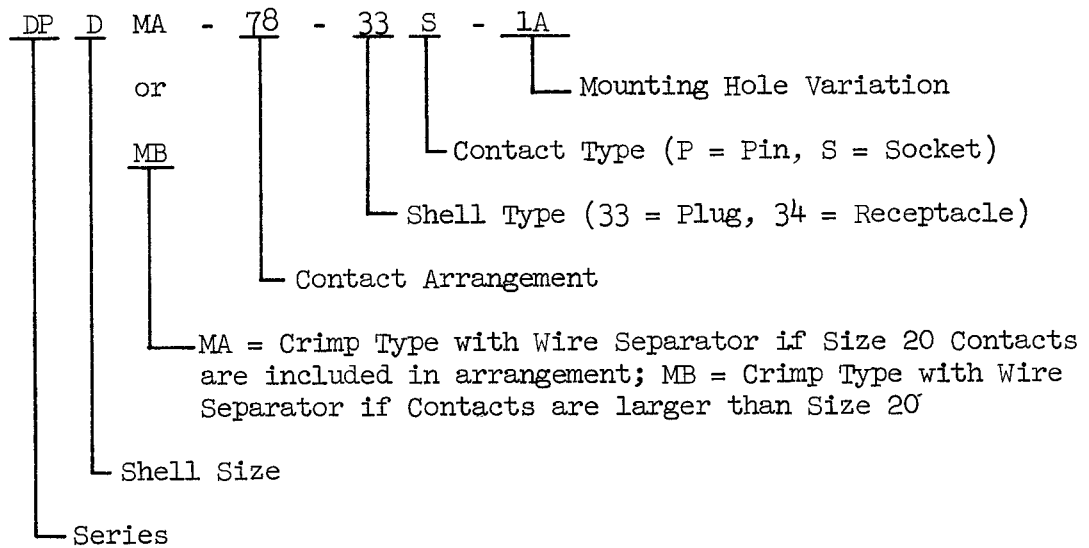


DPA Series Part Number
Figure 16

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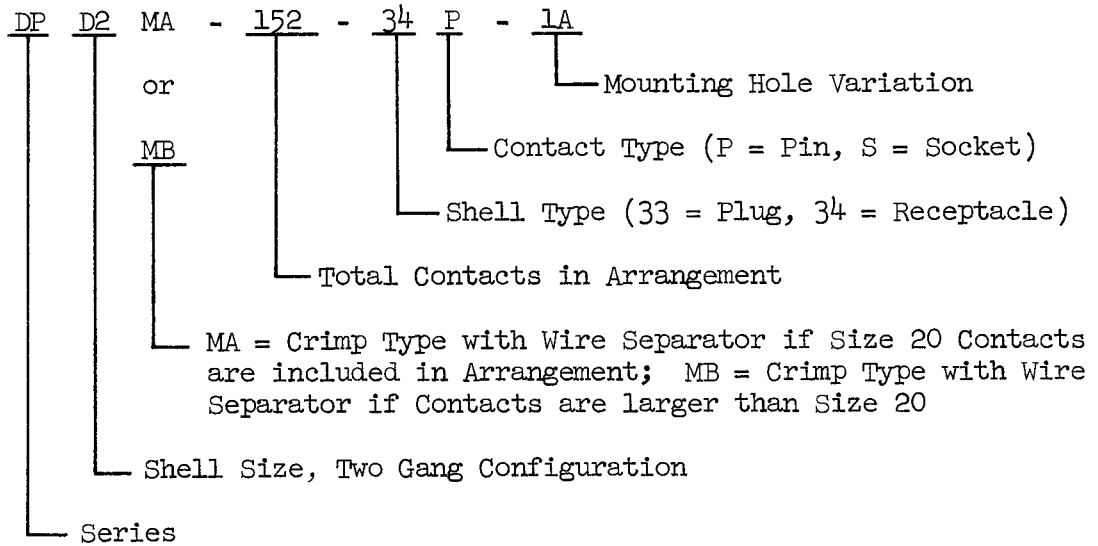


DPD Series Part Numbers - Single Gang Configuration
Figure 17

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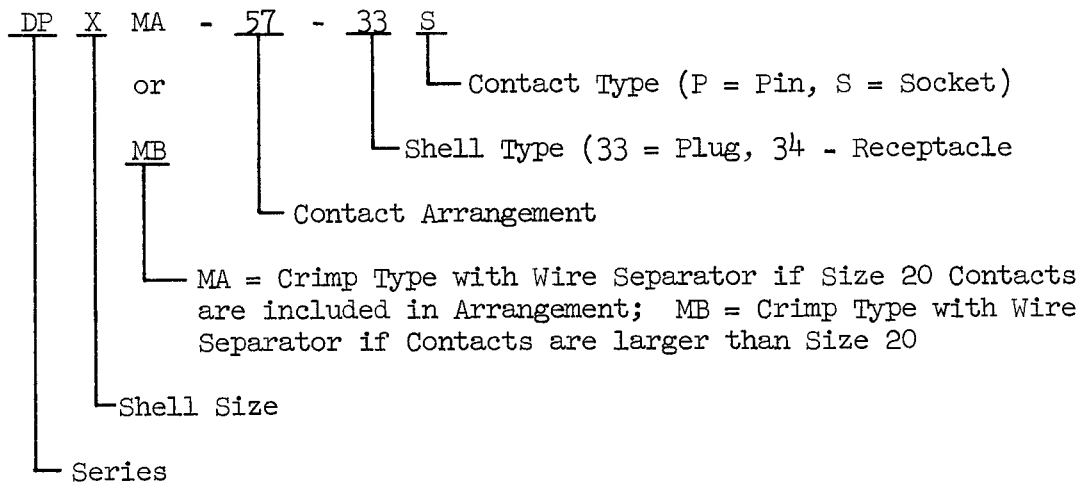


DPD Series Part Numbers - Two Gang Configuration
Figure 18

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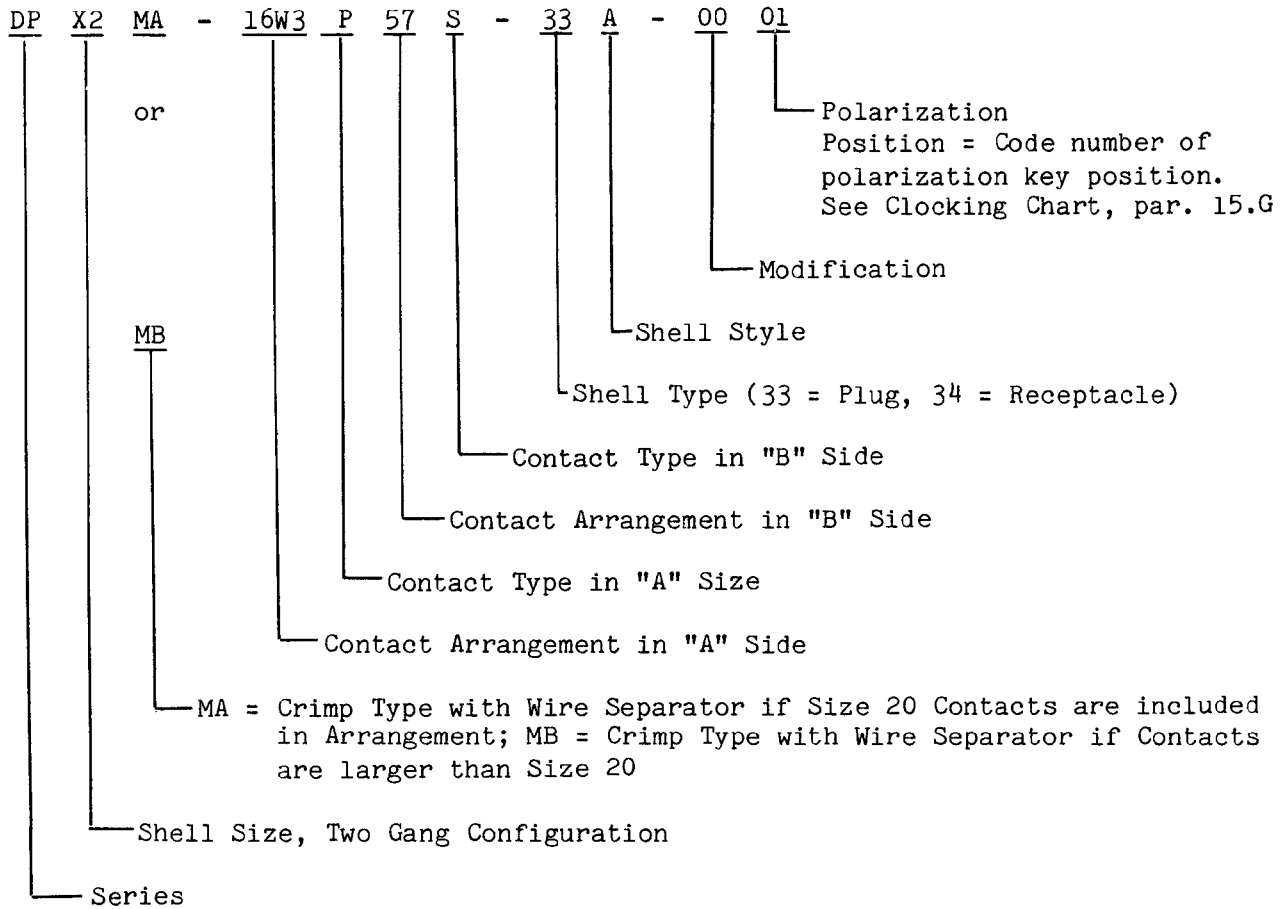


DPX Series Part Numbers - Single Gang Configuration
Figure 19

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DPX Series Part Numbers - Two Gang Configuration
Figure 20

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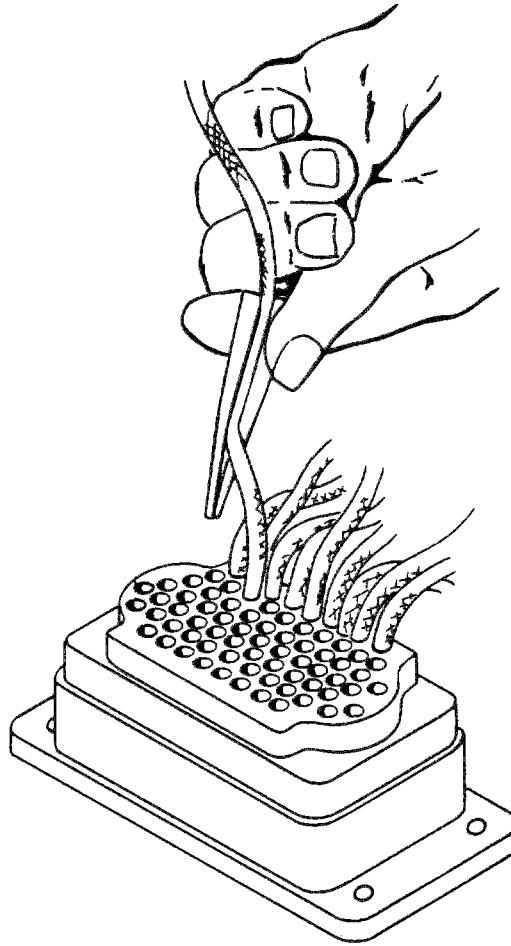


Code Number	Receptacle Shell			Plug Shell			Code Number	Receptacle Shell			Plug Shell		
	Left Key	Center Key	Right Key	Left Post	Center Post	Right Post		Left Key	Center Key	Right Key	Left Post	Center Post	Right Post
01	4	4	4	1	1	1	51	6	3	2	3	2	5
02	4	4	3	2	1	1	52	6	3	1	4	2	5
03	4	4	2	3	1	1	53	6	3	6	5	2	5
04	4	4	1	4	1	1	54	6	3	5	6	2	5
05	4	4	6	5	1	1	55	1	3	4	1	2	4
06	4	4	5	5	2	2	55	1	3	3	1	2	4
07	5	4	4	1	1	6	57	1	3	2	3	2	4
08	5	4	3	2	1	6	58	1	3	1	4	2	4
09	5	4	2	3	1	6	59	1	3	6	5	2	4
10	5	4	1	4	1	6	60	1	3	5	6	2	4
11	5	4	6	5	1	6	61	2	3	4	1	2	3
12	5	4	5	6	1	6	62	2	3	3	2	2	3
13	6	4	4	1	1	5	63	2	3	2	3	2	3
14	6	4	3	2	1	5	64	2	3	1	4	2	3
15	6	4	2	3	1	5	65	2	3	6	5	2	3
16	6	4	1	4	1	5	66	2	3	5	6	2	3
17	6	4	6	5	1	5	67	3	3	4	1	2	2
18	6	4	5	6	1	5	68	3	3	3	2	2	2
19	1	4	4	1	1	4	69	3	3	2	3	2	2
20	1	4	3	2	1	4	70	3	3	1	4	2	2
21	1	4	2	3	1	4	71	3	3	6	5	2	2
22	1	4	1	4	1	4	72	3	3	5	6	2	2
23	1	4	6	5	1	4	73	4	2	4	1	3	1
24	1	4	5	6	1	4	74	4	2	3	2	3	1
25	2	4	4	1	1	3	75	4	2	2	3	3	1
26	2	4	3	2	1	3	76	4	2	1	4	3	1
27	2	4	2	3	1	3	77	4	2	6	5	3	1
28	2	4	1	4	1	3	78	4	2	5	6	3	1
29	2	4	6	5	1	3	79	5	2	4	2	3	6
30	2	4	5	6	1	3	80	5	2	3	2	3	6
31	3	4	4	1	1	2	81	5	2	2	3	3	6
32	3	4	3	2	1	2	82	5	2	1	4	3	6
33	3	4	2	3	1	2	83	5	2	6	5	3	6
34	3	4	1	4	1	2	84	5	2	5	6	3	6
35	3	4	6	5	1	2	85	6	2	4	1	3	5
36	3	4	5	6	1	2	86	6	2	3	2	3	5
37	4	3	4	1	2	1	87	6	2	2	3	3	5
38	4	3	3	2	2	1	88	6	2	1	4	3	5
39	4	3	2	3	2	1	89	6	2	6	5	3	5
40	4	3	1	4	2	1	90	6	2	5	6	3	5
41	4	3	6	5	2	1	91	1	2	4	1	3	4
42	4	3	5	6	2	1	92	1	2	3	2	3	4
43	5	3	4	1	2	6	93	1	2	2	3	3	4
44	5	3	3	2	2	6	94	1	2	1	4	3	4
45	5	3	2	3	2	6	95	1	2	6	5	3	4
46	5	3	1	4	2	6	96	1	2	5	6	3	4
47	5	3	6	5	2	6	97	2	2	4	1	3	3
48	5	3	5	6	2	6	98	2	2	3	2	3	3
49	6	3	4	1	2	5	99	2	2	2	3	3	3
50	6	3	3	2	2	5	100	5	1	2	3	4	6

Polarization Key Position Clocking Chart
Figure 21

20-11-02

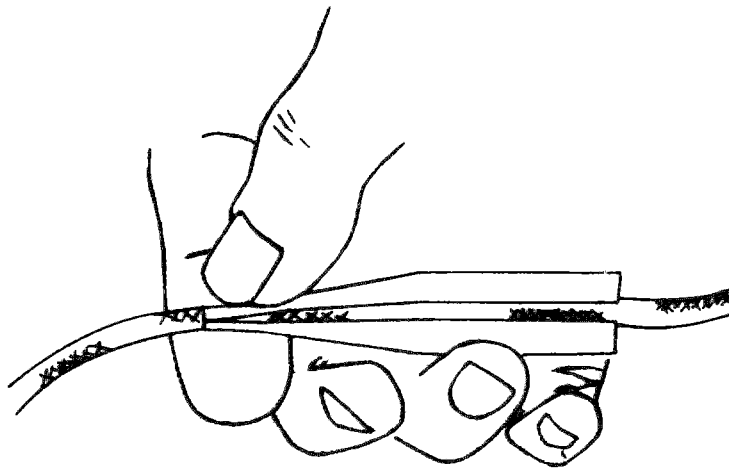
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Placing Removal Tool on Wire
Figure 22

20-11-02

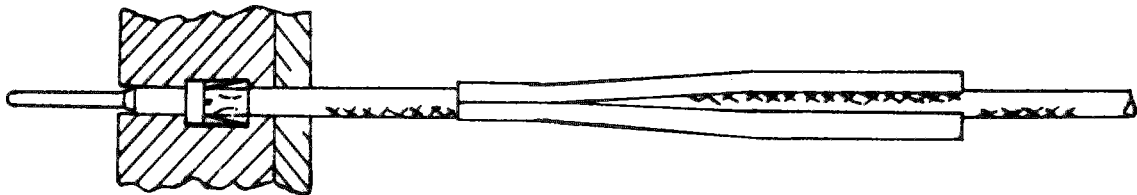
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Snapping Front Portion of Removal Tool on Wire
Figure 23

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Removal Tool In Position On Wire
Figure 24

20-11-02



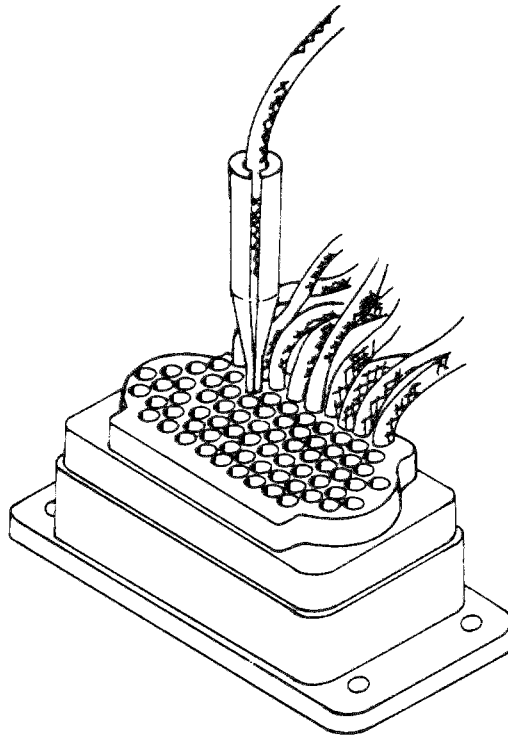
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Removal Tool Alteration
Figure 25

20-11-02

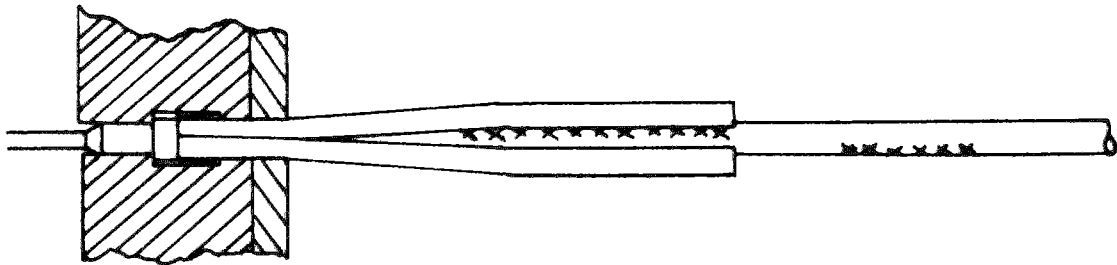
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Sliding Removal Tool Into Contact Cavity
Figure 26

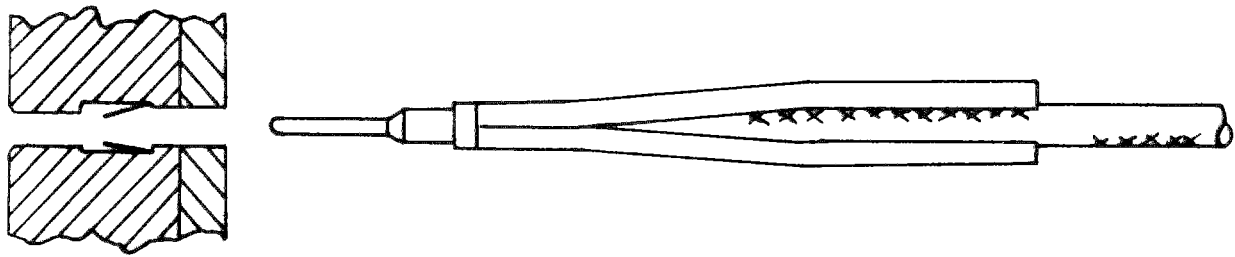
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Removal Tool Bottomed in Contact Cavity
Figure 27

20-11-02









Removing Contact and Removal Tool
Figure 28






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Contact Size	Wire Size	Crimping Tool Number	Contact Locator Number
20	 26	ST2220-1	 ST2220-1-1
	 24		ST2220-1-43
	22	ST2220-1-Y	
	20		
16	 26	ST2220-1	ST2220-1-2
	 24		
	 22	ST2220-1-Y	
	20		
	18		
16			
12	16	ST2220-1	ST2220-1-3
	14		
	12	ST2220-1-Y	

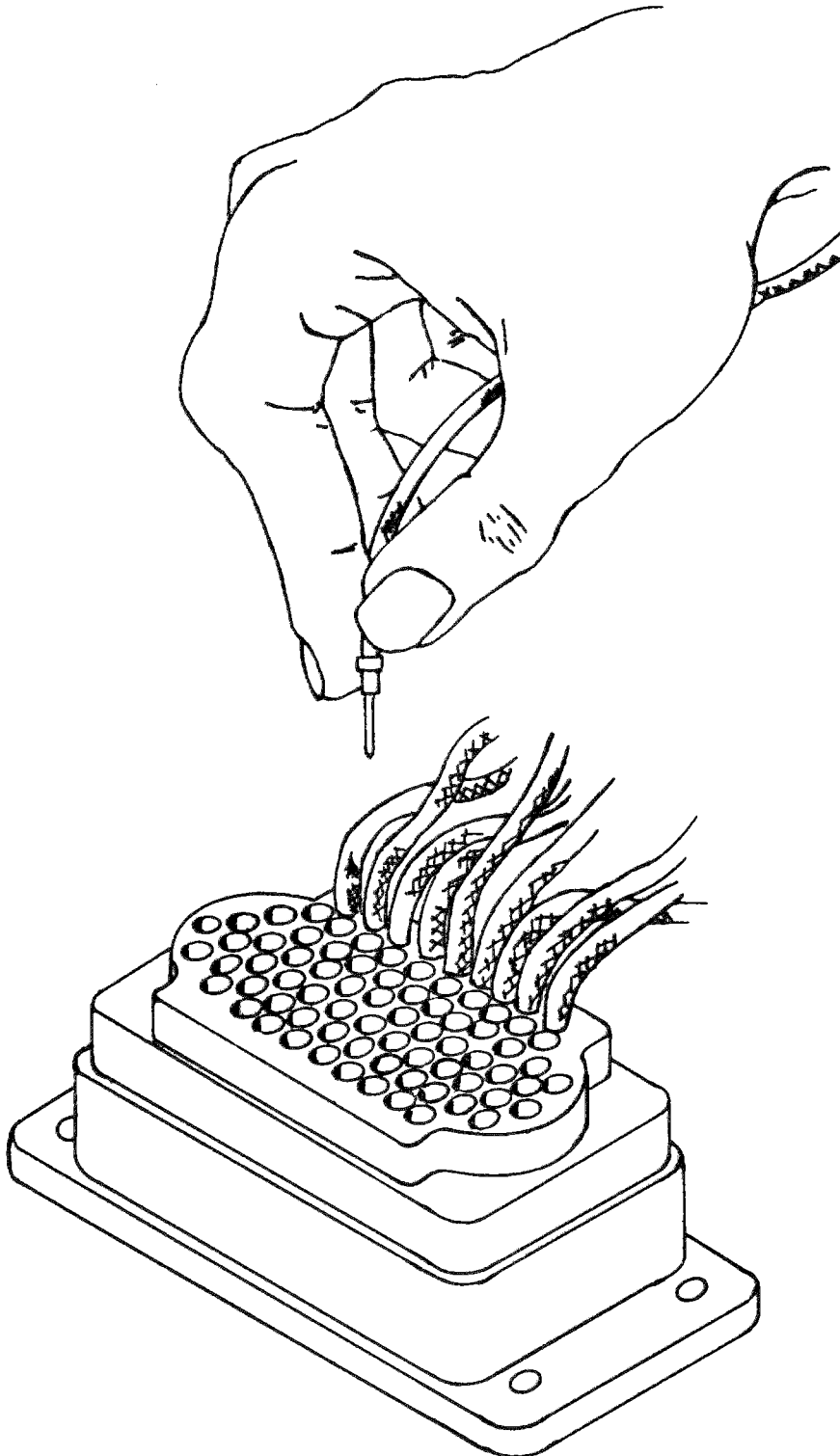
NOTE: Equivalent vendor tools may be used in place of ST - tools.

-  Do not use on DPX2MA-67 Series size 20 contact.
-  Strip wire $3/8 \pm 1/32$ inch and double back on itself.
-  BMS 13-30, size number 24 wire need not be doubled back.
-  Strip wire $9/16 \pm 1/32$ inch and double back on itself.
-  Use ST2220-1-43 contact locator on IIT Cannon DPX () MA-67. Size number 20 contacts only.

Boeing Standard Crimp Tools and Locators
Figure 29

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Installing Contacts in Connector
Figure 30

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STANDARD OVERHAUL PRACTICES MANUAL

16. REPAIR OF AMP, INC. 5XXXXX- SERIES PRINTED CIRCUIT TYPE CONNECTORS

A. Connector Description

- (1) This connector is a one-piece, printed circuit board edge connector. The connector block contains preinserted contacts which mate in a firm wiping action with pads of printed board. Contact positions are numbered front and rear.
- (2) Tab terminals are inserted into rear of housing by hand. No insertion tooling is required.
- (3) This connector is primarily for two-sided boards and is available in two versions; the dual type contact and the quad type contact. The dual commons the two rear wire terminals to both sides of printed circuit board. The quad (with four rear-wire terminals) commons two rear wire terminals to the top of board and two to the bottom; the board in this case is not commoned.
- (4) Tab terminals accommodate wire sizes 18 through 26.

B. Removing Contacts from Connector

- (1) Use extraction tool 91011-1 for removing contacts used on dual-type connectors (two tab terminals per position).
- (2) Use extraction tool 91017-1 for removing contacts used on quad-type connectors (four tab terminals per position).

C. Removing Wires from Solderless Contact

- (1) Cut wire at end of wire insulation, using wire cutters or similar tool.

D. Installing Contacts on Wire

- (1) Strip wire per Figure 31, using stripping tool ST2346 or equivalent.
- (2) Crimp wires in contacts with tooling per Figure 31.

NOTE: Lubricate all pins, pivot points and bearing surfaces of tool as needed with S.A.E. No. 20 motor oil.

- (a) Insert contact into back of tool 90090-2 so that contact tab fits into slot in locator (Figure 32). Make sure contact bottoms in locator.
- (b) Squeeze handles to raise lower crimping inserts just enough to retain contact (Figure 33). Do not deform contact wire or insulation barrels. As inserts close, contact positioner will engage contact.
- (c) Insert stripped wire into contact wire barrel until wire butts against wire stop (Figure 33).
- (d) Hold wire in place and finish crimp by closing handles until ratchet releases. Open tool handles and remove crimped contact from tool.

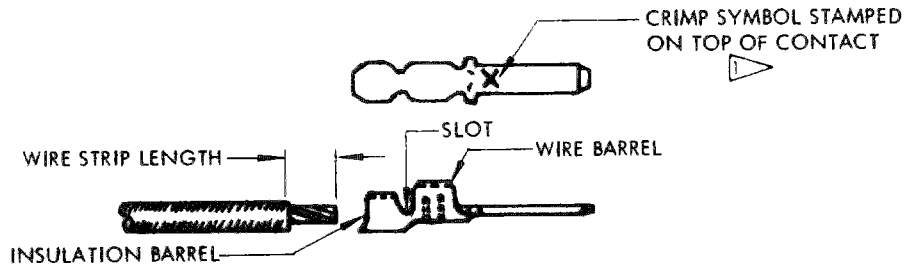
E. Installing Contacts in Connector

- (1) Insert contact into rear of housing by hand.
- (2) Check for proper seating of contact by grasping wire between thumb and forefinger only and pulling gently until thumb and forefinger slip on wire.

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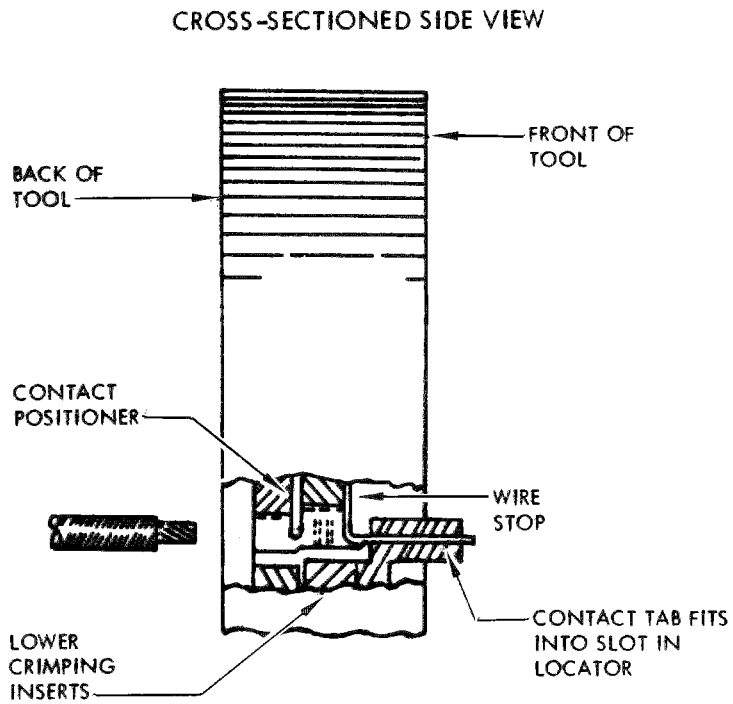
TOOL NUMBER	CONTACT NUMBER	CRIMP SYMBOL	WIRE SIZE	INSUL DIA	WIRE STRIP LENGTH
90090-2	66168 (66143LP)	O 26-22	26-22	0.040 0.053	0.120
	66169 (66144LP)	X 22-18	22-18	0.055 0.071	

1 THERE WILL BE TWO DOTS ON BOTTOM OF CRIMPED WIRE BARREL ON CONTACT NO. 66169 (66144LP), WHICH HAS AN "X" MARK CRIMP SYMBOL. THERE WILL BE ONE DOT ON BOTTOM OF CRIMPED WIRE BARREL ON CONTACT NO. 66168 (66143LP) WHICH HAS AN "O" MARK CRIMP SYMBOL.

Wire Stripping and Crimping Requirements
Figure 31

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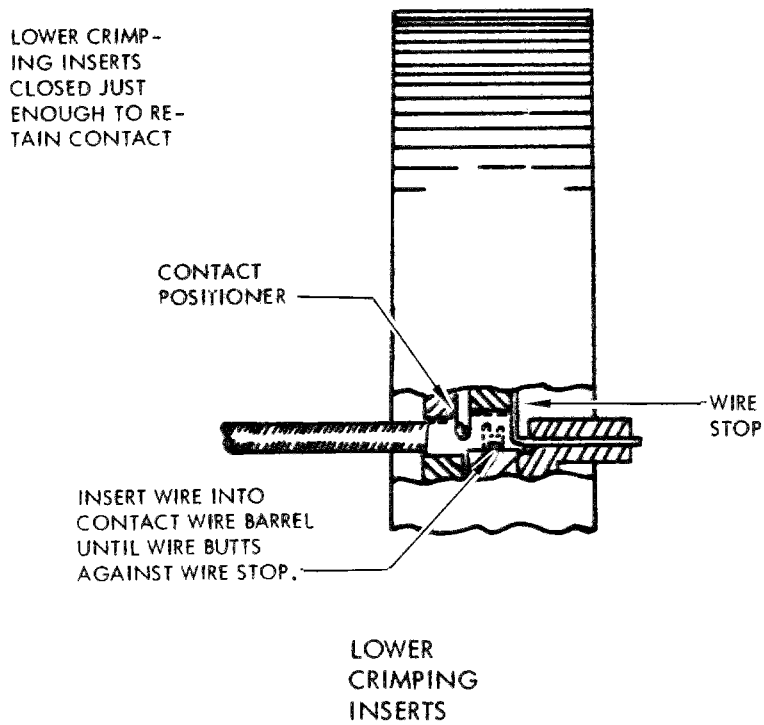


Contact Positioning
Figure 32

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CROSS-SECTIONED SIDE VIEW



Wire Positioning
Figure 33

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17. Repair of AMP, Inc. AM and AD Series Connectors

- A. Part Numbering (See Figure 34)
- B. Typical contacts are listed in Table 6.

Table 6: Connector Contacts

Size	Type	Vendor	P/N	Color Band
Sub 20	Pin	AMP	203840-2	Green
Sub 20	Socket	AMP	203841-1	Green
16	Pin	AMP	203884-2	Blue
16	Socket	AMP	203885-1	Blue
Sub 20	Pin	Amphenol	213-36017-02	Green
Sub 20	Socket	Amphenol	213-36009	Green
20	Pin	Amphenol	213-36001-02	Red
20	Socket	Amphenol	213-36000-01	Red
16	Pin	Amphenol	213-36018-02	Blue
16	Socket	Amphenol	213-36012	Blue

C. Contact Removal (Figure 35)

- (1) Select removal tool from Table 7.
- (2) Slide the removal tool tip into the insert and over the contact from the mating side. Insert carefully to avoid damage to grommet or retention clip.
- (3) When removal tool is at bottom of grommet, advance plunger to eject contact.
- (4) Grasp freed contact with fingers (do not use pliers) and remove from insert.
- (5) If sealing rod has been inserted in contact, do not remove rod before ejecting contact.
- (6) If contacts are difficult to remove, check tool tip for damage.

Table 7: Contact Removal Tools

Size	Color Band	Vendor	Tool P/N	Tip P/N	Tip Color
Sub 20	Green	AMP	91040-1	126118-1	Green
20	Red	Amphenol	294-280	—	Red
20	Red	Astro	ATA 2079	—	Red
16	Blue	Amphenol	294-219	—	Blue
16	Blue	AMP	91040-3	126118-3	Blue
Coax ^{*[1]}	—	AMP	91040-7	126118-7	Yellow

*[1] AMP size 0 coaxial contact numbers 51781-1 and -2

D. Contact Insertion

- (1) Install contacts on wire
 - (a) Strip wire per Paragraph 8., PREPARATION OF WIRES. Strip length varies with contact and wire size per Table 8.

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- (b) Select locator and crimp tool from Table 8. Place contact in locator.
- (c) Insert stripped end of wire into crimp barrel until insulation is butted against barrel. Check that bared wire is visible in inspection hole (Figure 3).

NOTE: Wire may be inserted in contact before placing contact in locator.

- (d) When wire is seated in contact, and contact shoulder seated in locator, close crimp tool handles until ratchet releases.
- (e) Remove contact/wire assembly from tool. Verify that no more than 1/32 inch of bared wire is exposed between insulation and contact barrel.

Table 8: Crimp Tools, Locators, and Wire Strip Length

Contact Size	Wire Size	Strip ($\pm 1/32$) Length	Crimp Tool	Locator
SUB 20	24 ^{*[1]}	7/16	MS3191-1 ST2220-1 ST2220-1-Y	ST2220-1-48
	22 20	3/16		
20	24 ^{*[1]}	7/16		MS3191-20A ST2220-1-1
	22 20	3/16		
16	22, 24 ^{*[1]}	9/16		MS3191-16A ST2220-1-2
	20, 18, 16	9/16		

*[1] Doubler wire back before inserting in contact (Figure 4).

NOTE: ST tools are Boeing parts.

- (2) Insert Contact Into Connector (Figure 36)
 - (a) Select insertion tool from Table 9.
 - (b) Slide contact into insertion tool tip as shown in Figure 36. Check that tool tip is not bent, spread, or flared, and that it is free of burrs or sharp edges that could damage connector. Tool tip should fit around crimp barrel (not rear edge).
 - (c) Withdraw tool carefully, retaining axial alignment until tool is clear of connector. Check by pulling on wire with thumb and forefinger (not fingernails) until wire slips between fingers.
 - (d) Insert unwired contacts in all unused grommet holes with Boeing tool ST2220-2-23.
 - (e) Insert sealing rods, smaller diameter end first, into all unwired contacts. Trim rods to leave 1/16 to 3/16 extension from insert face.

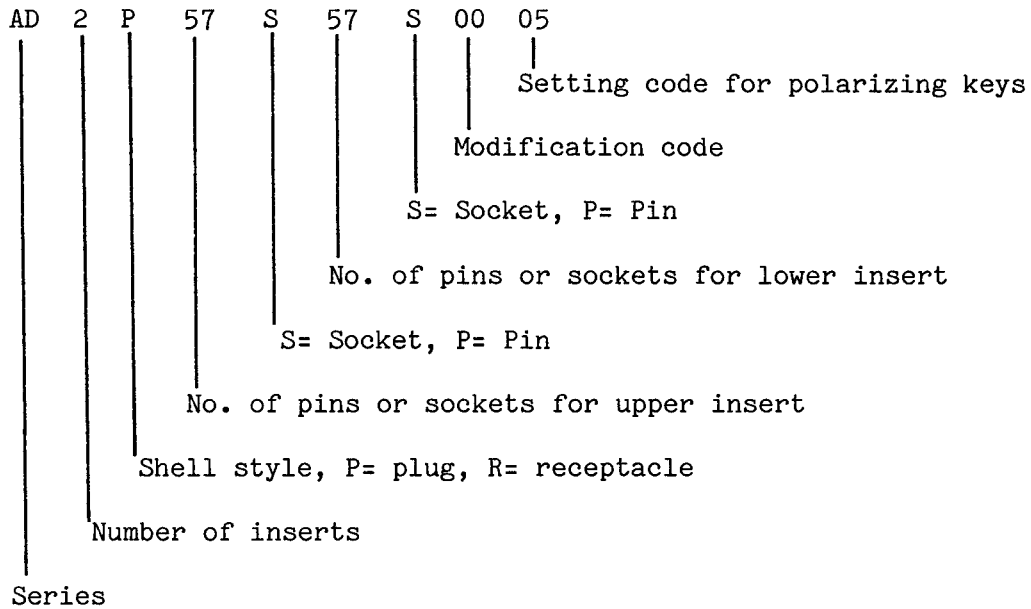
Table 9: Insertion Tools

Contact Size	Color Band	Tool Vendor	Tool P/N	Tip P/N	Tip Color
SUB 20	Green	AMP	91039-1	126117-1	Green
SUB 20, 20	—	Boeing	ST2220-2-28	—	—
20	Red	Amphenol	294-279	—	Red
16	Blue	AMP	91039-3	126117-3	Blue
16	Blue	Amphenol	294-192	—	Blue

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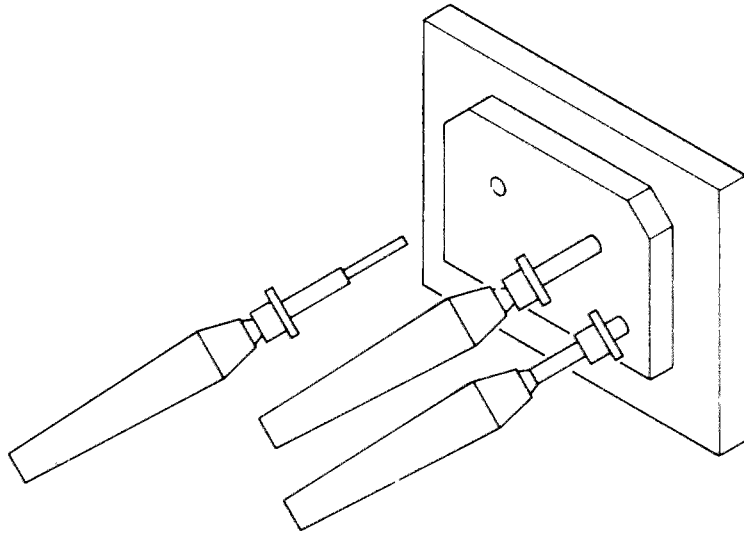
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AMP Connector Part Number Coding Details
Figure 34

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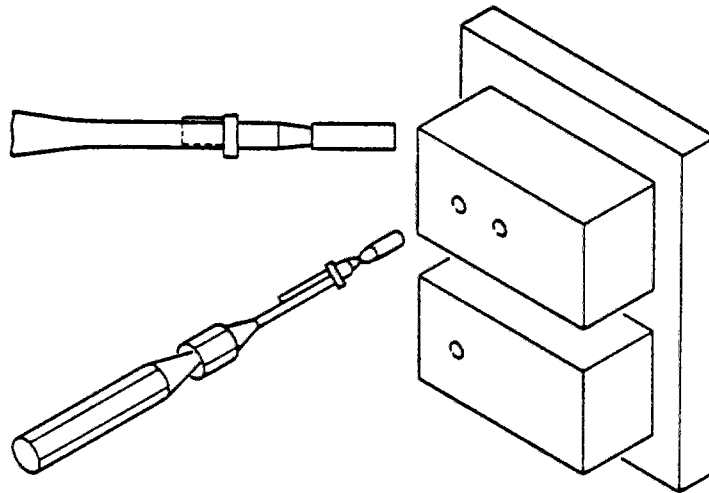
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Contact Removal
Figure 35

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Contact Insertion
Figure 36

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18. Repair of ITT Cannon FR, FV and Flight FC, FH Series Connectors (Ref BAC5162-53)

A. Part Numbering

- (1) ITT Cannon Connectors (See Figure 37)
- (2) Flight Connectors (See Figure 38)

B. These connectors could have standard contacts or thermocouple contacts. Standard contacts are shown in Table 10. Thermocouple contacts are shown in Table 11.

Table 10: Standard Connector Contacts

Contact Size	Contact Part Numbers				Color Code Stripes
	Boeing		Military		
	Pin	Socket	Pin MS90453	Socket MS90454	
16	BACC47DP1	BACC47DR1	-16-16	-16-16	Blue
12	BACC47DP2	BACC47DR2	-12-12	-12-12	Yellow
8	BACC47DP3	BACC47DR3	-8-8	-8-8	Red
4	BACC47DP4	BACC47DR4	-4-4	-4-4	Blue
1/0	BACC47DP5	BACC45DR5	-0-0	-0-0	Yellow

Table 11: Thermocouple Contacts (BAC5162-53 Table II)

Contact Size and Material	Contact Part Numbers				Color Code Stripes
	(Cannon)		(Flight)		
	Pin	Socket	Pin	Socket	
16 Alumel	030-1878-007	031-1040-003	016-0007-106	016-1007-206	Blue, Blue, Green
16 Chromel	030-1878-006	031-1040-004	016-0007-107	016-1007-207	Blue, Blue, White
12 Alumel	030-1879-009	031-1041-009	012-0008-106	012-0008-206	Yellow, Yellow, Green
12 Chromel	030-1879-010	031-1041-010	012-0008-107	012-0008-207	Yellow, Yellow, White

C. Contact Removal

- (1) Unscrew the cable clamp or end bell and slide the parts back over the wires.
- (2) Use the removal tool per Table 12. Put the tool around the mating end of the contact, and down into the cavity until the tool tip touches the bottom. Move the plunger to partially eject the contact. Remove the tool carefully.
- (3) Pull the wire and contact from the insert by hand. Do not use pliers to remove contacts.

Table 12: Contact Insertion and Removal Tools

CONTACT SIZE	INSERTION TOOL	REMOVAL TOOL
16	Cannon CIT 16	MS90456-1, or Cannon CET-FRF-16-22A
12	Cannon CIT 12	MS90456-2, or Cannon CET-FRF-12
8	Not Required	MS90456-3, or Cannon CET-FRF-8

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Table 12: Contact Insertion and Removal Tools (Continued)

CONTACT SIZE	INSERTION TOOL	REMOVAL TOOL
4	Not Required	MS90456-4, or Cannon CET-FRF-4
1/0	Not Required	MS90456-5, or Cannon CET-FRF-0

D. Contact Installation on Wire

- (1) Remove the insulation from the end of the wire to the stripped length D as shown in Figure 39.
- (2) When the wire size is smaller than that of the contact, use filler sleeves and filler wires per Table 13 to build up the undersized conductor.

Table 13: Filler Sleeves and Filler Wires

Wire Size (AWG)	Contact Size		Cannon Filler Part Number	Filler Wire	
	Engaging End	Crimp Barrel		Size (AWG)	Quantity
20	8	8	252-1231-000	10	1
18	8	8	252-1231-000	10	1
16	8	8	252-1231-000	10	1
			-	12	2
14	8	8	252-1231-000	12	1
			-	12	2
12	8	8	252-0146-000	-	-
			252-1231-000	14	1
			-	10	1
10	8	8	252-1231-000	-	-
	4	4	252-0128-000	12	1
8	4	4	252-0128-000	-	-
6	4	4	252-0318-000	-	-
4	1/0	1/0	252-0130-001	-	-
2	1/0	1/0	252-1230-000	-	-

- (3) Put the stripped end of the wire into the crimp barrel. Or put the contact in the locator or die set and then put the wire into the crimp barrel. Make sure all of the conductor strands are in the crimp barrel. Make sure you can see the conductor through the inspection hole. Put the contact and wire assembly in the crimp tool locator or die set per Table 14. For size 8 and larger contacts, put the contact in the dies with the open end of the contact barrel 0.01-0.03 inch inside the dies.
- (4) With the contact at the bottom of the locator or in the die set, close the crimp tool until the ratchet or the bypass valve releases.

E. Contact Installation in Connector

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- (1) Slide the backshell hardware back up the wire bundle in the order for assembly. Do not try to remove or turn the resilient grommet or insert parts, because they are solid parts of the connector assembly.
- (2) Make sure the contacts are straight.
- (3) If some of the contact locations of the connector will not be connected to wires, install spare contacts in these locations before you install the wired contacts.
- (4) To install size 16 and size 12 contacts, hold the contact-wire assemblies one at a time and guide them into their related grommet cavities. Make sure the shoulder is flush to 0.09 inch from the grommet surface. Slide the specified insertion tool (Table 12) over the wire, and against the contact shoulder. Carefully push the insertion tool and contact until it stops. Pull out the tool carefully. Note that sizes 8, 4 and 1/0 contacts can be installed by hand without tools.
- (5) To make sure the contact is correctly installed, hold each wire between your thumb and forefinger only, and pull slowly until your thumb and forefinger slip on the wire. Do not jerk on the wire, or put a nick in the wire insulation with your fingernails.
- (6) Install grommet seal rods behind size 16 and 12 spare contacts.

F. Connector Parts Assembly

- (1) When FRFXX28-22P, FRFXX28-22S, FC34XXKE28-22P and FC34XXKE28-22S series connectors or the optional FR series connectors are wired with AWG 4 wire, assemble the cable clamp as follows:
 - (a) Wrap a BACS45A115 spacer with 8 wraps of Permacel Electrical P263 tape, and put it between the wires and next to the connector grommet (Figure 40).
 - (b) Put another BACS45A115 spacer between the wires and underneath the cable clamp. Wrap the wires in this area with 8 wraps of Permacel Electrical P263 tape. Put the tape wraps under the cable clamp.
- (2) When FRFXX36-5X or FC34XXKX36-5X connectors are wired with AWG 2 or 4 wire, complete connector assembly as follows:
 - (a) When the endbell or cable clamp is supplied, assemble the endbell or cable clamp.
 - (b) Install a 1/2 inch diameter, 2 1/4 inch long, Teflon sealing rod in the unused cavity. Push the rod against the contact crimp barrel.
 - (c) Slide Matrix spacer 6000-052-000 between the wires and sealing rod with the large end against the connector grommet.
 - (d) Complete the cable clamp assembly. If a cable clamp is not used, tie the wires and sealing rod over the grooved portion of the spacer with grade D lacing tape.
- (3) Assemble the end bell or cable clamp and tighten it.

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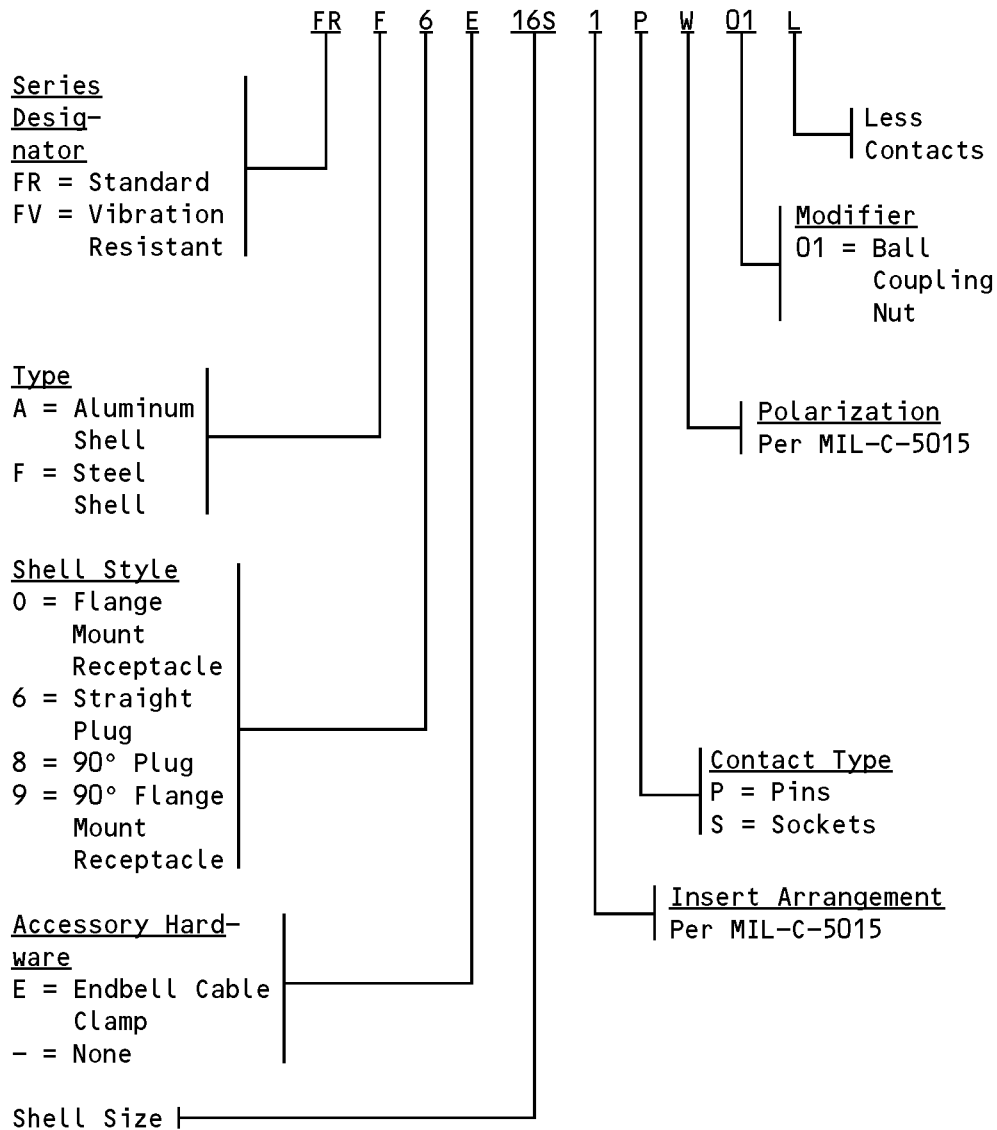
Table 14: Crimp Tools

Wire Size (AWG)	Crimp Barrel	Crimp Tool		Locator		Die Set	
		Basic Tool	Supplier	Part Number	Color	Primary	Secondary
24, 22, 20, 18, 16	16	294-126 MS22520/1-01 MS3191-1 ST2220-1-Y	Amphenol QPL QPL Boeing	- M22520/1-02 MS3191-16A ST2220-1-2	Blue - - -	- - - -	- - - -
20	12	M22520/1-01 MS3191-1 ST2220-1-Y	QPL QPL Boeing	M22520/1-02 MS3191-12A ST2220-1-3	- - -	- - -	- - -
18, 16, 15, 14, 13, 12	12	294-126 MS3191-1 M22520/1-01 ST2220-1-Y	Amphenol QPL QPL Boeing	- MS3191-12A M22520/1-02 ST2220-1-3	Yellow - - -	- - - -	- - - -
20, 18, 16, 14, 10, 8	8	13642 400-B 400-B-1 TBHD1 Y29BH	Thomas & Betts Pico Pico Daniels Burndy	- 4046A 4046A - -	- - - -	ST-2354-5 414DA-8N 414DA-8N ST2354-5 ST2354B-5	11732 - - 11732 -
10, 8, 6, 4	4	13642 400-B 400-B-1 TBDH1 Y29BH	Thomas & Betts Pico Pico Daniels Burndy	- 4112 4112 - -	- - - -	ST2354-2 414DA-4N 414DA-4N ST2354-2 ST2354B-2	11734 - - 11734 -
4, 2	1/0	13642 400-B-1 TBDH1	Thomas & Betts Pico Daniels	- 4066 -	- - -	11738 414DA-ON 11738	11737 - 11737
1/0	1/0	13642 400-B-1	Thomas & Betts Pico	- 4066	- -	11738 414DA-ON	11737 -

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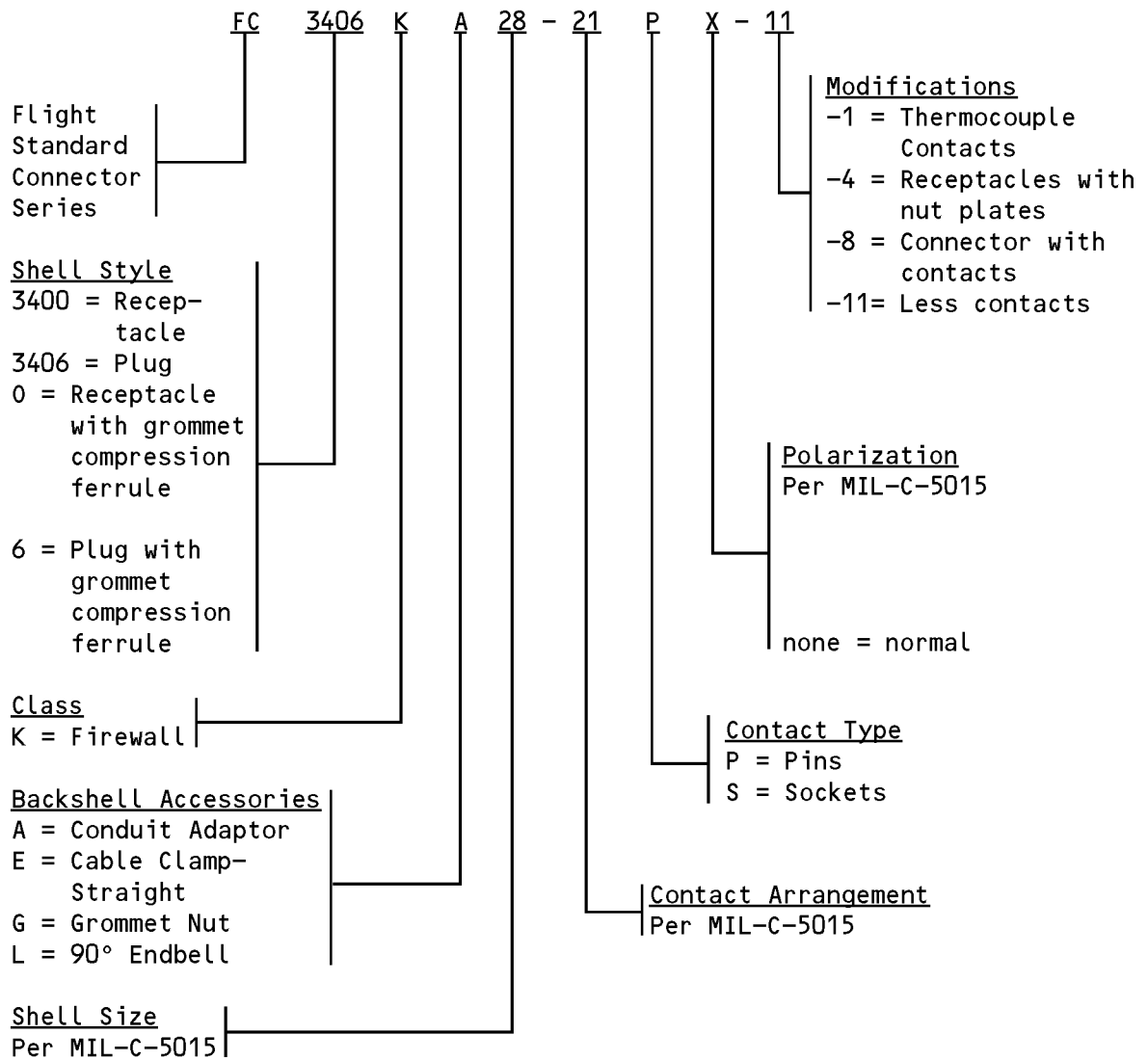


ITT Cannon Connector Coding Details
Figure 37

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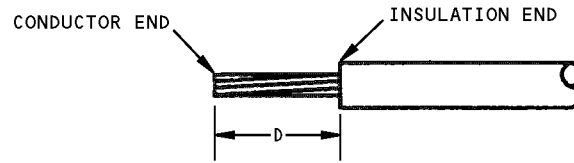


Flight Connector Coding Details
Figure 38

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WIRE SIZE (AWG)	CRIMP BARREL	-D-	NOTES
24	16	0.53 0.47	1
22	16	0.53 0.47	1
20	16	0.28 0.22	
	12	0.53 0.47	1
	8	0.53 0.47	
18	16	0.28 0.22	
	12	0.53 0.47	1
	8	0.53 0.47	
16	16	0.28 0.22	
	12	0.28 0.22	
	8	0.53 0.47	
15	12	0.28 0.22	
14	12	0.28 0.22	
	8	0.53 0.47	

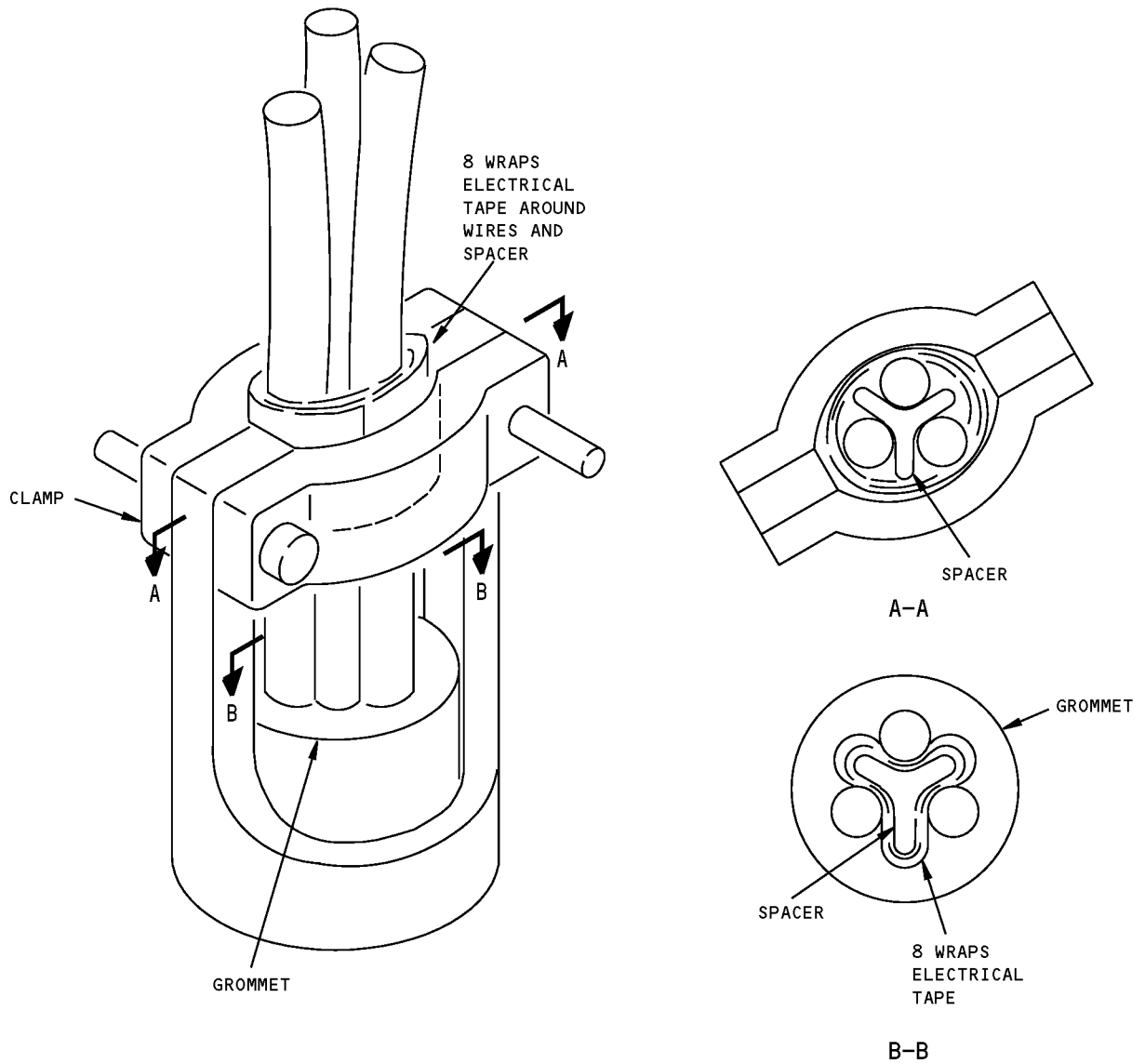
WIRE SIZE (AWG)	CRIMP BARREL	-D-	NOTES
13	12	0.28 0.22	
12	12	0.28 0.22	
	8	0.53 0.47	
10	8	0.53 0.47	
	4	0.53 0.47	
8	8	0.53 0.47	
	4	0.53 0.47	
6	4	0.53 0.47	
4	4	0.53 0.47	
	1/0	0.65 0.59	
2	1/0	0.65 0.59	
1/0	1/0	0.65 0.59	

1 FOLD THE CONDUCTOR BACK ON ITSELF, FOR A GOOD FIT IN THE BARREL ID.

Insulation Removal Length
Figure 39

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Assembly of FR and FC Series Connectors
Figure 40

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19. Assembly of Kidde 876633 and 876635 Connectors

- A. Assemble connector on 10-60816-17 wire (Preferred Method) – See Figure 41
- (1) Discard spring (6).
 - (2) Strip woven jacket, tapes and silicon liner from wire for a distance of 1-1/12 inches. Do not nick or scrape asbestos wrap over conductor.
 - (3) Strip asbestos wrap from conductor 11/32 inches
 - (4) Slide a 2-inch length of Penntube WTF #1241 sleeving (8) over wire.
 - (5) Position both inner and outer layers of sleeving (8) even with end of asbestos wrap and shrink in place. Use heater-blower combination producing 750°F at point of application.
 - (6) Cut 3/4-inch lengths of Penntube WTF #1206, #1212, and #1204 sleeving and slide on wire in that order.
 - (7) Slide sleeve (5) and insulator (4) in that order over conductor and shrunk sleeving up to jacket cut-off (Figure 41).
 - (8) Insert wire into contact (2, 876633 assembly) or (3, 876635 assembly) as far as possible.
 - (9) Crimp contact with one of the tools listed in Table 15.

Table 15: Crimp Tools

Basic Tool	(2) Pin Locator	(3) Socket Locator	Set
ST2220-1Y	Buchanan 3630-2	Buchanan 3630-4	–
M22520/1-01 or Balmar 85-550	Daniels TH302 or Balmar 56-302		6
	Red Locator	Blue Locator	

- (10) Mix Dow Corning RTV3112 with 5% catalyst S. (Pot life is 95 minutes at 60 to 80 degrees F.) Deaerate with a vacuum of at least 25 inches of mercury until foaming slows to a gentle boil. Release vacuum periodically to collapse excess foam.
- (11) Apply compound around bare wire and where wire enters contact. Do not allow compound to extend across contact flange.
- (12) Insert contact fully into connector body, holding sleeve (5) and insulator (4) away from connector body (1).
- (13) While holding contact in position, fill rear of connector body with RTV3112 compound with syringe. Fill slowly and avoid trapping air.
- (14) Push insulator (4) into body and thread sleeve (5) into connector (left hand thread). Do not allow contact to slip back while assembling.
- (15) Tighten finger-tight and wipe off excess compound. Cure 24 hours at room temperature.
- (16) Push WTF #1204 sleeving against flair on connector sleeve (5) then shrink in place.
- (17) Push WTF #1212 sleeving over flair on sleeve (5) and against connector body (1) then shrink in place.
- (18) Push WTF #1206 over connector body (1) and against coupling nut retainer ring then shrink in place.
- (19) Tie envelope containing sealing gaskets P/N 209592 to connector. One gasket is to be installed when coupling connector to sensing element. Follow instructions on envelope P/N 241833. Spare gaskets are to be tied to cable assembly with high temperature tying cord. If connector uncoupling is necessary, install new gasket.

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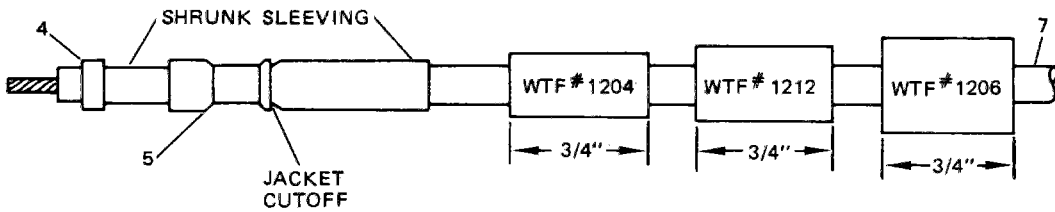
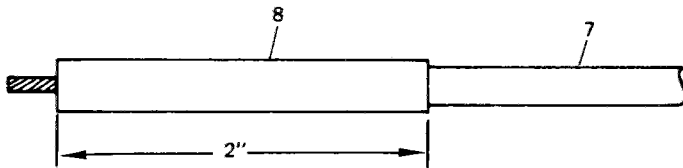
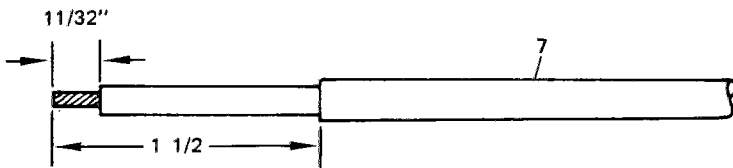
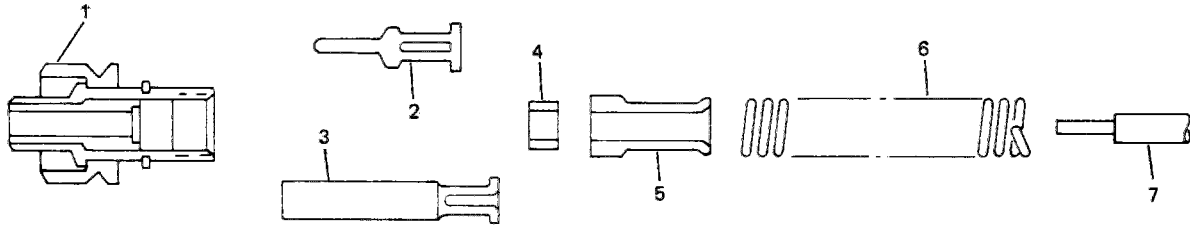
B. Assemble connector on 10-60816-17 wire (Alternate Method) (Figure 41)

NOTE: Connector end of spring may be modified to ease installation. Grip overlapped coil of spring with side-cutter plier and bend to remove overlap. Open last two coils (one spring wire thickness at most) to allow end of spring to be started over flare on connector sleeve. Do not enlarge coil diameter and do not modify both ends of spring.

- (1) Slide items in order over wire (7):
 - (a) Spring (6), overlapped end first
 - (b) Sleeve (5)
 - (c) Insulator (4)
- (2) Strip wire $1/32 \pm 1/32$ inch.
- (3) Insert wire into contact (2, 876633 assembly) or (3, 876635 assembly) as far as possible.
- (4) Crimp contact with one of the tools listed in Table 15.
- (5) Mix Dow Corning RTV3112 with 5% catalyst S. (Pot life is 95 minutes at 60 to 80°F.) Deaerate with a vacuum of at least 25 inches of mercury until foaming slows to a gentle boil. Release vacuum periodically to collapse excess foam.
- (6) Apply compound around bare wire and where wire enters contact. Do not allow compound to extend across contact flange.
- (7) Insert contact fully into connector body, holding sleeve (5) and insulator (4) away from connector body (1).
- (8) While holding contact in position, fill rear of connector body with RTV3112 compound with syringe. Fill slowly and avoid trapping air.
- (9) Push insulator (4) into body and thread sleeve (5) into connector (left hand thread). Do not allow contact to slip back while assembling.
- (10) Tighten finger-tight and wipe off excess compound. Cure 24 hours at room temperature.
- (11) Crimp sleeve (5) in area between threads and flare using Buchanan tool 612648 with die 614499.
- (12) Slide spring (6) forward and screw over flared portion of sleeve (left hand thread). A fair amount of force must be used to start the first coil over flare.
- (13) Tie envelope containing sealing gaskets P/N 209592 to connector. Gasket is to be installed when coupling connector to sensing element, with new gasket installed each time connector is uncoupled. Detailed instructions are on P/N 241833 envelope. The spare gaskets are to be tied to cable assembly with high temperature tying cord.

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Connector Assembly
Figure 41

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20. Assembly of Sperry 1510731-902 connector

A. Materials and Equipment

NOTE: Equivalent substitutes can be used.

- (1) Sleeve, outer – BACS13S287C
- (2) Sleeve, inner – BACS13S225B
- (3) Cable – BMS 13-31 or BMS 13-58, Type 3, Class 2, 18-gage conductors (replaces BMS 13-18, Type 3, Class 2)
- (4) Flux, acid – Amco 121, V70540
- (5) Solder, 95% tin, 5% antimony – QQ-S-571, alloy SB5WS
- (6) Flux – Kester 1544, V14597
- (7) Solvent – MEK, aliphatic naphtha or isopropyl alcohol (Ref SOPM 20-60-01)
- (8) Lacquer thinner
- (9) Lockwire, CRES, 0.020 inch dia. – MS20995C20 (Ref SOPM 20-60-04)

B. Equipment

NOTE: Equivalent substitutes can be used.

- (1) Swaging tools – Thomas and Betts WT211-14 tool, 214 die, V56501
- (2) Stripper, wire – ST2222-38
- (3) Resistance soldering tool
- (4) Brush, soft bristle
- (5) Megohmmeter, 500-volt

C. Connector installation (Figure 42)

- (1) Remove the outer jacket from the end of the cable to the length shown.
- (2) Slide the outer sleeve over the cable. Push it down the cable, away from the end.
- (3) Cut off the shield braid to the length shown.
- (4) Open up the outer end of the shield braid and slide the inner sleeve under the shield braid until the inner end of the sleeve is at the outer end of the cable jacket.
- (5) Slide the outer sleeve to the end of the cable until the inner end is at the end of the cable jacket.
- (6) Swage the sleeves with the swaging tool.
- (7) If there are strands of shield braid that extend out from the end of the sleeves, cut them off.
- (8) Cut the internal conductors and remove the insulation from the ends to the dimensions shown. Be careful not to cut or nick the wires with the wire stripper.
- (9) Make sure the eyelets of the connector are straight. Do not use a connector with eyelets that are not straight.

CAUTION: THE GLASS HEADER IN THE CONNECTOR IS EASILY DAMAGED. BE VERY CAREFUL NOT TO BREAK IT OR BEND THE EYELETS.

- (10) Apply acid flux to the eyelets of the connector. Do not let the flux get on the pin below the eyelet or on the glass seal.
- (11) With the soldering tool, apply solder to the eyelet. Do not let the eyelet get too hot. Be sure to remove the heat if the eyelet starts to glow red.

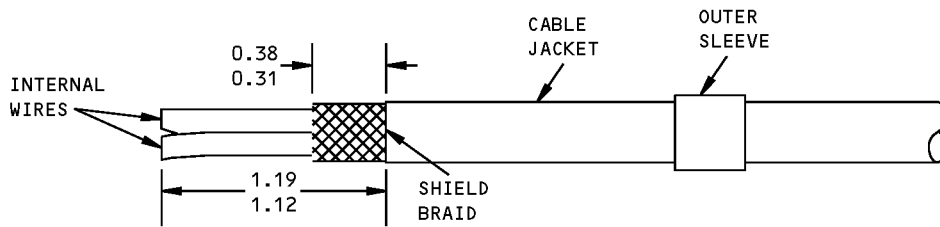
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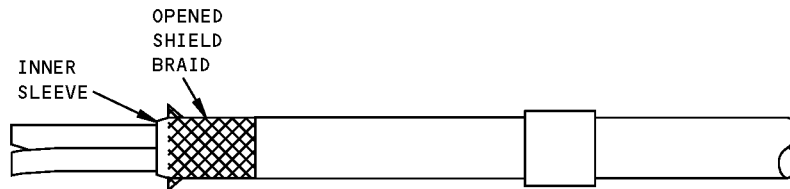
- (12) Let the connector cool. Then put the header under hot running water and remove the acid flux residue with the brush. Be sure to clean the area around the glass seal.
 - (13) Solder the wires to the eyelets as shown. Use the Kester flux with the solder. Apply the flux only to the wire and to the eyelet part of the connector pin. Move the wire back and forth in the eyelet as necessary to make the solder flow in to make a good bond between the wire and the eyelet. But be careful not burn the flux or make the eyelet too hot.
 - (14) Let the connector cool. Then put the connector header in solvent for 10-15 minutes. Every few minutes, use a brush to clean all parts of the connector. Be sure to include the glass seal.
 - (15) Examine the solder joints. Make sure that:
 - (a) The solder joints are clean, continuous, shiny and have no pores or unwanted matter.
 - (b) The conductor insulation has no signs of heat damage. Some discoloration is acceptable.
 - (c) The solder connections have no flux residue or splashed solder.
 - (d) The wire is not damaged at the end of the insulation.
 - (16) Remove dye from the corners of the outer sleeve with lacquer thinner.
 - (17) Install the clamp on the cover with short screws. Be sure to pull the shield braid tight before you tighten the screws.
 - (18) Lockwire the screws per SOPM 20-50-02.
- D. Make sure the resistance between the conductors, and between each conductor and the connector shell, is a minimum of 5 megohms at 500 volts.

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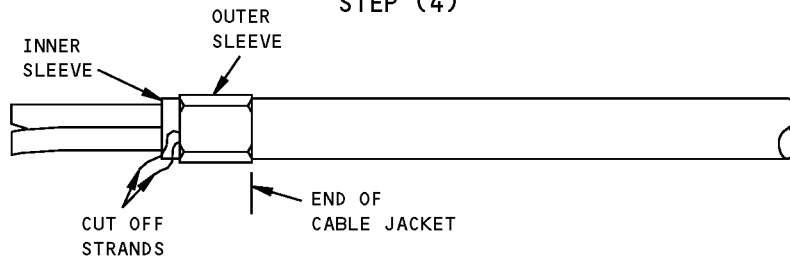
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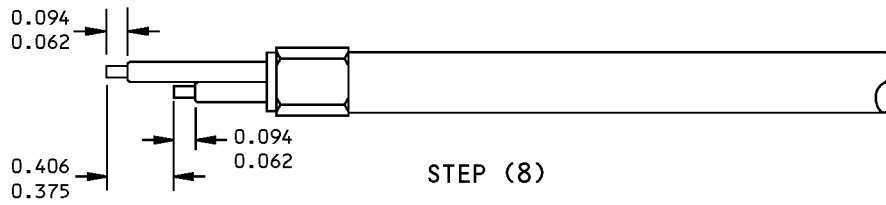
STEPS (1), (2), (3)



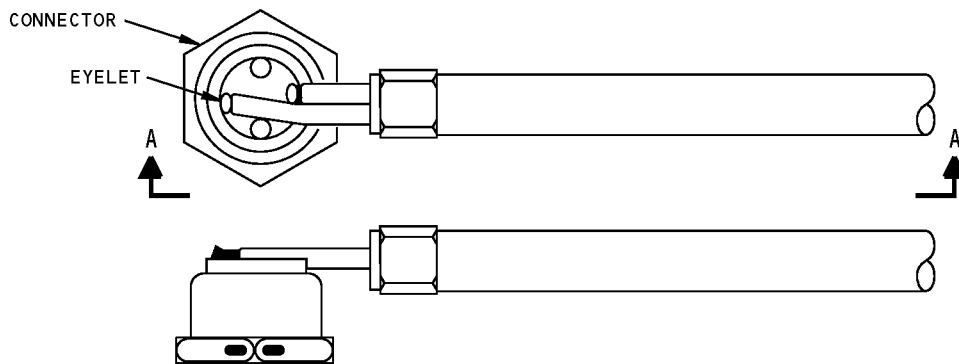
STEP (4)



STEPS (5), (6), (7)



STEP (8)



STEP (13)
A-A

ALL DIMENSIONS ARE IN INCHES

Installation of Sperry 1510731-902 Connector
Figure 42

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21. Repair of BACC66E thru BACC66K Series Connectors

A. Part Number Codes – See Figure 43

B. Contact Removal

(1) Use the applicable removal tool from Table 16.

(2) To remove crimp-type contacts:

(a) Slide the removal tool along the wire and into the insert cavity until the tool is at the bottom.

(b) Hold the wire and the removal tool at the same time and remove them from the insert cavity.

1) If the removal tool has an indicating ring, slide the tool along the wire and into the insert cavity until the indicating ring is flush with the top of the surface of the rubber grommet.

2) If the contact does not release, remove the tool, turn it 90 degrees and try again.

(3) To remove BACC47EW front release contacts:

CAUTION: MAKE SURE YOU REMOVE ALL WIRE PARTICLES AND UNWANTED SOLDER BEFORE YOU REMOVE A CONTACT. A THIN LAYER OF SOLDER CAN STAY ON SOLDER-TAIL CONTACTS.

(a) To remove the wire from a wire-wrap contact, unwrap it per SOPM 20-11-06. To remove the wire from a solder tail contact, desolder it per SOPM 20-12-01.

(b) Carefully put the removal tool into the contact cavity from the front of the insert. Remove the contact and the removal tool at the same time from the connector. To help removal, apply light pressure on the contact from the rear.

C. Install Wire on Contact

(1) If this is a contact with a crimp barrel, strip the wire, install it in the crimp barrel and crimp it per BAC5162-59.

(2) If this is a contact with a wire wrap post or solder tail, do not install the wire on the contact at this time. The wire will be installed on the contact after the contact is installed in the connector.

D. Install Contact Into Connector.

(1) Use the applicable insertion tool from Table 16.

(2) Put the contact in the insertion tool.

CAUTION: KEEP THE CONTACT AND THE INSERTION TOOL ALIGNED PERPENDICULAR TO THE FACE OF THE CONNECTOR DURING INSTALLATION TO PREVENT DAMAGE TO THE WIRE SEPARATOR.

(3) For BACC47EF and EG crimp style contacts, align the contact and the insertion tool perpendicular (approximately 90 degrees) to the back of the insert. For BACC47EW front release contacts, align the contact and insertion tool perpendicular (approximately 90 degrees) to the front of the insert.

(4) Guide the contact into the contact cavity. Put it in from the rear if this is a rear release contact or from the front if this is a front release contact. If this is a wire wrap contact, make sure the flats on the wire-wrap post are aligned with the flats in the contact cavity.

(5) Push on the contact until you hear or feel a click as it locks into the connector.

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CAUTION: DO NOT PUT A NICK IN THE WIRE WITH YOUR FINGERNAIL.

- (6) To make sure the contact is completely installed, hold the wire between your thumb and forefinger only and pull lightly until they slip on the wire.

E. Install wires on BACC47EW-series contacts.

- (1) Strip the wires and install them on the wire-wrap posts per SOPM 20-11-06.
 (2) Strip the wires and install them on the solder tails per SOPM 20-12-01.

Table 16: Contact Insertion and Removal Tools

Contact Size	Tool Part Number		Vendor
	Insertion	Removal	
2222		ATB02054B ATB02055 ^{*[1]}	V58164
	CIT-DPXMA-22-1 CIET-22	CET-DPXMA-22 CIET-22 CET-BKAF-22S ^{*[1]}	V71468
	DAK226J DAK226J-2SA DAK266 DAK266J	DRK226J DRK226J-2SA DRK266 DRK266J	V11851
	MS3156-22 M81969/1-01	MS3156-22 M81969/1-01	^{*[2]}
	282-880	282-890	VF0987
	8660-162	8660-162 ^{*[1]}	VF0323
	2020HD		CIET-20HDL
DAK145J		DAK125	V11851
MS3156-20 M81969/1-02		MS3156-20 M81969/1-02	^{*[2]}
282-881		282-891	VF0987
91066-4		91066-4	V00779
1616		CET16-15	V71468
	DAK55-16	DRK83-16	V11851
	MS3156-16 M81969/1-03	MS3156-16 M81969/1-03	^{*[2]}
	282-892 282-929	282-892	VF0987
	91066-3	91066-3	V00779

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Table 16: Contact Insertion and Removal Tools (Continued)

Contact Size	Tool Part Number		Vendor
	Insertion	Removal	
1212		CET12-4 CE912-4	V71468
		MS3178-002 M81969/28-02	*[2]
		282-945	VF0987
		91078-1	V00779
0808 Twinax		CET8-T	V71468
	M81969/28-03		*[2]
	RIT-04-C-1		
0808 Power or Ground		CET8-T	V71468
COAX#5		CET-C8	V71468

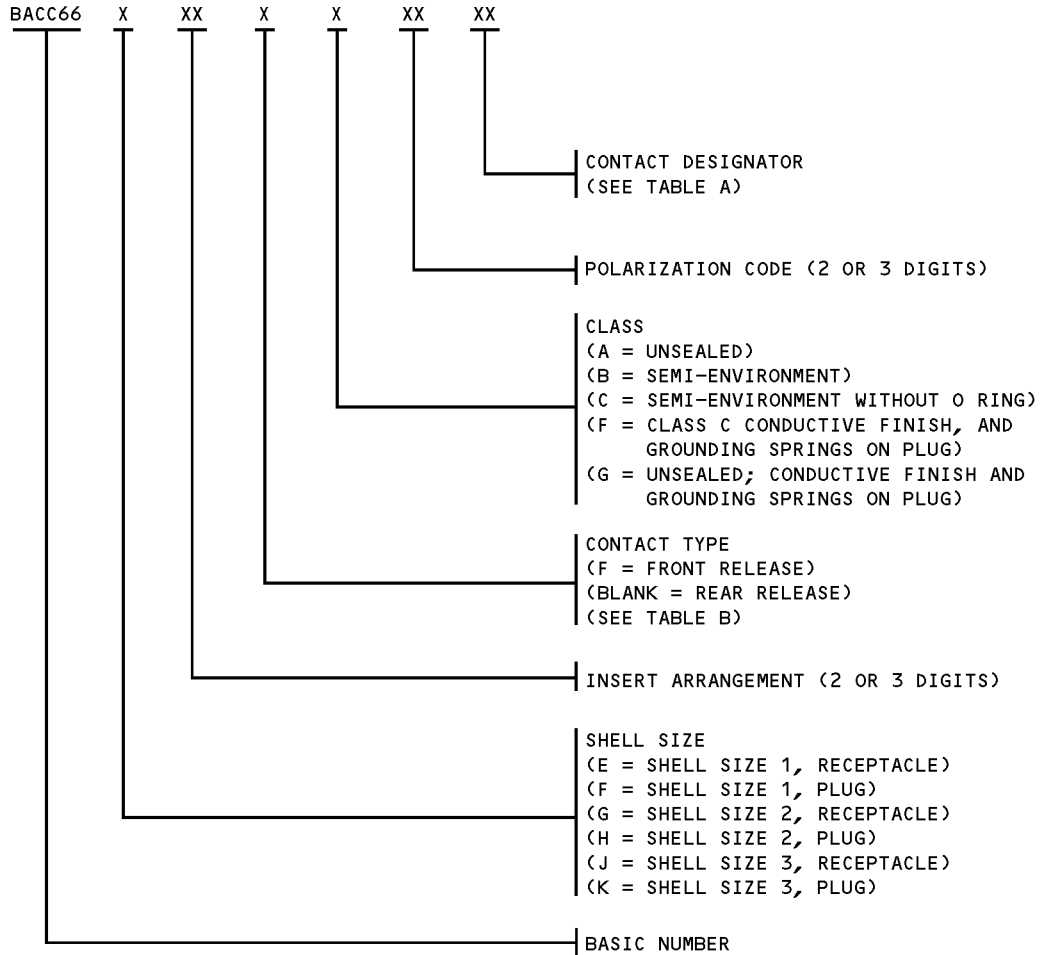
*[1] Used to remove BACC47EW Size 22 contacts only.

*[2] Refer to the applicable Qualified Products List of the specification for approved part numbers and vendors.

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CONTACT DESIGNATOR CODE	CONTACT OPTIONS
00	WITHOUT CONTACTS
01	WITH BACC47EF, BACC47EG AND COAX CONTACTS
02	WITH COAX CONTACTS ONLY
03	WITH BACC47EF, BACC47EW11 AND COAX CONTACTS
04	WITH BACC47EF, BACC47EW12 AND COAX CONTACTS
05	WITH BACC47EF, BACC47EW13 AND COAX CONTACTS
06	WITH BACC47EF, BACC47EW21 AND COAX CONTACTS
07	WITH BACC47EF, BACC47EW22 AND COAX CONTACTS
08	WITH BACC47EF, BACC47EW23 AND COAX CONTACTS
09	WITH BACC47EF, BACC47EW24 AND COAX CONTACTS

TABLE A

BACC66 Connector Part Number Codes
Figure 43 (Sheet 1 of 2)

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CONTACT SIZE		CONTACT TYPE			
ENGAGING END	CRIMP BARREL	PIN	SOCKET	SOLDER TAIL	WIRE WRAP
22	--			BACC47EW21 BACC47EW22 BACC47EW23 BACC47EW24	BACC47EW11 BACC47EW12 BACC47EW13 BACC47EW14
22 20 16 12	22 20HD 16 12	BACC47EF1 BACC47EF2 BACC47EF3 BACC47EF4	BACC47EG1 BACC47EG2 BACC47EG3 BACC47EG4		

TABLE B

BACC66 Connector Part Number Codes
Figure 43 (Sheet 2 of 2)

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