

ELECTRICAL SAFETY PRECAUTIONS - DESCRIPTION AND OPERATION

1. General

- A. This section contains general information on physical and chemical processes which require the use of chemicals, solvents or other commercially available materials.
- B. The user of this publication should obtain the material safety data sheets (Occupational Safety and Health Act (OSHA) Form 20 or equivalent) from the manufacturers or suppliers of materials to be used. The user must become completely familiar with the manufacturer/supplier information and adhere to the procedures, recommendations, warnings, and cautions of the manufacturer/supplier for the safe use, handling, storage and disposal of these materials. Users of this manual are also advised to refer to pertinent safety information contained in the "NIOSH Occupational Guideline for Chemical Hazards" published by the United States Department of Labor.
- C. WARNINGS are provided to alert operating and maintenance personnel to potential hazards that could result in personal injury; they do not replace the manufacturers' recommendations.
- D. CAUTIONS are provided to alert operating and maintenance personnel to conditions that could result in equipment damage.

2. General Safety Warnings

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH MANUFACTURER'S OR SUPPLIER'S RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER OR DEATH.

- A. Xylene is toxic and flammable. Do not breathe vapors. Use in a well ventilated area free from sparks, flame or hot surfaces. Wear splash goggles, solvent resistant gloves and other protective gear. In case of eye contact, flush with water and seek medical attention. In case of skin contact, wash with soap and water.
- B. Isopropyl alcohol is toxic. Do not breathe vapors. Use in well ventilated area free from sparks, flame or hot surfaces. Wear splash goggles, solvent resistant gloves and other protective gear. In case of eye contact, flush with water and seek medical attention. In case of skin contact, wash with soap and water.
- C. 1,1,1 trichloroethane is toxic. Do not breathe vapors. Use in well ventilated area free from sparks, flame or hot surfaces. Wear splash goggles, solvent resistant gloves and other protective gear. In case of eye contact, flush with water and seek medical attention. In case of skin contact, wash with soap and water.
- D. Acid chromate deoxidizing solution is corrosive to human tissue. Do not breathe vapors. Use in well ventilated area. Wear chemical resistant clothing, gloves, splash goggles and face shield. In case of eye or skin contact, flush with water and seek medical attention.
- E. Chromate chemical conversion coating and nitric acid are both corrosive to human tissue. Do not breathe vapors. Use in well ventilated area. Wear chemical resistant clothing, gloves, splash goggles and face shield. In case of eye or skin contact, flush with water and seek medical attention.
- F. Alcohol base rosin solder flux is flammable. Use in well ventilated area free from sparks, flame or hot surfaces.
- G. When using compressed air for cleaning or drying, regulate pressure to 29 pounds per square inch or less. Wear goggles or face shield to protect eyes.

3. General Cautions

- A. Solder type relay terminals to which no leads are connected should be protected with shrinkable tubing to prevent the possibility of shorting or grounding resulting in erratic operation or damage.
- B. Reduce all power supplies to zero before connecting or disconnecting electrical devices.
- C. Tag and identify wires as they are removed from connector or any other electrical device to facilitate reinstallation.

4. Printed Circuit Board Repair Cautions

- A. Repair of printed circuit board assemblies by other than experienced technicians is not recommended. Unless a malfunction can be localized to a particular component, an entire board should be replaced to correct a fault.
- B. Semiconductor devices are heat sensitive. Use a suitable heat dissipater between solder connection and body of component when soldering or removing solder connections.
 - (1) All solder and solder removal tools should be low wattage (40 watt) and low temperature (750° maximum). Do not overheat the circuit board lands.
 - (2) To avoid heat damage, remove solder joint within three seconds and solder a joint within two seconds.
 - (3) Excessive pressure from a solder or solder removal tool can delaminate the circuit pads or runs. Use a light touch when using these devices.
 - (4) Avoid placing the hot soldering iron near components or printed circuitry when iron is not in use.
- C. Use only rosin cored solder material conforming to Federal Specifications QQ-S-571, Composition Sn60. Use rosin solder flux with an alcohol base. In no case is acid core solder or acid base flux to be used to install electrical components.
- D. Do not use ultrasonic equipment, Methyl n-Propyl Ketone or chlorinated hydrocarbon solutions to clean printed circuit board assemblies.
- E. Steel wool, steel wire brushes and abrasives containing iron or iron oxide shall not be used for mechanical cleaning.
- F. Use care when handling printed circuit board assemblies to avoid flexing and cracking boards and to avoid wire breakage at soldered connections.
- G. Special Handling of Static Sensitive Devices.
 - (1) Integrated circuits and some other components used on printed circuit boards can be damaged by static electricity.
 - (2) Use precautionary procedures when touching, removing or inserting components and assemblies identified as being electrostatic discharge sensitive.
 - (3) Static sensitive devices are sent from the manufacturer with conducting material shorting the leads. Maintain the short on the device leads and case while storing or moving components.

- (4) Keep static sensitive devices in their containers in the same configuration as they were originally shipped whenever possible. Place the containers on a grounded metal plate at any station where operations are to be performed. Do not remove container cover unless in a static free area.
- (5) Repair personnel shall ground themselves before handling any static sensitive device.
- (6) Personnel shall wear a conductive wrist strap connected to a ground having a resistance of 0.25 to 2 megohms.
- (7) Handle devices only when necessary, and then by first grasping the ceramic body or the metal can before touching any of the individual leads with tweezers or other tools. Do not handle by leads or terminals. Ceramic packages with brazed leads require extra careful handling to avoid breaking off the leads since bending and twisting can fracture the braise.
- (8) Perform all assembly operations involving static sensitive devices on a grounded conductive surface having a resistance of 100K ohms to 2 megohms/per square.
- (9) Electrically ground all metal cabinets and conductive containers used for storing static sensitive devices.
- (10) Personnel shall wear smocks made of cotton or antistatic nylon. Do not use smocks made from ordinary nylon or other synthetic materials. Antistatic garments shall be plainly marked.
- (11) All electrical assembly equipment (soldering irons and tips, insulation strippers, heat guns, etc.) must be grounded. All solder and solder removal tools and equipment must also be grounded. Ionized air blowers can be used to reduce charge buildup in areas where grounding is not possible or desirable.

WIRING - MAINTENANCE PRACTICES

1. General

- A. The airplane wiring consists of electrical (power) and electronic (avionics) wiring.
- B. Whenever an electrical circuit has been disconnected for maintenance or inspection purposes, the circuit shall be tested for integrity by performing an operational test or continuity check of all circuits involved.

2. Wire Types

- A. Refer to [Figure 201](#) for examples of each category.

3. Wire Specification

- A. Wire specifications are identified by a combination of letters and numbers that define the wire, number of cables, shield style and material and jacket material. This specification may or may not be embossed on the wire jacket.
- B. Replace wires with the type specified, if defined in the applicable wiring diagram.
- C. When the wire specification is not defined in the applicable wiring diagram, the following procedure should be used to determine wire specification when ordering for replacement purposes.
 - (1) First determine the wire type by referring to [Figure 201](#).
 - (2) Determine wire gage by referring to the wire identification number on the applicable wiring diagram.
EXAMPLE: HJF162-96PF15(20) - wire gage is 20.
 - (3) Determine the number of conductors by referring to the applicable wiring diagram
 - (4) For unshielded single conductor wires use the following procedure.

NOTE: Always use the following information to determine wire specification even if the wire being replaced has a different wire specification than that shown. Due to specification changes and superseding wire specification numbers, the wire specification of the wire being replaced may not be in use any longer.

- (a) Refer to Table 201 to determine base part number and refer to Table 202 for color codes. Part number is (BASE PART NUMBER) - (GAGE) - (COLOR)

Table 201. Single Conductor, Unshielded Wires

SPECIFICATION	USE	EFFECTIVITY
MIL-W-22759/16	Non-shielded single conductor wire: 22 thru 4 gage.	17280001 - 17280938 172S8001 - 172S8755
MIL-W-22759/16	8 thru 4 gage	17280939 & On 172S8756 & On
MIL-W-81044/12	Non-shielded single conductor wire used aft of firewall only: 22 thru 12 gage	17280939 & On 172S8756 & On
MIL-W-81044/9	Non-shielded single conductor wire used forward of firewall: 20 thru 10 gage.	17280939 & On 172S8756 & On
M27500-**TG*T14	Shielded wire: **Gage (22 thru 14) *Number of conductors	17280001 & On 172S8001 & On

Table 202. Color Codes for Single Conductor, Unshielded Wires

0=BLACK	1=BROWN	2=RED	3=ORANGE	4=YELLOW
5=GREEN	6=BLUE	7=VIOLET	8=GRAY	9=WHITE

EXAMPLE: HJF162-96PF15(22), single conductor wire not requiring high temperature wire has a wire specification of M81044/12-22-9.

EXAMPLE: 3S183-SP227(20), single conductor high temperature wire has a wire specification of M22759/3-20-9.

EXAMPLE: GND17-ESG1(00), single conductor starter generator has a wire specification of M22759/41-00-9.

- (5) For twisted unshielded wire uses part number M27500 - (GAGE) ML * U00.

Substitute * with the number of conductors.

EXAMPLE: Pair of wires, EJF28-MPF143(20) WHITE and FJF28-KPF143(20) BLACK (shown as pair on diagram) has a wire specification of M27500-20ML2U00.

- (6) For Shielded single and multiconductor wire use Part number M27500 - (GAGE) ML * T08. Substitute * with the number of conductors.

EXAMPLE: 9PT52-9PT54(22) (shown as shielded on the diagram) has a wire specification of M27500-22ML1T08.

- D. Single Conductor Shielded, Jacketed and Multiconductor Wires.
 - (1) Refer to Figure 202 for an explanation of MIL-C-27500 part numbers.
- E. Special wires are used in the control wheels.
 - (1) Order S3333-1 Multiconductor Cable for the left control wheel.
 - (2) Order S3333-2 Multiconductor Cable for the left control wheel with Electric Trim.
 - (3) Order S3333-3 Multiconductor Cable for the right control wheel.

4. Wire Identification

- A. Refer to Introduction for details of wire numbering.
- B. Each wire shall be identified with legible characters at intervals not exceeding 15 inches for the length of the wire. The wire should also be marked approximately 3 inches from each break or each terminal except that this distance can be increased to install ties, clamps, connectors, supporting devices or terminals.
- C. No identification marks or numbers are required on external wires that are part of vendor furnished equipment.
- D. Wires or cables less than 3 inches in length need not be identified.
- E. Wire identification can be marked on the wire as follows:
 - (1) Hot embossing of single wire.
 - (2) Hot embossing of pressure sensitive tape.
 - (3) The marking of vinyl sleeves.
 - (4) The marking of printing foils.
- F. Coaxial cables may be identified by applying the identification code directly to shrink tubing and installing within 3 inches of termination.

5. Reidentification of Wires

- A. Reidentification of a wire is required when wire runs are replaced or when existing wire is used for new purposes.

6. Tools and Equipment

NOTE: The materials (or equivalent) listed in Table 203 are required.

Table 203. Tools and Equipment

NAME	NUMBER	MANUFACTURER	USE
Aliphatic Naphtha	TT-N-95	Locally available	Cleaning agent.
Petrolatum	AN-P-51	Locally available	Wire installation.
Twine	MIL-T-713	Locally available	Wire installation ties.
Vinyl Tape	CT-93C	Resin Industries Inc. Santa Barbara, CA	Wrapping cables.
Sleeving	MIL-I-7444B Type I	Locally available	Insulation and protection.
Sleeving	MIL-I-7444B Type II	Locally available	Identification of wires.
Lacquer	MIL-L-7178	Locally available	Overcoating ties.
Fiberglass Cord	MIL-Y-1140	Locally available	Wire installation ties.
Tape, Adhesive Insulating	MIL-I-7798	Locally available	Insulation and wire repair.
Braided Glass Sleeving	MIL-I-3190	Locally available	Protect wires from abrasion.
Insulation Tubing	MIL-I-23053/5	Raychem Corp. 300 Constitution Dr. Menlo Park, CA 94025	Heat shrink insulation.
Glass Fabric Tape	P31D	Pemacel Division Johnson and Johnson P.O. Box 671 New Brunswick, NJ 08903	High Temperature Insulation

NAME	NUMBER	MANUFACTURER	USE
Tie (Sta-Strap)	MS3367	Locally available	Tying wire bundles.
Tie Tool	Panduit GS-2B	Panduit Corp.	Installing ties.
Red Glyptal Insulating Varnish	90-2	GC Electronics Division of Hydrometals, Inc. 6820 Latijere Blvd. Los Angeles, CA 90045	Coat areas adjacent to wire bundles for insulation
Tape, Pressure Sensitive	365	Minnesota Mining and Mfg. Co. St. Paul, MN 55101	High temperature insulation and repair.

7. Removal/Installation of Wires

A. Install Wire. Observe the following general rules when installing wires in open runs.

- (1) Avoid crossovers, twists and kinks.
- (2) Wiring shall not be attached to or supported by plumbing lines containing flammable liquids or oxygen. Where possible, wire should be routed above these lines.
 - (a) Wires and cables should be located a minimum of 6 inches from lines where practical.
 - (b) A separation of between 2 and 6 inches is acceptable, provided the wires are rigidly clamped.
 - (c) When a minimum of 2 inches cannot be maintained, a separation of between 0.5 to 2 inches shall be acceptable, provided the electrical wires are rigidly clamped and covered with electrical insulating material.
- (3) Cables installed in locations where fluid can be trapped must be protected against contamination by fluid.
 - (a) All wiring insulation shall be protected from moisture deterioration by using drain holes in the tubing, sleeving or conduit and by keeping wiring out of sumps and areas of excessive moisture.
 - (b) When routed through areas where cables may become saturated with oil, they shall be enclosed in conduits.

CAUTION: MAKE SURE THAT FLUID DOES NOT CONTACT WIRES, AND REMOVE ANY FLUID FROM THE WIRES, THE HARDWARE THAT HOLDS THEM, OR AVIONICS AND ELECTRICAL EQUIPMENT. COLLECT AND DISCARD ANY FLUID SPILLED WITH CLOTHS, PLASTIC SHEETS, AND CONTAINERS. FLUID CONTAMINATION CAN CAUSE WIRE INSULATOR DETERIORATION AND SHORT CIRCUITS.

- (4) Wires shall not be routed closer than 3 inches to components producing heat in excess of 140°F. Wires required to connect with heat producing components shall be routed directly away from the component and maintain the 3 inch clearance thereafter. Wiring operating in elevated temperatures shall be wrapped with tape or contained in conduits.
- (5) Wires and cables shall be positioned or protected to avoid contact with rough or irregular surfaces and sharp edges.
 - (a) All wiring shall be protected from chafing by the use of grommets, protective sleeves, by proper support and correct routing.
 - (b) All screws or metal edges that are within 0.20 inch of a wire or cable shall be coated with Glyptal, protected by nylon caterpillar-type grommets or other protection.
 - (c) Wiring shall be routed to avoid contact with moving parts.
 - (d) Wiring around sharp edges should be avoided at all times.

CAUTION: USE A CLOTH TO COVER ANY WIRES, AVIONICS OR ELECTRICAL EQUIPMENT THAT IS IN A LOCATION WHERE METAL CHIPS OR SHAVINGS CAN FALL. BE SURE TO REMOVE ANY METAL CHIPS OR SHAVINGS FROM WIRES, AVIONICS AND ELECTRICAL EQUIPMENT. CONTAMINATION FROM METAL SHAVINGS CAN CAUSE WIRE INSULATOR DETERIORATION AND SHORT CIRCUITS

- (e) Wiring shall be routed so they will not be crushed or pinched during installation.
- (6) Lightly coat wire with petroleum jelly or water before pulling through pressure feed-thru.
- (7) Leave enough slack in wiring to accomplish the following:
 - (a) Permit staking of terminals.
 - (b) Ease of maintenance.
 - (c) Permit free movement of shock-mounted equipment.
 - (d) Prevent mechanical strain on wiring and wiring supports.
 - (e) Provide adequate drip and service loops.

CAUTION: DRIP LOOPS MUST BE ARRANGED SO THAT DRIP FROM LOOP DOES NOT FALL ON EQUIPMENT WHICH MIGHT BE ADVERSELY AFFECTED. ON MOISTURE RESISTANT CONNECTORS, DRIP LOOPS MAY BE OMITTED WHERE SPACE IS LIMITED. COAXIAL CABLE ASSEMBLIES IDENTIFIED AS IMPEDANCE MATCHING UNITS MUST BE A SPECIFIED LENGTH. DO NOT SHORTEN CABLE TO REMOVE EXCESS SLACK.

- (8) The securing of wire groups, bundles, sleeves, adapter clamps and tape shall be accomplished with a clove hitch knot secured with a square knot. Refer to [Figure 203](#).
 - (a) MIL-T-713 twine and Sta-straps shall be limited in use to operational temperatures of less than 200°F.
 - (b) The free ends of the MIL-T-713 twine shall be a minimum of 3/8 inch long.

- (c) Wire groups or bundles shall be tied at intervals not to exceed 12 inches.
- (d) Insulating sleeving over splices and identification sleeves shall be bound securely at both ends. The ties shall be made approximately 1/4 inch from the ends of the sleeves. Sleeves over bare terminals shall be tied at one end only or the tie shall be made around the wire or cable at the end of the sleeve away from the terminal.
- (e) Wires or cables in conduit or insulating sleeving shall not be tied.
- (f) In no case shall a tie be drawn so tightly that cutting or penetration of the conductor jacket or insulation will result.
- (g) Tying cord shall not be used for support of the bundle.
- (h) Two or more wire groups may be tied to each other and installed in the same clamp provided sufficient ties are left on the individual groups to retain group identity.
- (i) When cable groups cross each other, they shall be tied together at point of contact.
- (9) The minimum bend radius of any cable other than coaxial cable is ten times the outside diameter of the cable.
 - (a) At terminals where the cable is suitably supported, the minimum radius may be five times the outside diameter.
 - (b) When impractical to meet radius requirements, shorter bend radii are permitted if the bend is enclosed in insulated tubing. For electrical equipment and accessories, the minimum bend radius may be three times the diameter of the wire.
 - (c) For coaxial cables, the minimum bend radius shall be six times the outside diameter of the cable.
- (10) Wiring shall be routed in open areas where visible for maintenance when possible.
- (11) Adhesive tapes, which will dry out in service, produce chemical reaction with wire insulation or absorb moisture, shall not be used.
- (12) Wiring shall be supported at intervals of not more than 12 inches except when contained in ducts or conduits.
 - (a) Tie wraps shall be used to maintain a bundle at intervals no more than 6 inches or less than 4 inches.
 - (b) Wiring supporting devices shall be of such size that the wires will be held securely in place without damage to the insulation.
 - (c) Hot glue shall not be used to support wiring.
- (13) All wiring shall be protected against any factor which would disrupt the correct functioning such as shorts, grounding, parting, corrosion or environmental exposure.

CAUTION: INSTALL CAPS OR OTHER PROTECTION ON ELECTRICAL CONNECTORS THAT ARE DISCONNECTED. THIS WILL HELP TO PREVENT CONTAMINATION WITH FLUID AND MOISTURE.

8. Terminal Board Installation

- A. All screws fastening the terminal board to the structure shall be inserted with the head toward the terminal side of the board, if possible. All screws inserted with the thread end toward the terminal side shall have a maximum of 2 one-half threads through the nut.
- B. A maximum of four terminals shall be attached to one terminal lug.
- C. The terminal shall be attached to the terminal block so that no part of the wire proper shall contact the terminal stud.
- D. When tightening the nut on the stud, caution shall be exercised to prevent breaking loose or shearing the molded-in stud or breaking the frame.
- E. All terminals shall be orientated on the terminal strip stud in such a manner that a possible movement of the terminal shall tighten the top stud nut. When more than one terminal is attached to a terminal post, only the top terminal must be arranged as described.
- F. The washers, wire terminals and/or bus bars, and terminal stud nuts shall be assembled on terminal studs in the following sequence starting at the terminal block; (1) plain washers; (2) lockwashers; (3) first stud nut; (4) terminal(s) and/or bus bar(s); (5) plain washer; (6) lockwasher; (7) final stud nut. When a terminal is attached to an equipment item with a screw, the screw shall be passed through a lockwasher, a plain washer and the terminal(s) in sequence with the wire terminal against the attachment point on the equipment. Refer to [Figure 204](#).

9. Wire Repairs

- A. General Instructions.
 - (1) Replace broken, frayed, cracked or damaged wire with new wire. The entire wire segment should be replaced. Replacement wire segment must be size and type indicated on the applicable wiring diagram. If wire or cable damage is limited to outer covering only, wire or cable may be repaired as outlined in this section.
- CAUTION:** DO NOT SPlice, SOLDER OR TAPE DAMAGED WIRE UNLESS INVESTIGATION PROVES THAT SYSTEM INTEGRITY WILL NOT BE AFFECTED. DO NOT USE SMALLER SIZE WIRE. USE OF SMALLER SIZE WIRE CAN RESULT IN BURNED WIRING OR MALFUNCTIONING EQUIPMENT.
- B. Braided Nylon Insulated Wires.
 - (1) Clean area to be repaired with aliphatic naphtha.
 - (2) Lay loose nylon strands as evenly as possible over damaged area.
 - (3) Spiral wrap double layer of vinyl tape over damaged area, overlapping 1/2 width of tape. Tape should extend at least one inch beyond both ends of damaged area.
 - (4) Tie both ends of tape with nylon cord and brush knots with clear lacquer.
 - (5) Small gage wires may be wrapped with adhesive vinyl tape.
- C. Chromel/Alumel Thermocouple Wire.
 - (1) Clean damaged area with solvent.
 - (2) Lay loose fiberglass covering ends as evenly as possible over damaged area.
 - (3) Tension spiral wrap double layer of glass fabric tape (Permaceel EE-3343) over damaged area, overlapping 1/2 width of tape. Tape should extend at least one inch beyond both ends of damaged area. Maximum length of taped area should be no greater than 3-1/2 inches.
 - (4) Cure tape in place by heating with heat gun or lamp to approximately 320°F for 30 minutes. Protect adjacent wires from heat by covering with

heat resistant material.

- (5) The ends of the outer insulation which has been stripped back and trimmed on the thermocouple leads should be served from the ends of the insulation back to approximately 1/2-inch by wrapping cord as shown in [Figure 205](#).

D. Splicing Electrical Wires. Splicing of wires is not recommended; however, in some cases, splicing of wires may be necessary.

- (1) Refer to [Splices and Terminals](#) for splices and tools.
- (2) All splices shall be covered with an insulating sleeve and secured. Preinsulated splices need not be covered by an additional sleeve as long as the splice is completely covered.
 - (a) The splice crimping tool for preinsulated splices has an insulation crimping adjustment set to 1, 2, 3 or 4 depending on the thickness of insulation. The splice should have a firm crimp on insulation without damage.
- (3) Splices in the same wire group or bundle shall be staggered to prevent excessive enlargement of the group or bundle.
- (4) Aluminum cables shall not be spliced.
- (5) Splicing Shielded Wires. Refer to [Figure 206](#).
 - (a) Refer to [Splices and Terminals](#) for splices and tools.
 - (b) Splices in the same wire group or bundle shall be staggered to prevent excessive enlargement of the group or bundle.
 - (c) Splices shall not be located under a clamp or in a place where the wire bundle is flexed, such as at a wire bundle breakout to an instrument.
 - (d) Stagger inner conductor splices as shown in [Figure 206](#).
 - (e) After installing braided solder sleeve the solder shall be completely melted and environmental seal bands must make contact with the outer jacket of the wire.
 - (f) After installing the braided solder sleeve, the braided solder sleeve must not be cut or split. Shield strands must not extend through the braided solder sleeve.

E. Splicing Coax Cables. Splicing of coax is not recommended; however, in some cases, splicing of coax may be necessary.

- (1) Coaxial cables used in a system where a specific length of cable is required for proper operation shall not be spliced.

Examples of systems that require specific coax lengths are Radio Altimeter and ELT.

- (2) Triax cable shall not be spliced.
- (3) Splicing of coax is limited to Nav, Comm and DME systems.
 - (a) Cut the coax at the location of the damage.
 - (b) Install TNC style (threaded) coax plug and jack on the ends of the coax or install TNC style (threaded) coax plugs on both ends of the coax and connect to a bulkhead feed-thru connector.
 - (c) Cover the connectors with heat shrink tubing per MIL-I-23053. Refer to [Heat Shrink Tubing - Maintenance Practices](#).

F. Terminal Installation.

- (1) Refer to [Splices and Terminals](#) for terminals.

G. Heat Shrink Tubing Installation.

- (1) Refer to [Heat Shrinkable Tubing - Maintenance Practices](#) for heat shrink tubing.

H. Wire Stripping.

- (1) All wires shall be stripped with wire stripping tools. Hand knives shall not be used except when required for cables and aluminum wires.
- (2) Sufficient insulation shall be stripped from the wire so no insulation will touch the connection.
- (3) Care shall be taken to avoid nicking or otherwise damaging the wire or remaining insulation. For the minimum requirements that will be acceptable for nicking or cut wire strands, refer to Table 204.

Table 204. Maximum Nicked or Broken Strands For Stripped Wire

NUMBER OF STRANDS	MAXIMUM ALLOWABLE NICKED OR BROKEN STRANDS
LESS THAN 7	0
7-15	1
16-18	2
19-25	3
26-36	4
37-40	5
41 OR MORE	6

I. Soldering.

- (1) Refer to [Soldering - Maintenance Practices](#) for soldering.

J. Backshell

- (1) All non self locking backshell coupling nuts shall have a bead of RTV157 applied to the nut and backshell body after tightening.

Figure 201 : Sheet 1 : Wire Catagories

B11

Wire, single conductor unshielded

————— HJF162-96PF15(22) —————

High temperature wire, unshielded (wire number is underlined)

————— 3S183-SP227(20) —————

Twisted pair of wires, unshielded

⌘ 23PF119-CPF41(22)WHITE ⌘
8PF119-EPF41(22)BLACK ⌘

Shielded single conductor

⊖ 9PT52-9PT54(22) ⊖

Shielded two conductor

⊖ EJF28-MPF143(20)WHITE ⊖
FJF28-KPF143(20)BLACK ⊖

NOTE: CAN BE SHOWN WITH OR WITHOUT WIRE NUMBERS.

Figure 202 : Sheet 1 : Wire Part Numbers

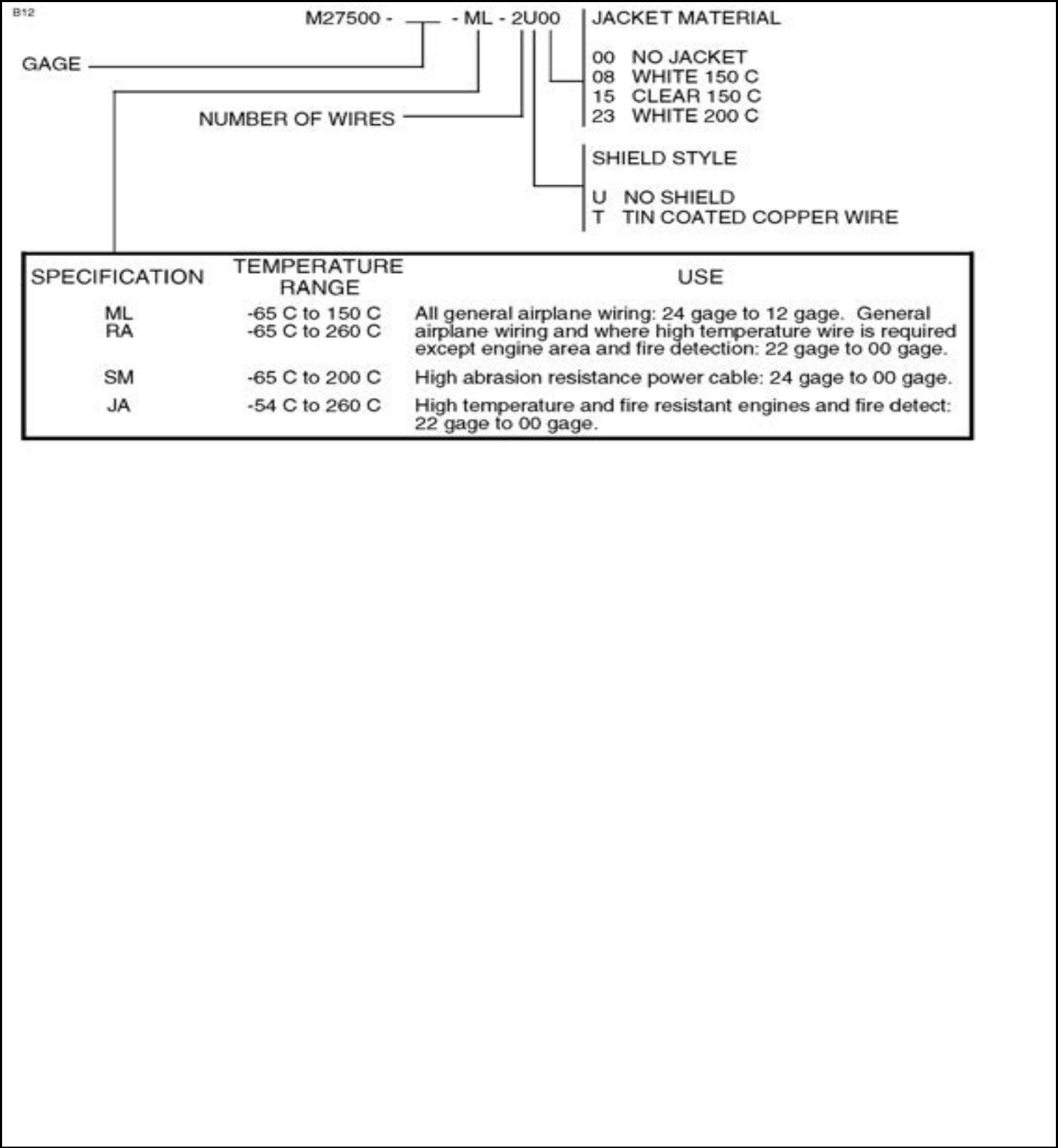


Figure 203 : Sheet 1 : Binding Tie

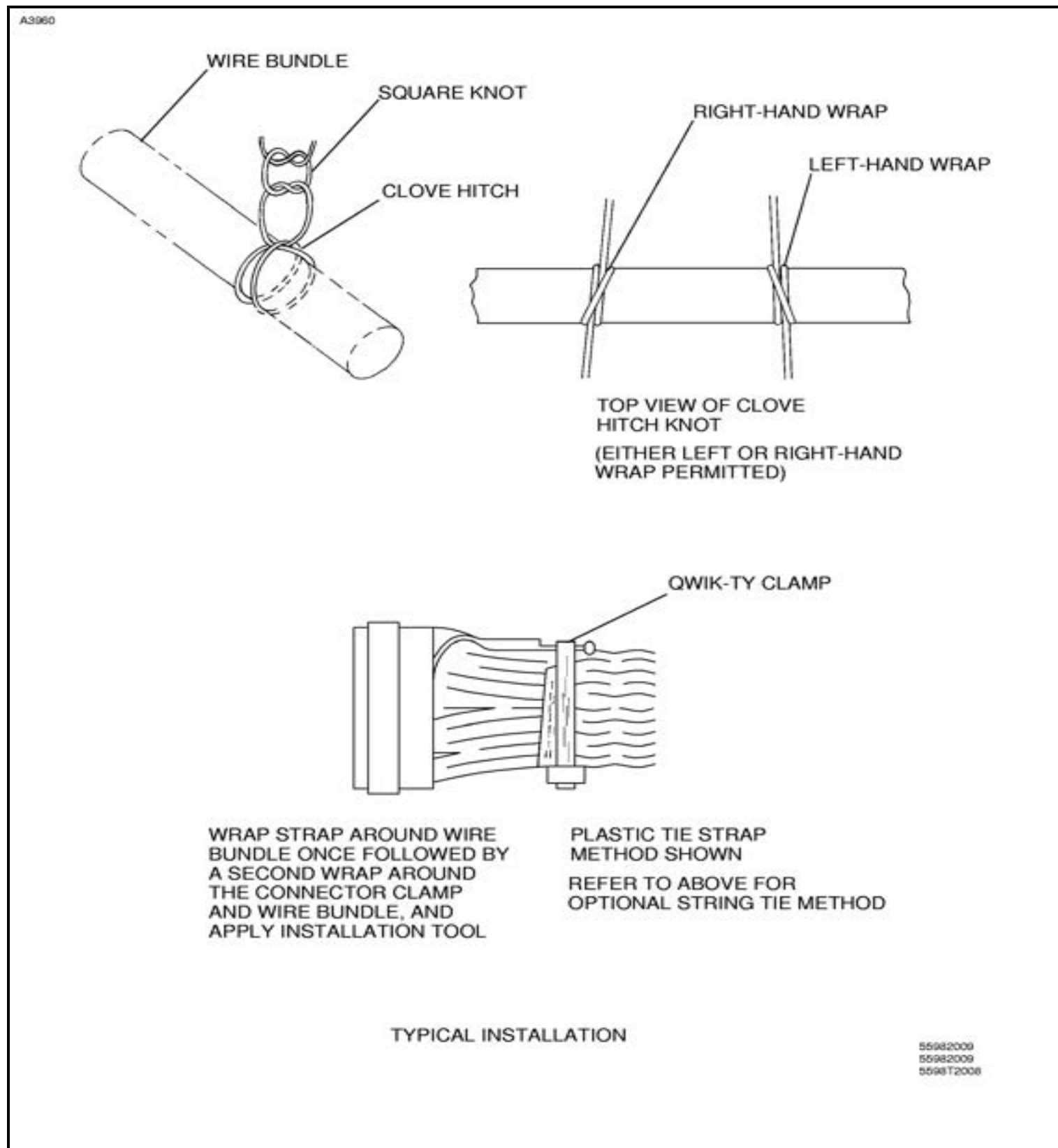
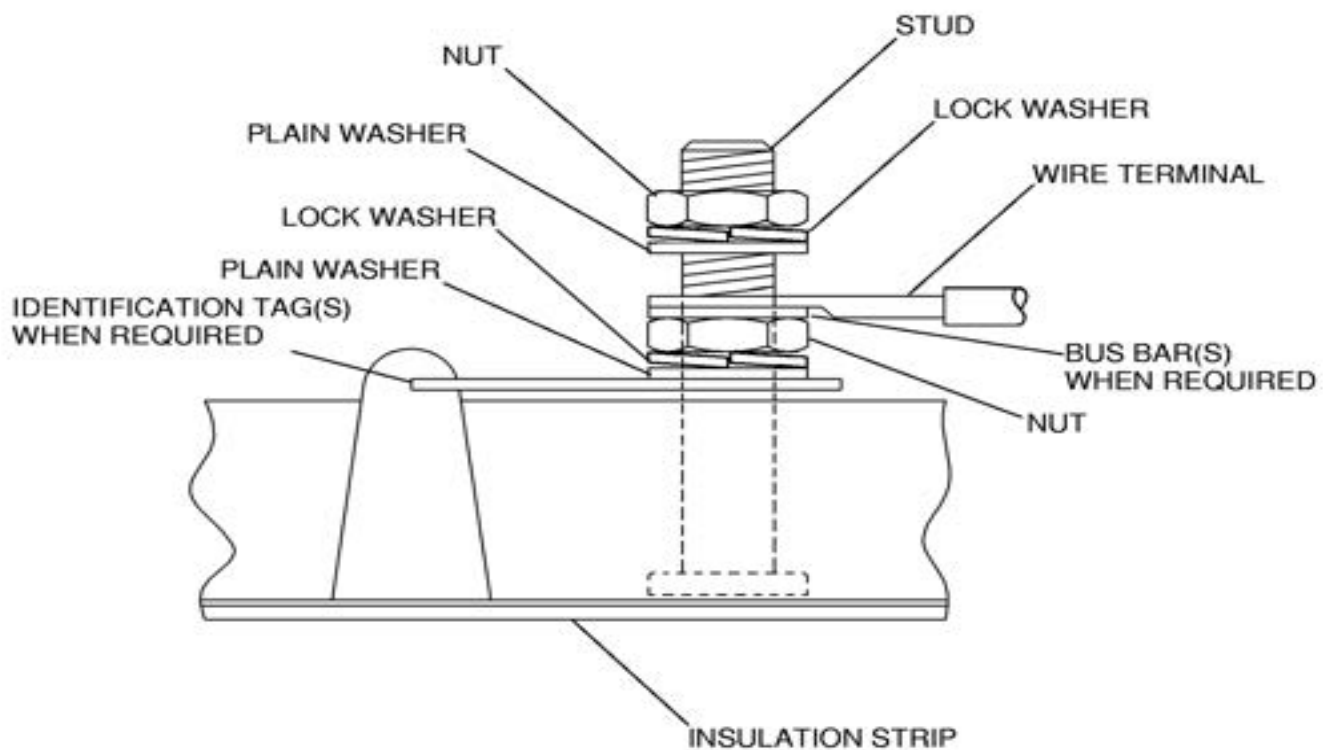


Figure 204 : Sheet 1 : Terminal Board Installation

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Figure 205 : Sheet 1 : Serving Thermocouple Leads

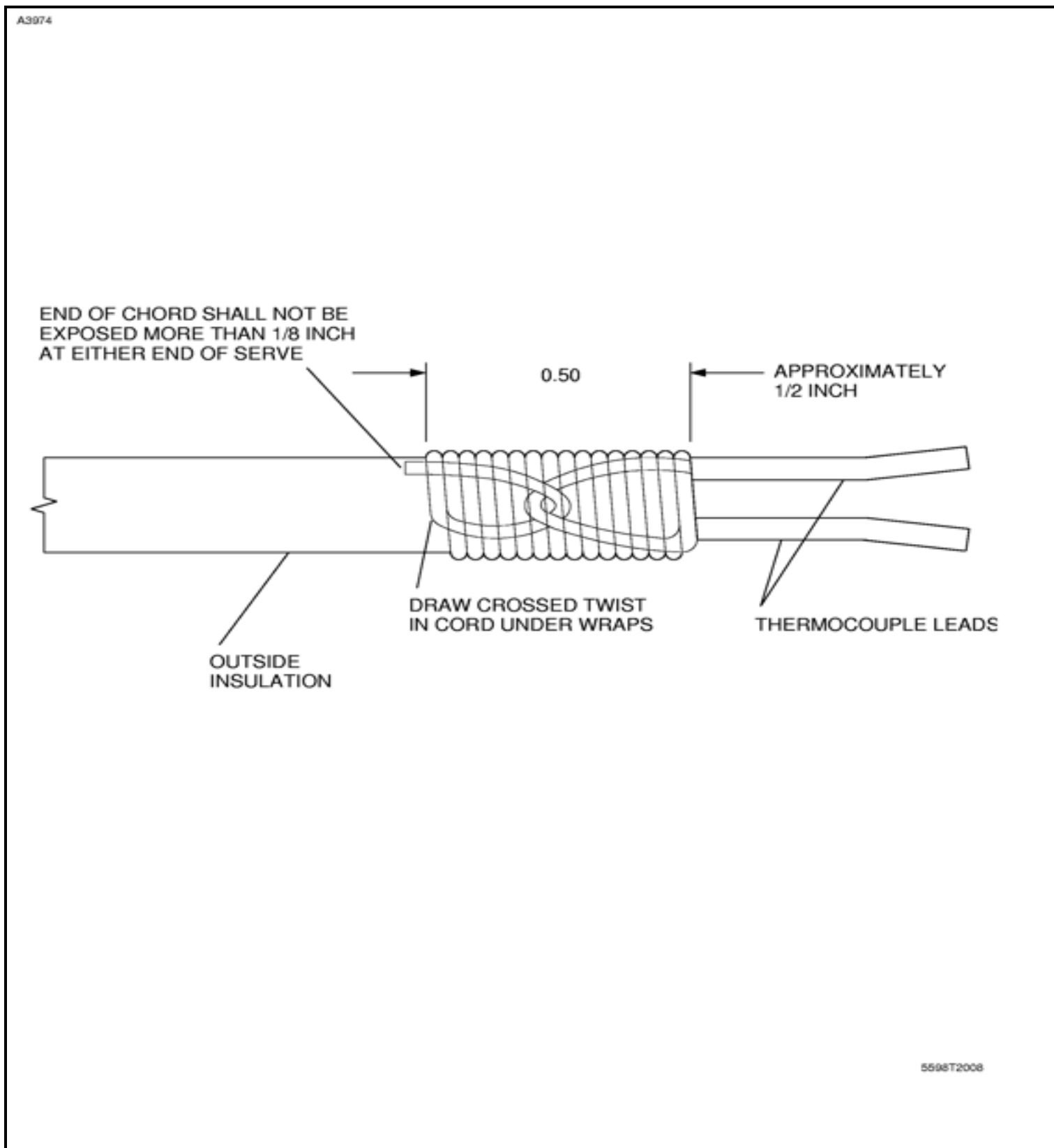
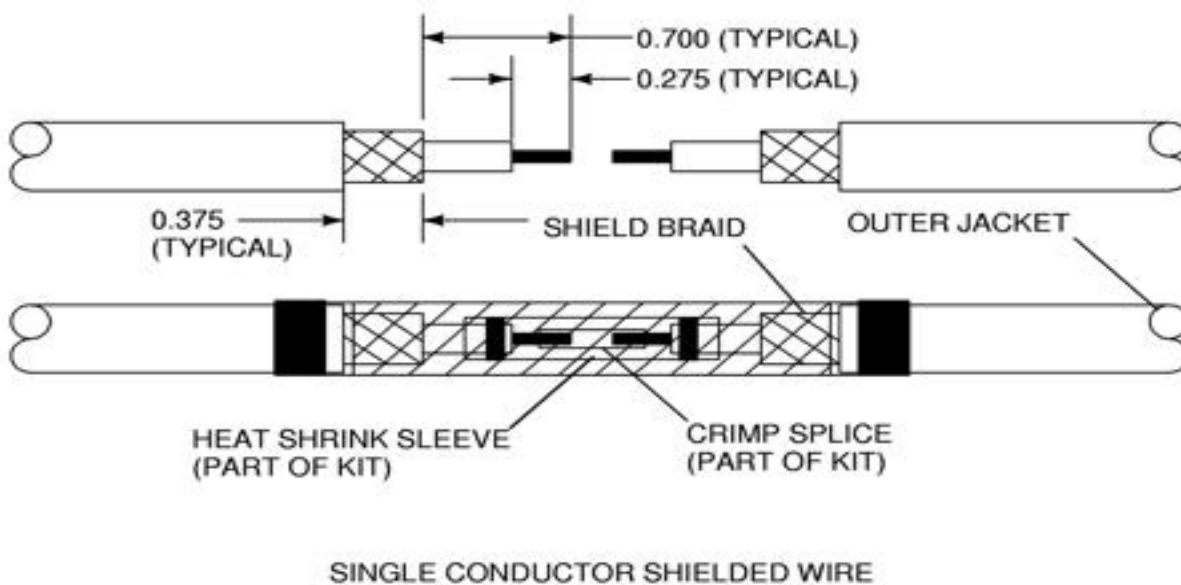
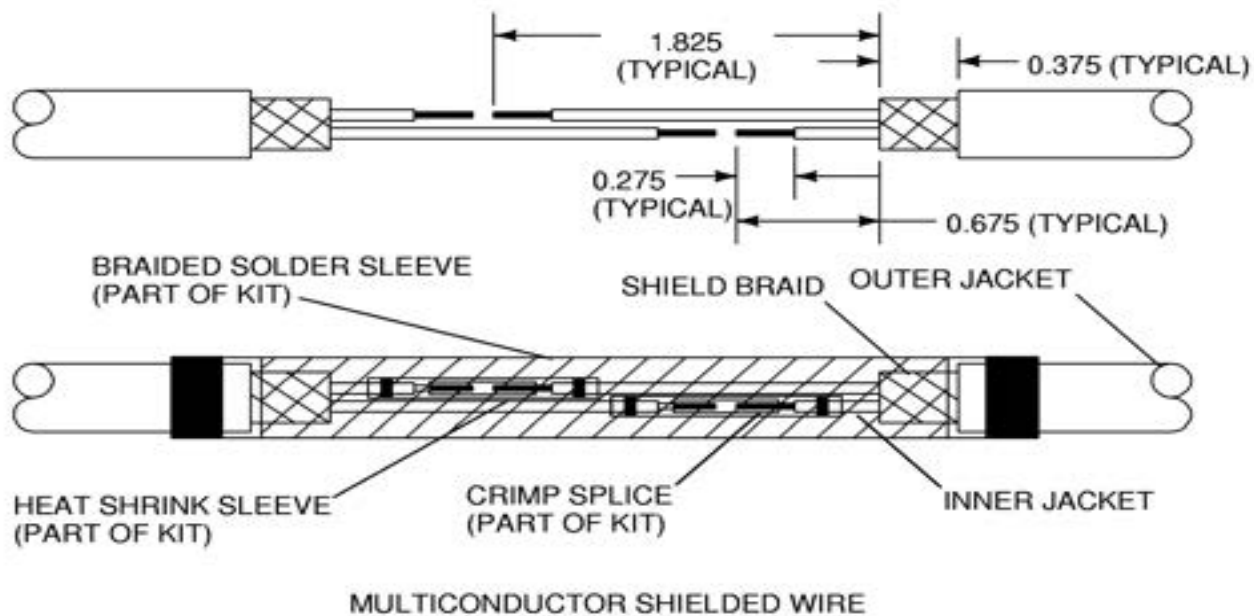


Figure 206 : Sheet 1 : Shielded Wire Splices



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BONDING AND GROUNDING - MAINTENANCE PRACTICES

1. General

- A. All installed components and equipment should be bonded and grounded.

2. Removal/Installation of Bonding and Grounds

- A. Surface Preparation for Bonding.
- (1) Remove oil, grease, dirt and other contaminants with clean cotton cloth dampened with solvent.
 - (2) Completely remove paint, dyes or stains with an approved solvent. Wipe dry with a clean, dry cloth.
 - (3) Use adhesive finishing paper or cloth, Number 320 grit or finer, or aluminum wool to remove nonconductive coatings from surfaces to be bonded.
- B. Install Ground.
- (1) There shall be no more than four terminals attached to any ground stud.
 - (2) A maximum of two ground wires may be crimped in one terminal. If shown on a wire diagram, it is permissible to have three braid straps per ground terminal.
 - (3) Install terminal to grounding structural member in accordance with [Figure 201](#).
 - (4) Touch up or refinish the bonded members by reapplying the original paint finish.
 - (5) The perimeter of all permanent electrical contact areas shall be sealed after assembly using Type I or Class VC sealant. Refer to the Maintenance Manual, Chapter 20, [Solvents, Sealants And Adhesives](#) for sealant types and application.

3. Installation of Shielded Cable Grounds

- A. Shield termination using Method I. To be used when a single or small number of shielded cables terminate at a common point.
- (1) Strip cable in accordance with dimensions in [Figure 202](#). Use Thomas & Betts Tool Number WT-700 or functionally equivalent to cleanly cut the shield to required length.
 - (2) Refer to Table 201 to determine proper solder sleeve for cable being used.
 - (3) The sleeve should be placed on the cable large end first. The shield should be bottomed against the necked portion of the sleeve thus correctly positioning the sleeve for shrinking and soldering.
 - (4) Position the sleeve so that it is centered between the inserts of the nose cone on a heat gun and move side to side until proper shrinking and soldering is observed. Use the Raychem Zap Gun or Raychem Model CV-4504 Shop Air Heater for this purpose.
 - (5) For terminating a relatively small number of shields at a common point, apply Method I as shown in [Figure 203](#).

Table 201. Shielded Cable Ground Installation

Shielded Wire Mil-C-27500	Solder Sleeve Raychem P/N D144-
22B1T2	-50
22B2T2	-51
22B3T2	-51
20B1T2	-50
20B2T2	-51
20B3T2	-51
18B1T2	-50
18B2T2	-51
16B1T2	-51
14B1T2	-51

- B. Shield termination using Method II. To be used when a large number of shielded cables terminate at a common point.
- (1) Prepare individual shielded cables as shown in [Figure 204](#). Use Thomas & Betts Tool Number WT-093B to slip conductor(s) out of shield. [Refer to Figure 205](#) for wire stripping dimensions.
 - (2) Slip all prepared shielded cables and all unshielded wires that terminate at the same point through the appropriate size solder sleeve.
 - (3) Position sleeve per [Figure 205](#) and use procedure described in 3.A.(3) for shrinking and soldering of sleeve.
- C. Alternate method. To be used when solder sleeves are not available.
- (1) Cut the outer jacket around its circumference four inches from the end of the cable as shown in [Figure 206](#).
 - (2) Push the metal braid shielding back over the insulated wire to make a hump.
 - (3) Make an opening by separating the wires in the metal braid at the hump. Work the insulated wire through the opening. Push the shielding even further over the wire. Wrap one or two turns of vinyl tape around the wire at the base of the hump. Slide the braid over the taped joint.

CAUTION: DO NOT DAMAGE THE WIRE INSULATION OR SHIELDING.

- (4) Slide the outer covering over the pigtail and taped wire. Wrap two or three turns of tape around the cut end of the outer jacket to make a moisture and dustproof joint.
 - (5) Cut the insulated wire to proper length, strip insulation and install connector.
 - (6) Cut the pigtail to length. Enclose pigtail in vinyl sleeving and stake terminal to pigtail.
- D. Dead ending a shield.
- (1) Strip cable and cut heat shrink tubing to length according to dimensions in [Figure 207](#).
 - (2) refer to Heat Shrinkable Tubing - Maintenance Practices for proper size tubing and further installation details.

NOTE: Part number D144-50 solder sleeve is for a single 22 AWG pigtail. For more than one pigtail or pigtail larger than 22 AWG use a D144-51 solder sleeve.

NOTE: For Mil-W-16878 Type D shielded cable use shrink tube for a heat sink between the conductor insulation and the shield.

4. Terminating Shielded Cables

- A. When terminating shielded cables, the following guide lines should be observed.
- (1) Shield terminations (jumper wires or braid strap) shall be as short and as straight as possible to the back of a connector or to a ground stud.
 - (2) Ground shields only where indicated by the applicable wiring diagram.
 - (3) There shall be no more than two jumper wires (or braid straps) per ground terminal. If shown on a wire diagram, it is permissible to have three braid straps per ground terminal.
 - (4) Only jumper shielded cables together as shown on the applicable wiring diagram.
 - (5) Refer to [Table 201](#) to determine proper solder sleeve for shielded cable to be terminated.

Table 202. Solder Sleeves for Shielded Cable

Diameter - Inches (Wire and Jumper)		Solder Sleeve	Raychem P/N
Maximum	Minimum		
0.105	0.035	S2974*1	
0.145	0.055	S2974*2	D108-10
0.200	0.085	S2974*3	D108-11
0.255	0.130	S2974*4	
0.300	0.170	S2974*5	D108-12
0.450	0.225		D142-65
0.535	0.350		

- B. Strip the shielded cable in accordance with dimensions in [Figure 202](#).
- (1) Use Thomas & Betts tool Number WT-700 (or equivalent) to cleanly cut the shield to required length.
 - (2) The fold back strip method is required for M27500 Type B shielded cable.
 - (3) The center strip method is used when terminating shields at a connector backshell, equipment rack or using a single solder sleeve for several shielded cables.
- C. Position the solder sleeve and jumper (or braid strap) and heat with a Raychem Zap Gun or Raychem Model CV-4504 Shop Air Heater (or equivalent), move side to side until proper shrinking and soldering is observed. Refer to [Figure 208](#).
- NOTE: For MIL-W-16878 Type D shielded cable use shrink tube for a heat sink between the conductor insulation and the shield.**
- (1) There shall be no more than two jumpers (or braid straps) per solder sleeve.
 - (2) If using a single solder sleeve for several shielded cables, slip the shielded cables and all unshielded wires that terminate at the same point through the solder sleeve.
- D. Dead ending a shield. Refer to [Figure 207](#).
- (1) Strip shield braid within 1.5 inches from the end of the wire.
 - (2) Position heat shrink tubing 0.75 inch long over the shield braid. Refer to Chapter 20, [Heat Shrinkable Tubing - Maintenance Practices](#).
 - (3) Heat the heat shrink tubing with a Raychem Zap Gun or Raychem Model CV-4504 Shop Air Heater (or equivalent), move side to side until proper shrinking is observed.
- E. Terminating shields at connector backshells or equipment racks. Refer to [Figure 209](#).
- (1) Solder sleeves shall be four inches or less from the connector.
 - (2) Only use S2974-X Solder Sleeves (with braid strap).
 - (3) Crimp braid strap(s) in terminal to match strain relief screws. Refer to Chapter 20, [Splices and Terminals](#), to determine terminal size required.
 - (4) Ensure connector backshell and strain relief clamp are properly tightened.
- F. Terminating shields with a band clamp. Refer to [Figure 210](#).
- (1) Band clamps are used to terminate shields at a connector backshell or equipment rack. Band clamps are also used to terminate shield

overbraids that cover an entire wire bundle.

- (2) Refer to Table 202 for band clamp and installation tool part numbers.

Table 203. Band Clamp and Installation Tool Part Numbers

Name	Part Number	Manufacturer	Use
Band Clamp	600-052	BAND-IT - IDEX, Inc. P.O. Box 16307 Denver, CO 80216-0307	Shield and shield overbraid termination
Tie-Dex II Tool	A40199	BAND-IT - IDEX, Inc. P.O. Box 16307 Denver, CO 80216-0307	Installation of band clamps

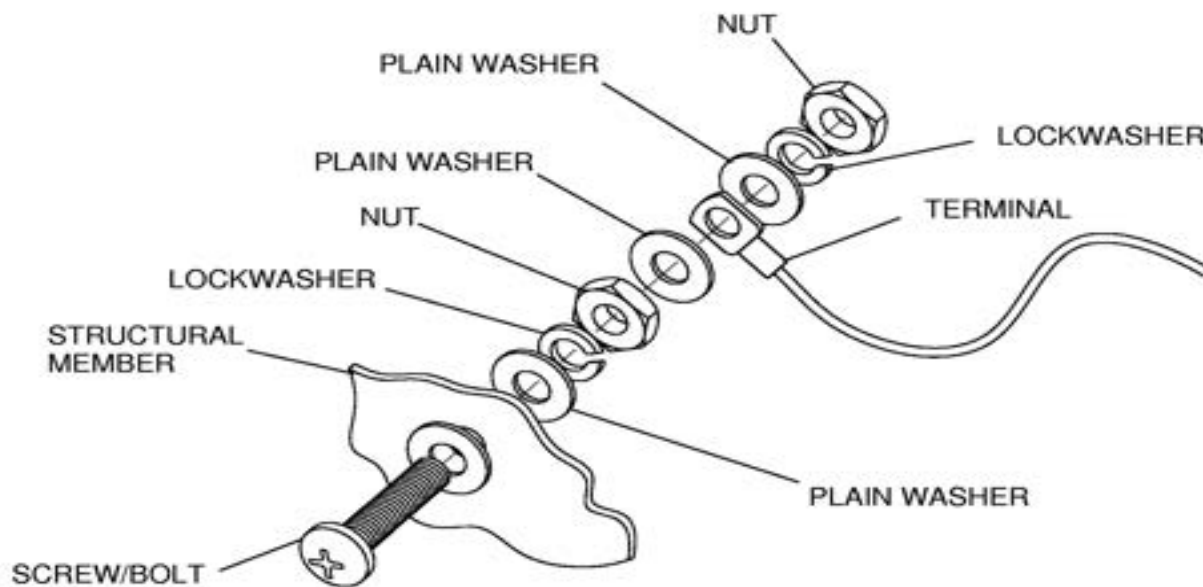
- (3) When replacing band clamps, the following guidelines should be observed.
- (a) Substitutions, such as tie wraps, are not allowed.
 - (b) Only use S2974-X Solder Sleeves (with braid strap) or braid straps when terminating shields with a band clamp.
 - (c) Ensure wires are not under the area to be clamped.
 - (d) Band clamps may not be reused. Band clamps must be replaced when removed for maintenance.
 - (e) After installation, the band clamp shall lay flat across the area to be clamped and shall be secure (cannot be moved by hand).
- (4) Removal of band clamps.
- (a) Using a flat screwdriver, bend down the locking lip on the band clamp and slide the band through the band clamp buckle.
- (5) Installation of band clamps.
- (a) Double wrap the band clamp around area to be clamped. Both wraps of the band clamp must pass through the slot on the band clamp buckle.
 - (b) Squeeze the gripper release handle on the band clamp installation tool and insert the band into the installation tool band slot.
- NOTE: The cut-off handle (white handle) should be on the same side as the band clamp buckle.**
- (c) Repeatedly squeeze the pull-up handle (blue handle) until the handle locks against the installation tool body.
 - (d) Squeeze the cut-off handle (white handle) to crimp a locking lip on the band clamp and cut off excess band.

5. Resistance Values for Shield Terminations

- A. Resistance measured from a shield termination (braid strap) to a ground point shall be 0.010 ohms (10 milliohms) or less. Refer to [Figure 211](#).
- B. Resistance measured from a ground point to the connector body shall be 0.005 ohms (5 milliohms) or less. Refer to [Figure 211](#).

Figure 201 : Sheet 1 : Terminal Grounding

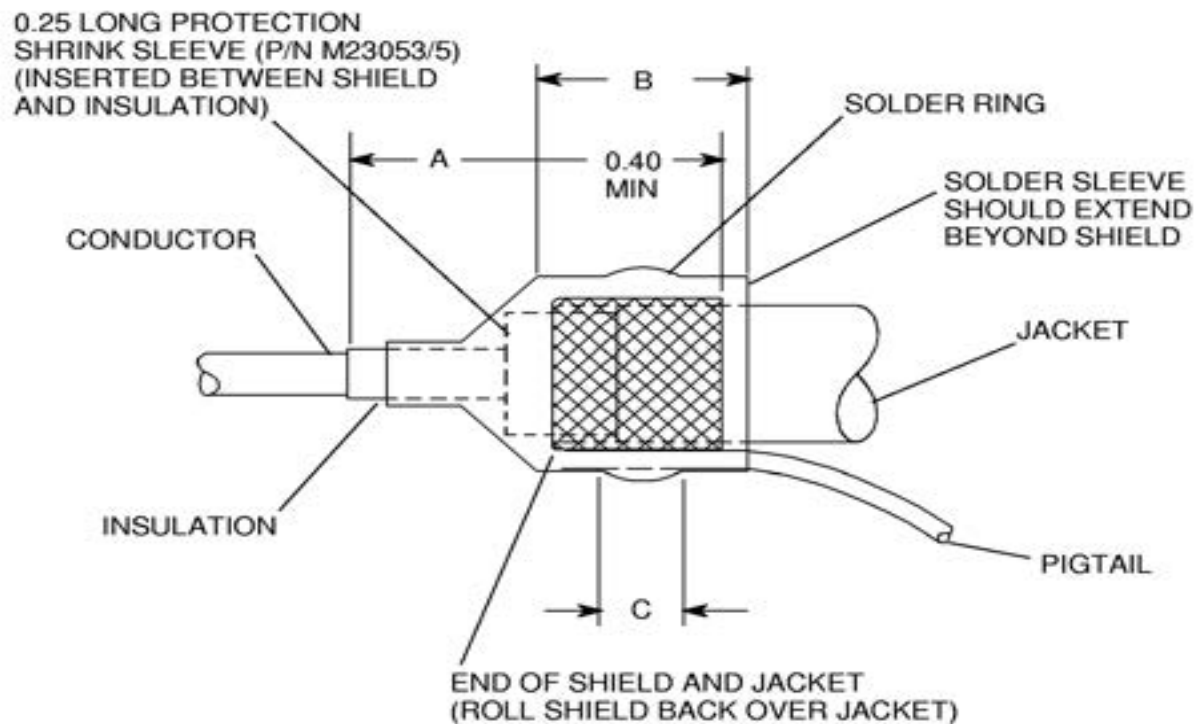
B14



6280X1085
6280X1085

Figure 202 : Sheet 1 : Solder Sleeve Assembly Using Method I

B15

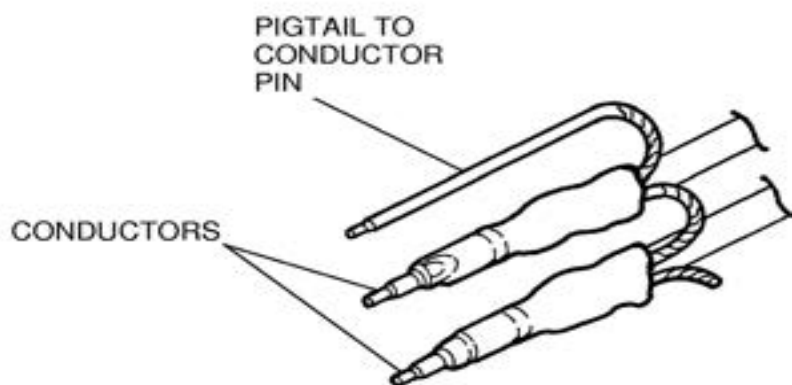


DIM.	MIN.	MAX.
A	0.50	3.00
B	0.625	0.675
C	0.20	0.50

NOTE: SINGLE CONDUCTOR SHOWN. THIS METHOD ALSO APPLICABLE TO DUAL AND TRIPLE CONDUCTOR SHIELDED CABLE.

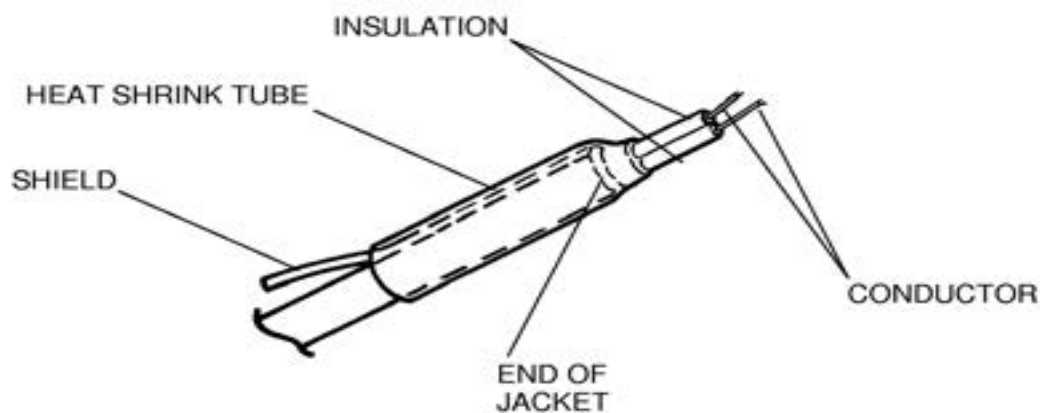
6016C1039

Figure 203 : Sheet 1 : Multiple Shield Terminations Using Method I



65181202

Figure 204 : Sheet 1 : Preparation of Individual Shielded Cables Before Applying Method II



NOTE: TWO CONDUCTOR SHIELDED CABLE SHOWN. THIS METHOD ALSO APPLICABLE TO SINGLE AND TRIPLE CONDUCTOR SHIELDED CABLE

6516X1201

Figure 205 : Sheet 1 : Multiple Shield Terminations Using Method II

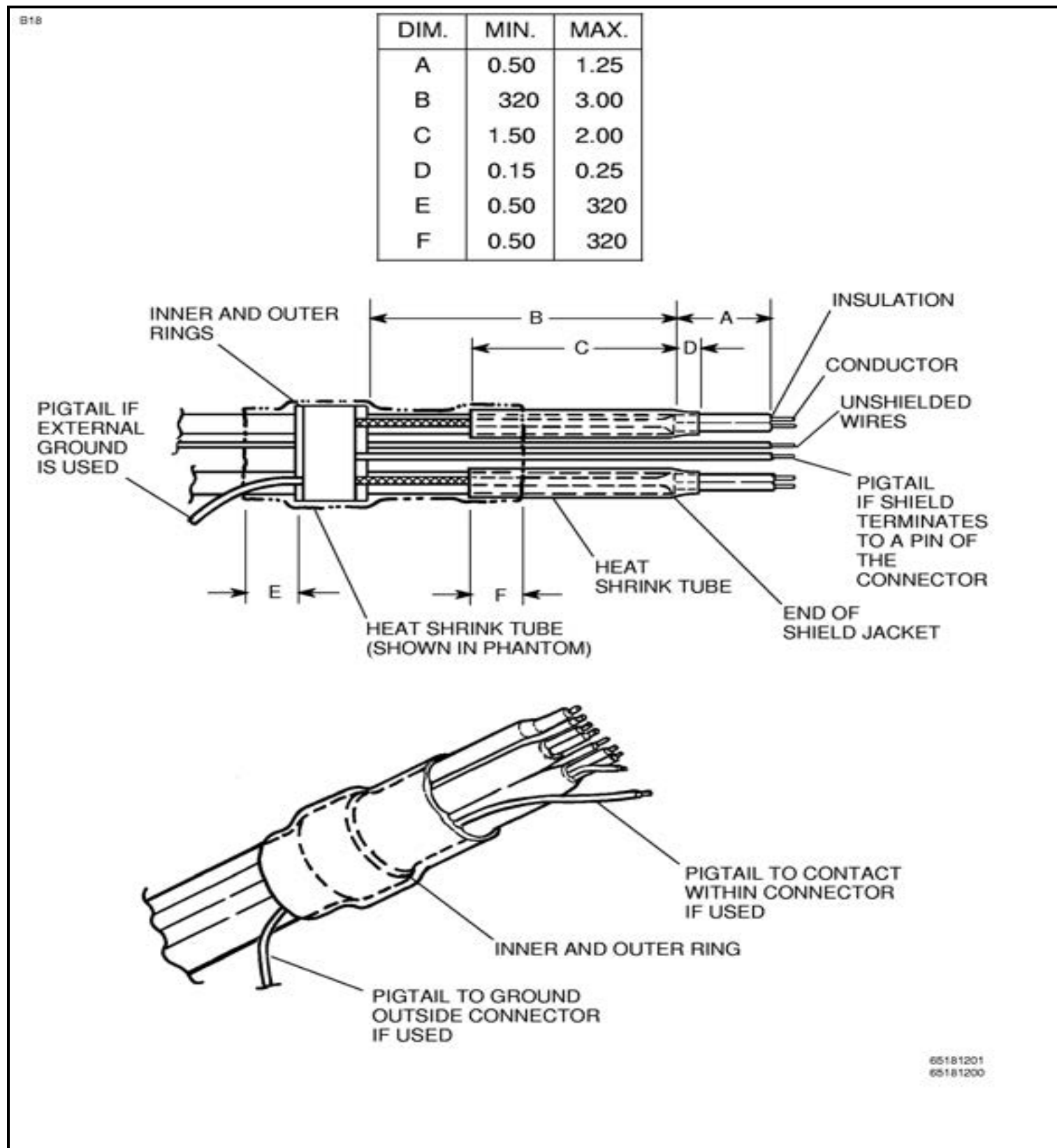
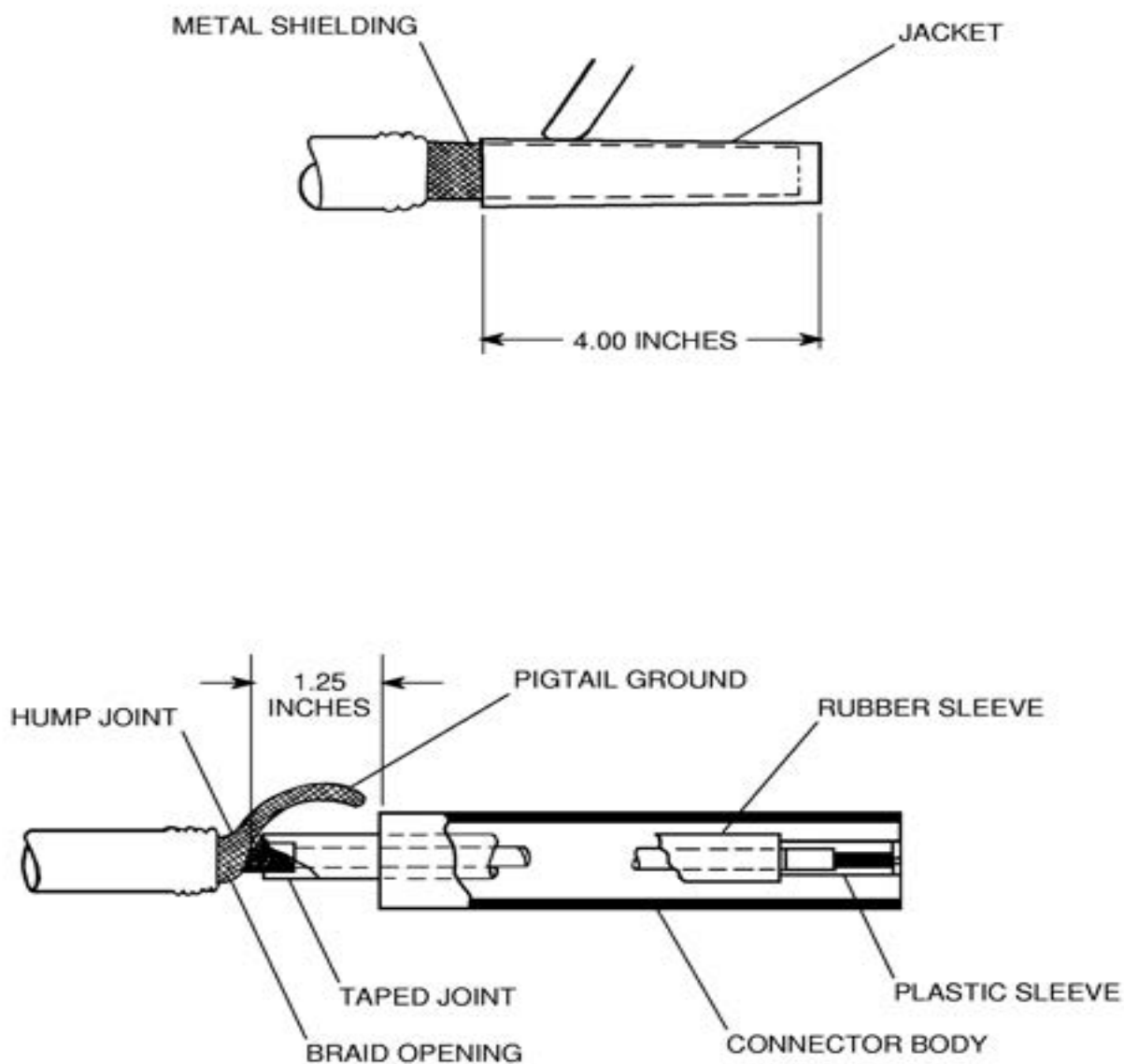


Figure 206 : Sheet 1 : Shielded Cable Ground Installation

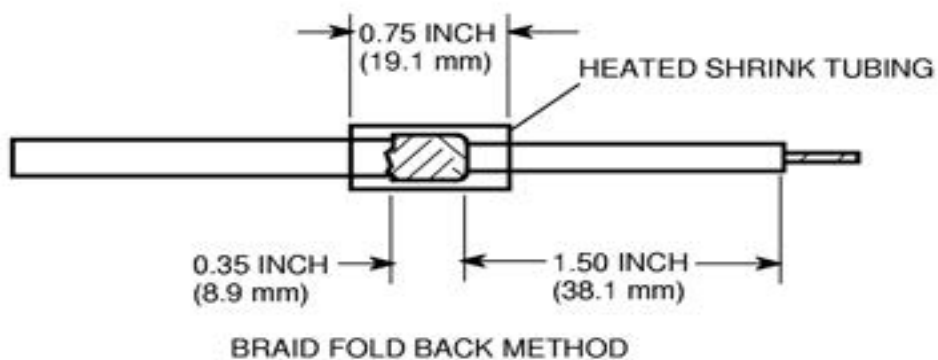
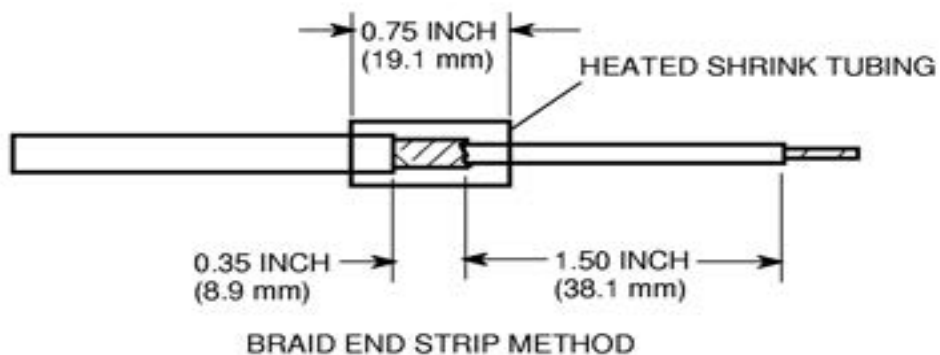
B19



55982011
55982011

Figure 207 : Sheet 1 : Dead End Shield Terminations

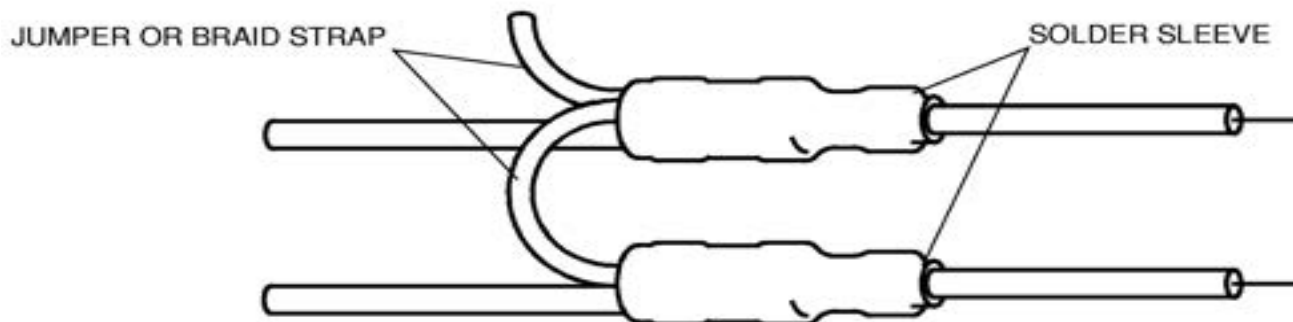
A3968



6718T1277

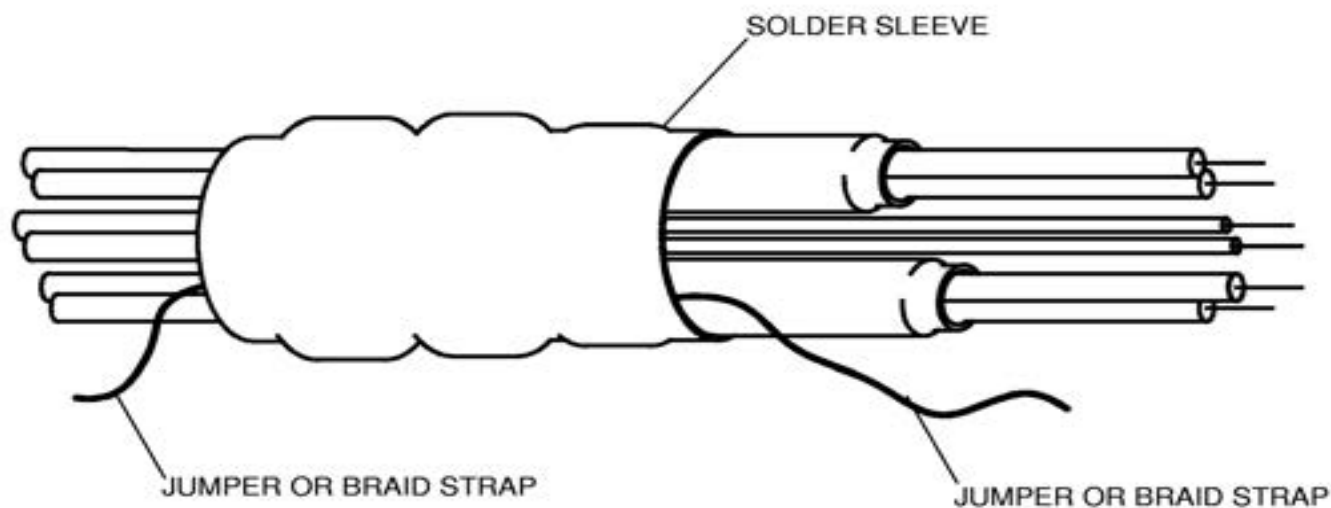
Figure 208 : Sheet 1 : Shielded Cable Terminations

A3967



NOTE: ONLY JUMPER SHIELDED CABLES TOGETHER
AS SHOWN ON WIRING DIAGRAM.

MULTIPLE SHIELD TERMINATIONS



SINGLE SOLDER SLEEVE FOR MULTIPLE SHIELDED CABLES

6718T1276

Figure 209 : Sheet 1 : Shield Terminations at Connector Backshells

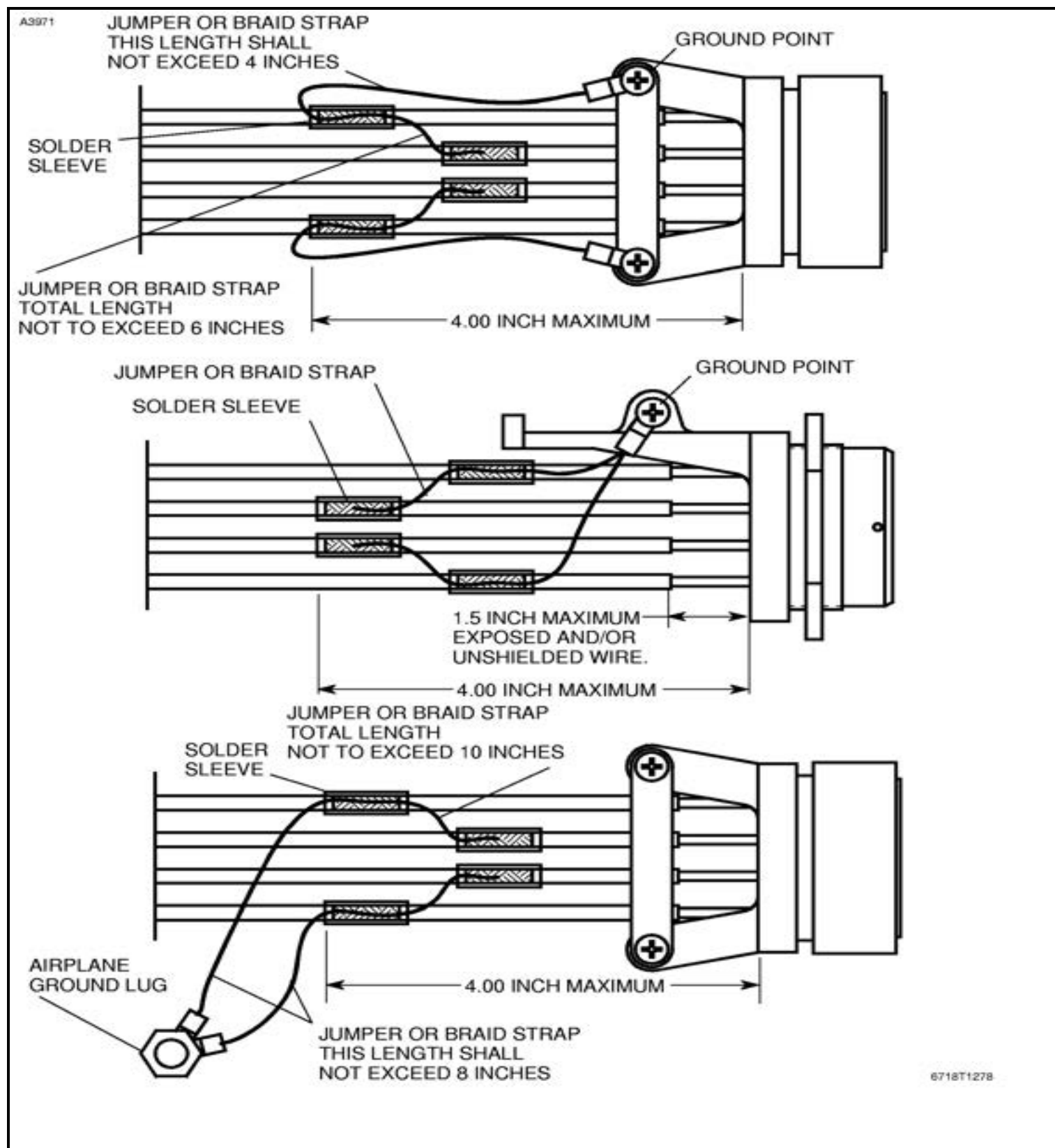


Figure 210 : Sheet 1 : Band Clamp Installation

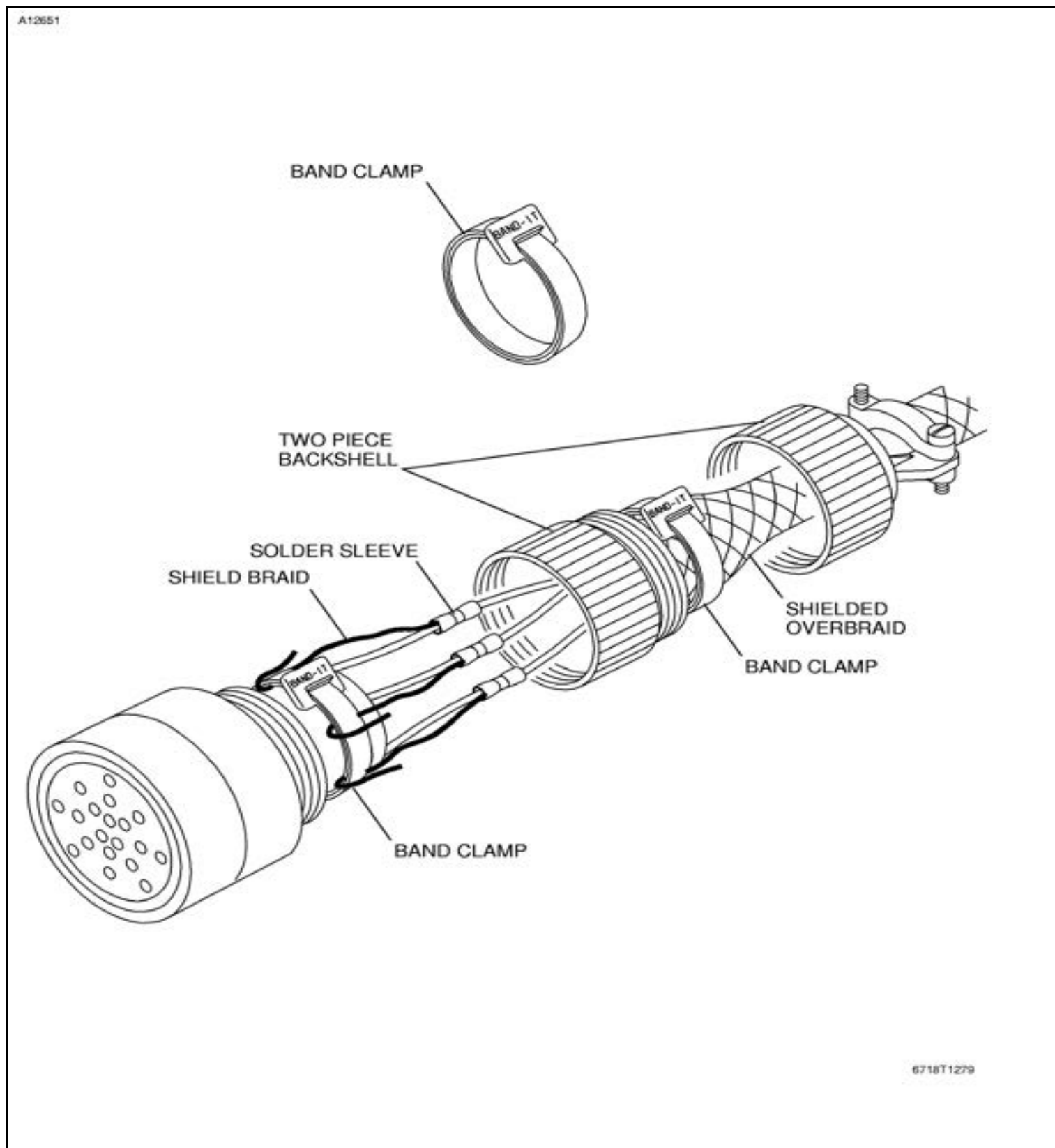


Figure 210 : Sheet 2 : Band Clamp Installation

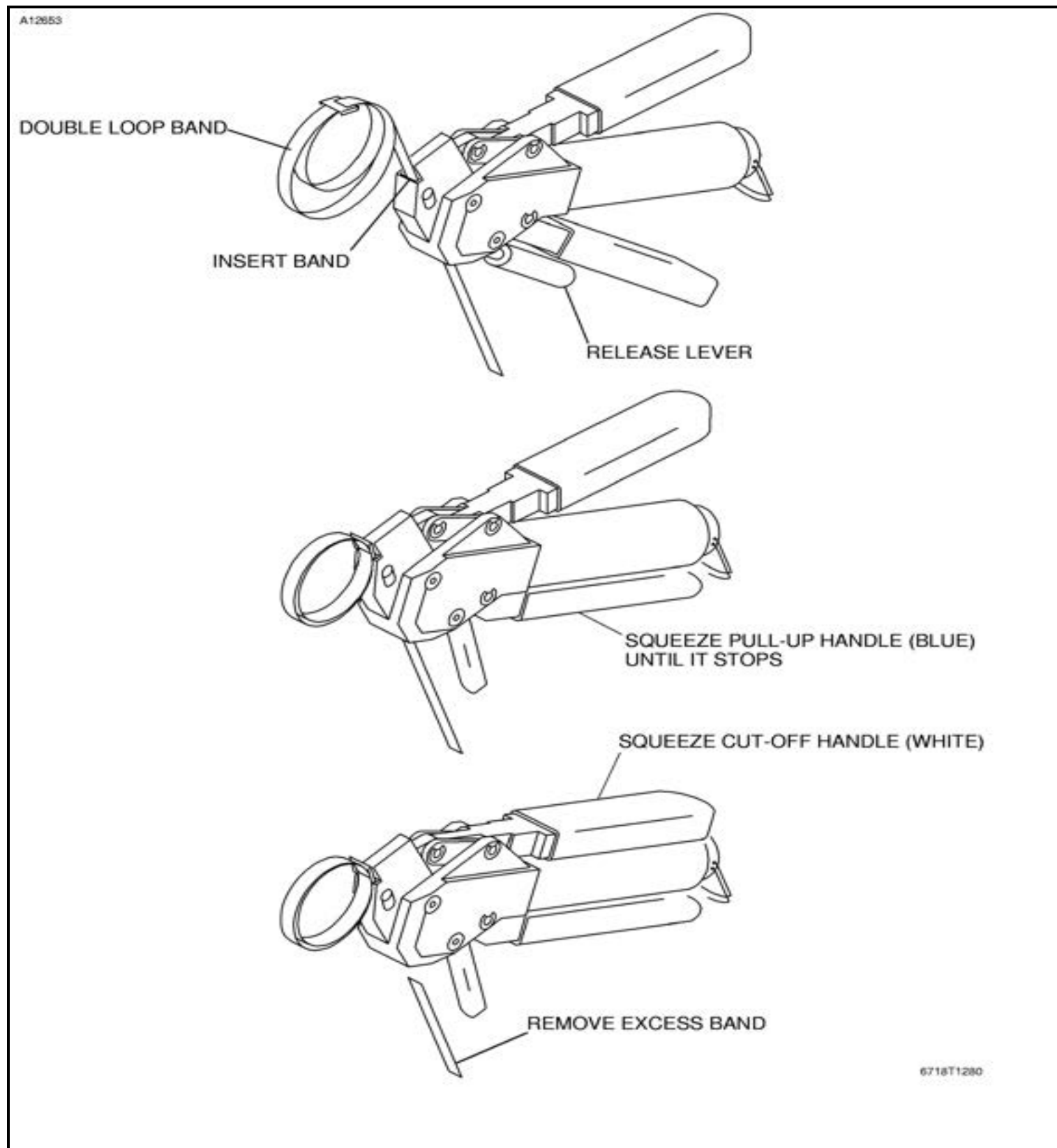
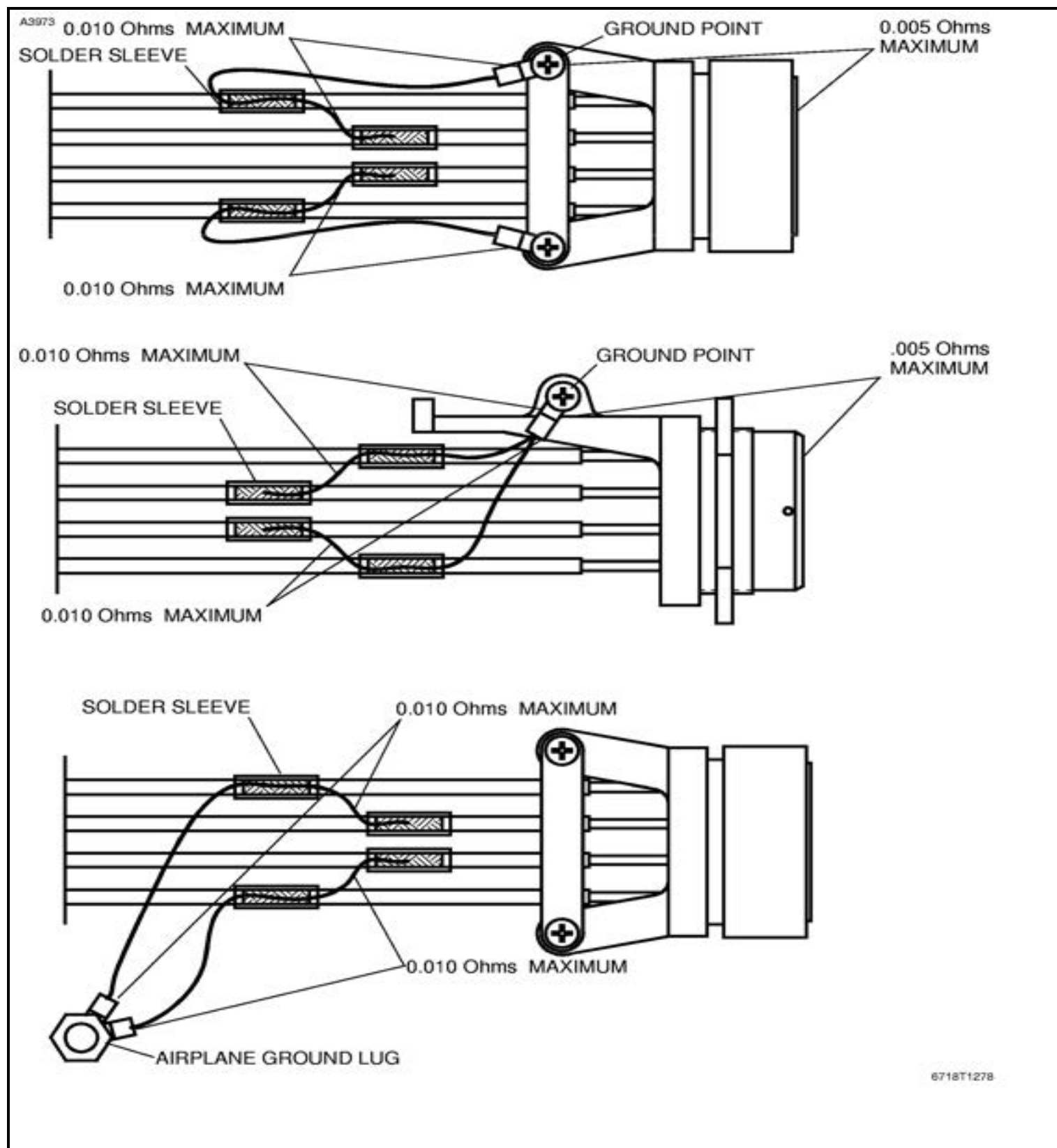


Figure 211 : Sheet 1 : Resistance Values for Shield Terminations



SOLDERING - MAINTENANCE PRACTICES

1. General

- A. This section describes procedures for making solder joints with a filler metal having a flow temperature below 800° F. (Refer to [Figure 201](#), [Figure 202](#), [Figure 203](#), [Figure 204](#), [Figure 205](#), [Figure 206](#), and [Figure 207](#))
- B. Electrical wiring and connections should be soldered with a tin-lead solder using a noncorrosive flux.

2. Tools and Equipment

- A. Solder.

CLASS	AWS	ASTM	COMPOSITION PERCENT BY WEIGHT	TEMPERATURE		USAGE	FLUX AND FLUX SOLVENT
				SOLIDUS °F	LIQUIDUS °F		
SN 60	QQ-S-571E	Tin 60	Lead 40	361	374	General purpose for connection (applications below 250°F)	Flux: Use Rosin Core Solder QQ-S-571E WRMAP2 Flux Solvent: Aliphatic Naphtha (TT-N-95) or Trichloroethylene (ASTM D4080)
SN 63	(QQ-S-571E) (WRMAP2)	Tin 63	Lead 37	360	360	Special purpose electrical wiring and printed circuits where temperature limitations are critical.	Flux: Use Rosin Core Solder QQ-S-571E WRMAP2 Flux Solvent: Aliphatic Naphtha (TT-N-95) or Trichloroethylene (ASTM D4080)
AG 1.5		Tin 1.0 Silver 1.5	Lead 97.5	588	588	This solder has good joining properties to 350°F. Use electrical connectors and low temperature thermocouples to 350°F copper, brass and steel.	Flux: Type RA and AC Zinc-Chloride Base QQ-S-571E Flux Solvent: Water and Organic Solvent
AG 5.5		Lead 94.5	Silver 5.5	579	689	Good joining properties to 350°F copper, brass and steel.	Flux: Zinc-Chloride Base of Type RA and AC (QQ-S-571E) Flux Solvent: Water and Organic Solvents

ABBREVIATION:
ASTM - American Society for Testing and Materials
AWS - American Welding Society
QQ - Federal Specification
QPL - Qualified Products List
Kester Solder Division
Litton Systems, Incorporated
4201 Wrightwood Avenue
Chicago, IL 60639

- B. Solvents used for the removal of grease, oil, and other dirt from the parts prior to soldering, as well as flux residues from the joint area after soldering.

- (1) Non-flammable.
 - (a) Tetrachloroethylene (perchloroethylene) electronic grade.
 - (b) Trichloroethylene electronic grade.

WARNING: TETRACHLOROETHYLENE AND TRICHLOROETHYLENE ARE TOXIC. DO NOT BREATHE VAPORS. USE IN WELL VENTILATED AREA FREE FROM SPARKS, FLAME OR HOT SURFACES. WEAR SPLASH GOGGLES, SOLVENT RESISTANT GLOVES AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

- (2) Flammable.
 - (a) Ethyl alcohol, grade 1, class A.
 - (b) Isopropyl alcohol, 99 percent pure.

WARNING: ISOPROPYL ALCOHOL IS TOXIC AND FLAMMABLE. DO NOT BREATHE VAPORS. USE IN WELL VENTILATED AREA FREE FROM SPARKS, FLAME OR HOT SURFACES. WEAR SPLASH GOGGLES, SOLVENT RESISTANT GLOVES, AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

3. Soldering

- A. Strip sufficient insulation from the wire or component leads so that no insulation will touch the solder connection. Insulation clearance is the gap between the insulation and the edge of the terminal or solder cup. Refer to [Figure 207](#). Refer to [Table 201](#) for insulation clearance.

Table 201. Insulation Clearance

WIRE SIZE (AWG)	CLEARANCE	
AMERICAN WIRE GAUGE	MINIMUM	MAXIMUM
Smaller than 20	Visible Clearance	0.06
20 thru 10	0.03	2 Times Diameter of Insulation
8 thru 2	0.03	0.375
1 and Larger	0.03	0.5

- B. Surfaces to be joined by soldering must be free of dust, oil and oxides. Clean surfaces with solvent or wire brush, do not use steel wool.
- C. Pretin wires and leads before joining by soldering. Part leads or terminals pretinned by the manufacturer do not require tinning unless corrosion has occurred during storage. Corrosion must be removed and the part pretinned before soldering.
- D. When required, shrink tubing or other insulating sleeving should be installed on wires prior to attachment to terminal. Refer to [Figure 205](#).
- E. Hold the parts to be soldered together in a position to assure proper fit during the soldering operation.
- (1) Wires and component leads should be wrapped around a turret terminal or solder hook, or held, in a manner that will prevent the wire from moving while the solder is cooling. Movement of the wire during cooling will result in a cold solder joint.
 - (2) The wrap of a conductor around a turret terminal should not be less than 90 degrees or more than 270 degrees. Refer to [Figure 201](#)
- F. The soldering iron tip should be clean, smooth and brightly tinned. A cellulose sponge moistened with water provides a good pad for cleaning the tip.
- (1) The soldering iron should be a size that will heat the joint rapidly, but will not damage adjacent areas.
 - (2) The soldering iron tip should be grounded when soldering voltage sensitive components.
- CAUTION: THERMAL SHUNTS (HEAT SINKS) SHOULD BE USED TO PREVENT EXCESS HEAT FLOW TO ADJACENT PRESOLDERED JOINTS OR HEAT SENSITIVE PARTS.**
- G. Apply the soldering iron tip to the connection in such a manner that soldering temperature will be reached in the minimum time. Refer to [Figure 203](#) and [Figure 207](#) for examples of acceptable and unacceptable solder joints.
- (1) Solder should be applied to the joint when the temperature of the joint will readily melt the solder.
 - (2) Solder should not be applied at the junction of the soldering iron tip and the parts to be joined, nor shall solder be melted on the soldering iron tip and allowed to flow over the parts to be joined.
 - (3) Apply sufficient solder to cover the conductor.
 - (a) A concave fillet should be formed between the center of the conductor and the terminal.
 - (b) The contour of the terminal and the conductor should not be completely obscured by solder. When the conductor is completely covered by solder, or when a solder spike or other excessive amount piles upon the terminal that could touch some adjacent component, the excessive solder must be removed.
 - (c) Wicking of solder in stranded wires should not extend to the insulation.
 - (4) Cold solder joints require reheating and reflowing of the solder.
 - (5) Rosin-base flux residue need not be removed, when required to be removed use appropriate solvent.
 - (6) After the connection has cooled, residue of nonrosin base flux should be completely removed to prevent corrosion.
- H. Thermal shunting should be used on all solder connections where heat flow to adjacent presoldered joints or heat sensitive components could occur. If in doubt, use a heat sink. Refer to [Figure 206](#).
- (1) Thermal shunts (heat sinks) shall preferably be made of copper for good heat conductivity. They should be large enough to give adequate thermal protection, while causing as little interference to soldering as possible.
 - (2) Attach the thermal shunt (heat sink) as close as possible to the joint to be soldered.
 - (3) Several smaller thermal shunts (heat sinks) may be used in place of a large unit and often serve a double purpose of eliminating movement of wire leads preventing cold solder joints.
- I. Pretinning of wires before soldering.
- (1) All portions of stranded wires which come in contact with the area to be soldered can be tinned by dipping the fluxed wire in a solder pot or by use of a soldering iron.
 - (2) The tinning shall extend only far enough onto the wire to take full advantage of the area coming in contact with the connector or solder joint.
 - (3) A thin coating of solder shall be applied to all portions of the conductor wire coming in contact with the solder joint area. The solder shall penetrate to the inner strands of stranded conductors. To permit inspection for nicks or cuts at the point of insulation termination, solder and wicking shall not conceal the individual outer wire strands. A thermal shunt may be used to prevent this occurrence.
 - (4) The distance between the end of the wire insulation and the beginning of the tinned portion shall be no less than 1/2 the outside diameter of wire insulation.
 - (5) Part leads or terminals that are pretinned by the part manufacturer will not require further tinning unless corrosion has occurred during storage. Corrosion products shall be removed by pretinning of the lead or terminal.
 - (6) Parts which are dip-tinned shall be held in the solder container (Pot) until a bright, continuous, tightly adhering coat of solder is formed. The solder pot shall operate at a temperature 20°F to 50°F above the liquidus of the solder alloy used. The molten solder shall be of such volume that the temperature will not be reduced more than 10°F when parts are dipped.
- J. When soldering components on printed circuit boards, the old component must be removed and the solder cleaned from the holes before installing the new component.
- (1) When lead wires must be bent to install a component, the minimum distance to the start of the bend is two lead wire diameters, but not less than

0.030 inch. Refer to [Figure 202](#).

- (2) Components with the value stamped on one side, the leads should be bent so the value will be visible when installed; if practical.
 - (3) Component leads on opposite side of printed circuit board may be clinched or extend straight through approximately 0.03 of an inch. Refer to [Figure 203](#).
 - (4) Horizontally mounted ceramic components shall touch the board at least at one point. Maximum clearance of ceramic components is 0.015 inch. Glass components shall not rattle against the board during vibration and shall not touch the board. Maximum clearance of 0.03 inch between glass components and board shall be observed. Refer to [Figure 202](#).
 - (5) For clearance requirements on circuit boards with plated-thru-holes refer to [Figure 204](#).
 - (6) Protect adjacent areas with thermal shunts. Refer to [Figure 206](#) for typical thermal shunts.
 - (7) Solder with low melting point solder.
 - (8) Solder joints shall be free of cracks, fractures and projections. Porosity, voids, and foreign materials in the solder joint shall not exceed 25% of the total area between the lead and the wall of the plated-thru-hole. Solder wetting of the component lead and of the hole wall to the pad must be evident.
- K. Soldering of sleeved or insulated terminals shall be accomplished in the following manner.
- (1) Insulation tubing shall be installed over wires, leads and harnesses prior to their attachment to terminals of relays, connectors, and similar items which are not protected by insulating grommets or potting.
 - (2) Insulation tubing shall be pushed back far enough from the terminal so as not to interfere with the securing and soldering operations.
 - (3) Insulation tubing shall be slipped back, after the solder has solidified and cooled and the joint is cleaned, over the wires and terminals and, where applicable, heat shrunk.
 - (4) After installation, the tubing shall extend above the stripped portion of the attached conductor; a distance equal to or greater than the tubing diameter.
- L. Soldering of solder cup terminals shall be accomplished in the following manner. Refer to [Figure 207](#) for examples of acceptable and unacceptable solder joints.
- (1) The solder cup shall contain a sufficient amount of precut solder to completely fill the cup when solder is melted and the tinned wire inserted into the bottom of the cup.
 - (2) Sufficient heat shall be applied after the cup is filled with solder to assure that the flux has boiled up and out of the bottom of the cup. It is desired that continuous soldering iron contact be maintained throughout the soldering operation.
 - (3) The tinned wire or lead shall not be bent or formed for solder cup termination.
 - (4) All conductors terminating in a solder cup shall bottom in the cup.
 - (5) Insulating clearance shall be maintained, clearance shall be referenced from the point of entry into the cup.
 - (6) The solder shall follow the contour of the cup entry slot and shall not spill over or adhere to the sides of the cup. Connection may be made with either a resistance or conduction type soldering iron. When a conducting type soldering iron is used, the slight tinned effect occurring at the point where the tip contacts the base of the cup is normal and is acceptable provided there are no peaks, globules, or excessive buildup of solder.
 - (7) Excess solder in the form of buildup or overflow on a hollow terminal must not be in excess as to cause a short circuit between pins of other conductors and excess solder cannot interfere with the mechanical function of the terminals.

4. Component Removal (Solder Removal Technique)

WARNING: XYLENE IS TOXIC. DO NOT BREATHE VAPORS. USE IN WELL VENTILATED AREA FREE FROM SPARKS, FLAME OR HOT SURFACES. WEAR SPLASH GOGGLES, SOLVENT RESISTANT GLOVES AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

- A. Printed circuit board assemblies are coated with an approved silicone resin coating. Before removing a component, carefully soften this coating with xylene or equivalent solvent. Remove resin from component and solder joint with a cleaning pad.
- B. Identify component by reference designation and note its polarity and pin orientation before removing it from board.
NOTE: Time between removal of old component, cleaning and soldering of new component must be kept to a minimum to prevent the formation of metallic oxides on surfaces to be soldered.
- C. Two methods for component solder removal are provided. Select a method based on equipment availability.
 - (1) Solder Extraction with Continuous Vacuum.
 - (a) Select solder extraction tool and tip on the following criteria:
 - 1 Extraction Tool: Furnish adequate heat to melt solder.
 - 2 Tip I.D.: Minimum inside diameter that will fit over lead or pin while allowing sufficient clearance around the lead to permit solder and air to pass through it.
 - 3 Tip O.D.: Maximum outside diameter should not cover the pad completely nor touch the circuit board base material.
 - (b) Set tip temperature so as to melt solder in two to three seconds.
 - (c) Lightly place solder tip over lead and onto solder connection perpendicular to board or terminal.
 - (d) Once solder begins to melt, use the tip to move the lead until it swings freely, indicating full solder melt.
 - (e) Continuing to move the lead, start vacuum to remove solder and cool the solder joint. Apply vacuum for one to two seconds.
 - (f) Remove the tip then turn off vacuum.
 - (2) Solder Removal with Solder Wick.
 - (a) If component has exposed leads, cut leads and discard damaged components and leads.
 - (b) Place a soldering iron equipped with the appropriate tip where lead end passes through board.
 - (c) Heat the solder carefully.

- (d) Once solder has softened, extract lead end from board from the side opposite component.
- (e) Place solder wick over location of extracted component lead and heat solder wick with soldering iron.
- (f) Wick remaining solder from lead connection hole in board.
- (g) Repeat this procedure for both sides of lead connection hole.

D. Wire Lead Solder Removal.

- (1) Using a soldering iron equipped with the appropriate tip, carefully heat the lead to be removed until the solder melts.
- (2) Carefully remove the lead wire so as to alter the shape of the connecting bend as little as possible.
- (3) Place solder wick over location of extracted wire lead. Heat solder wick with soldering iron to remove remaining solder from wire lead.

Figure 201 : Sheet 1 : Soldering Turret Terminals

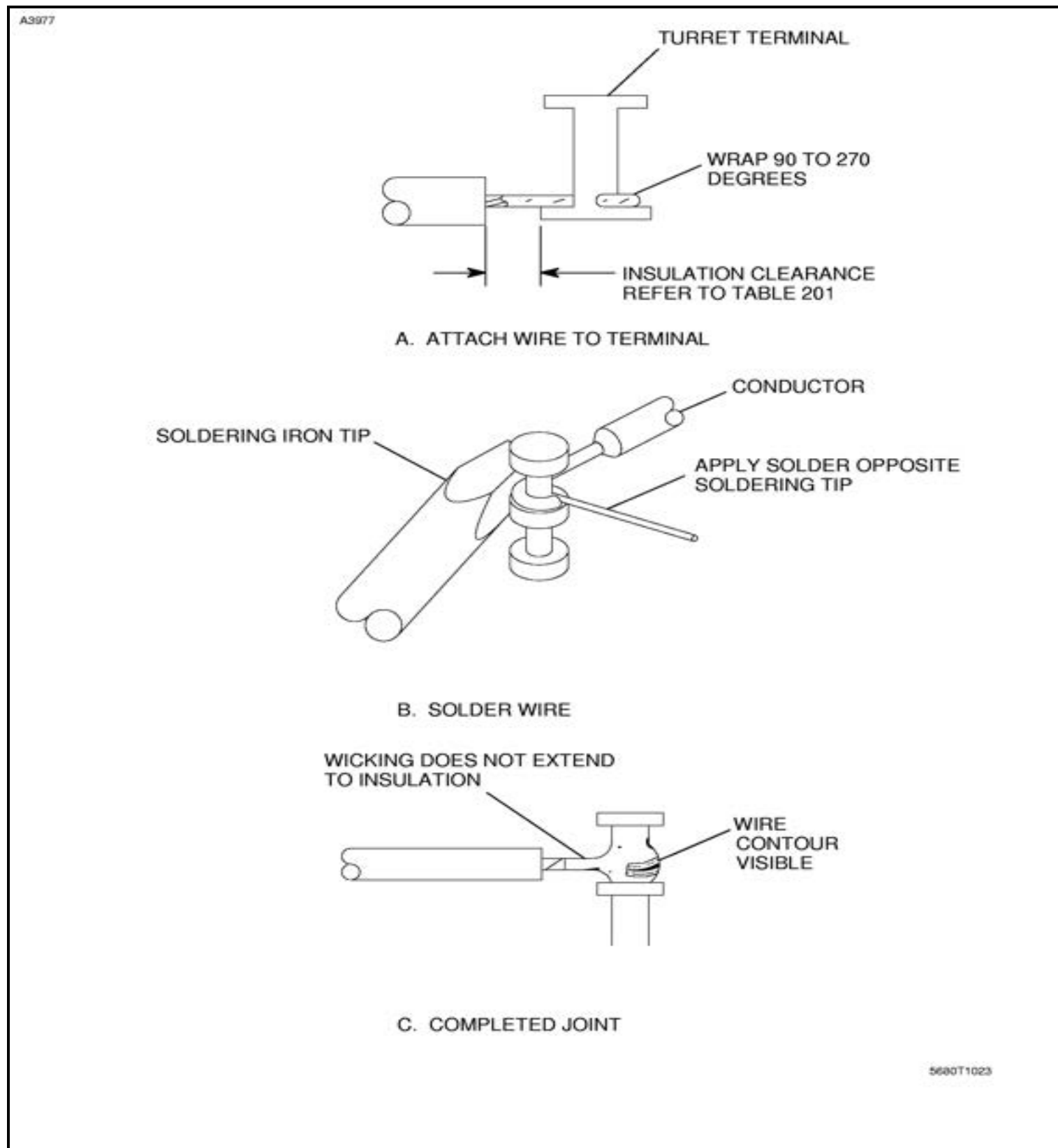


Figure 202 : Sheet 1 : Installing Components on Printed Circuit Boards

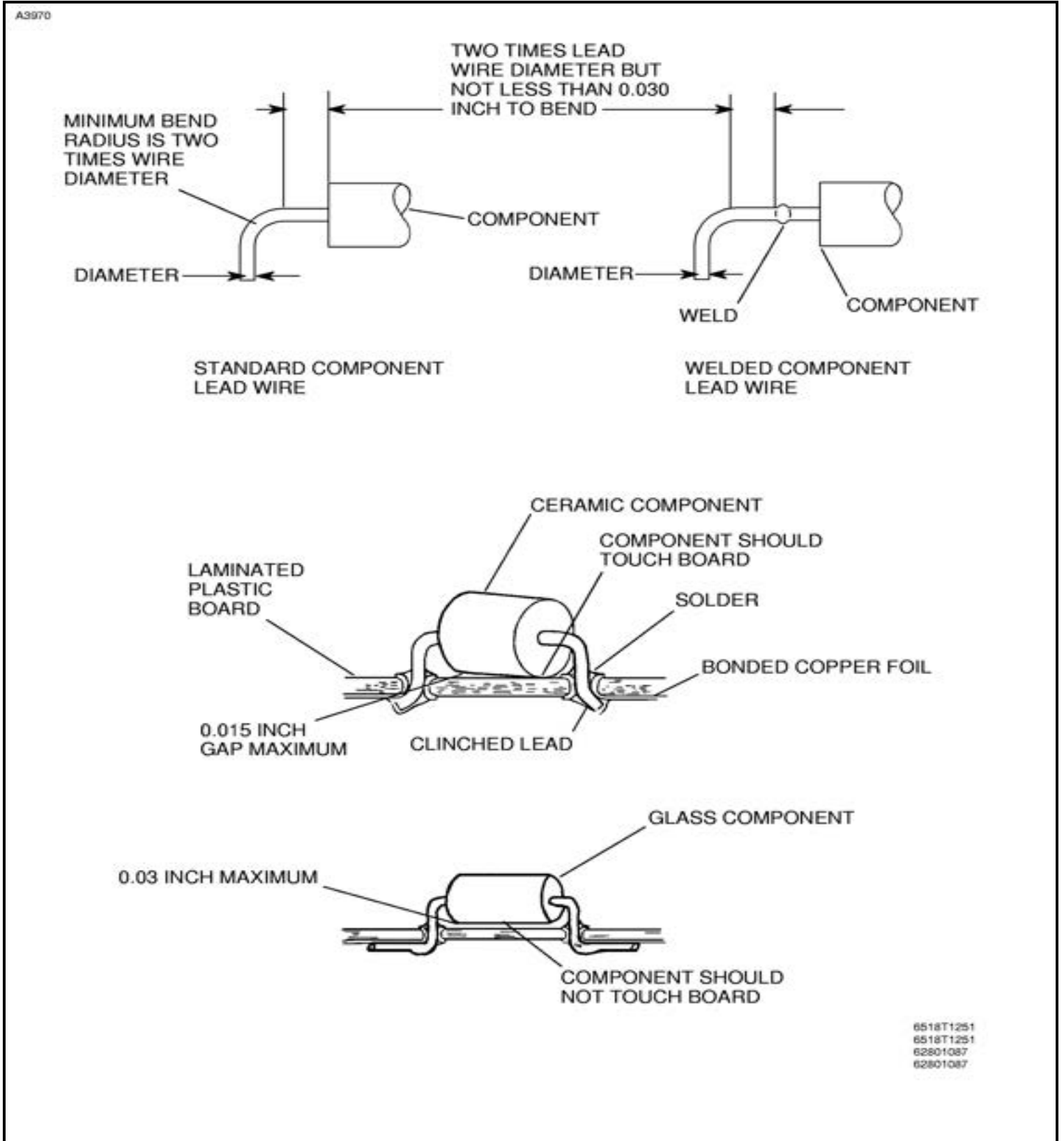
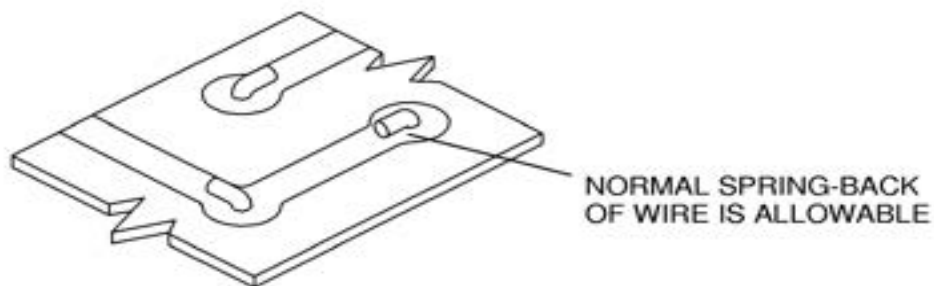
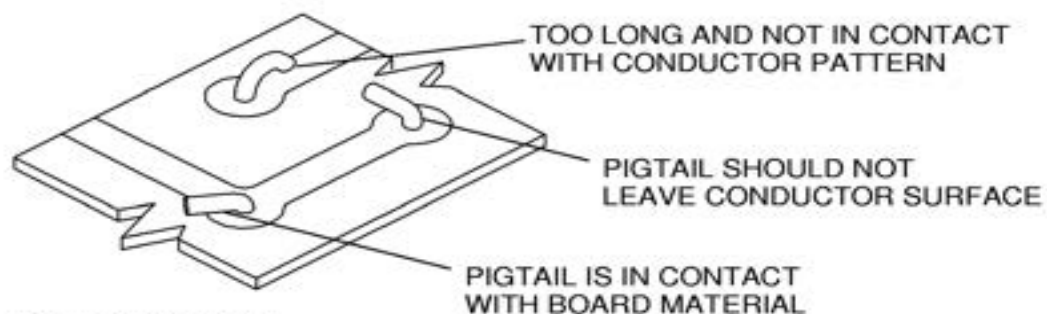


Figure 202 : Sheet 2 : Installing Components on Printed Circuit Boards

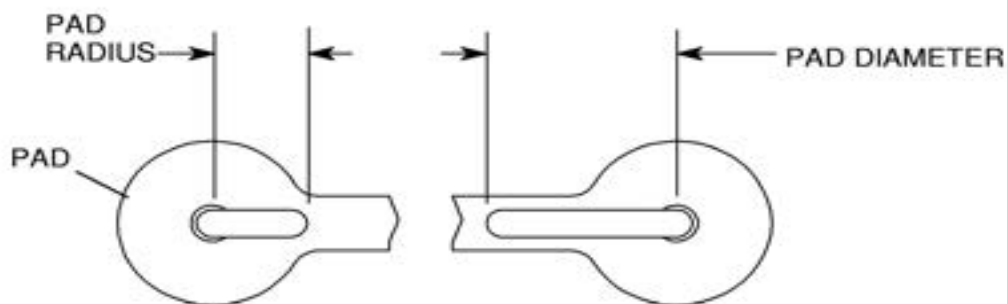
A3979



PREFERRED



NOT ACCEPTABLE



MINIMUM CLINCH LENGTH
EQUAL TO PAD RADIUS

MAXIMUM CLINCH LENGTH
EQUAL TO PAD DIAMETER



PREFERRED



ACCEPTABLE



NOT ACCEPTABLE

6518T1251
6518T1251
6518T1251
6518T1251

Figure 203 : Sheet 1 : Soldering Printed Circuit Boards

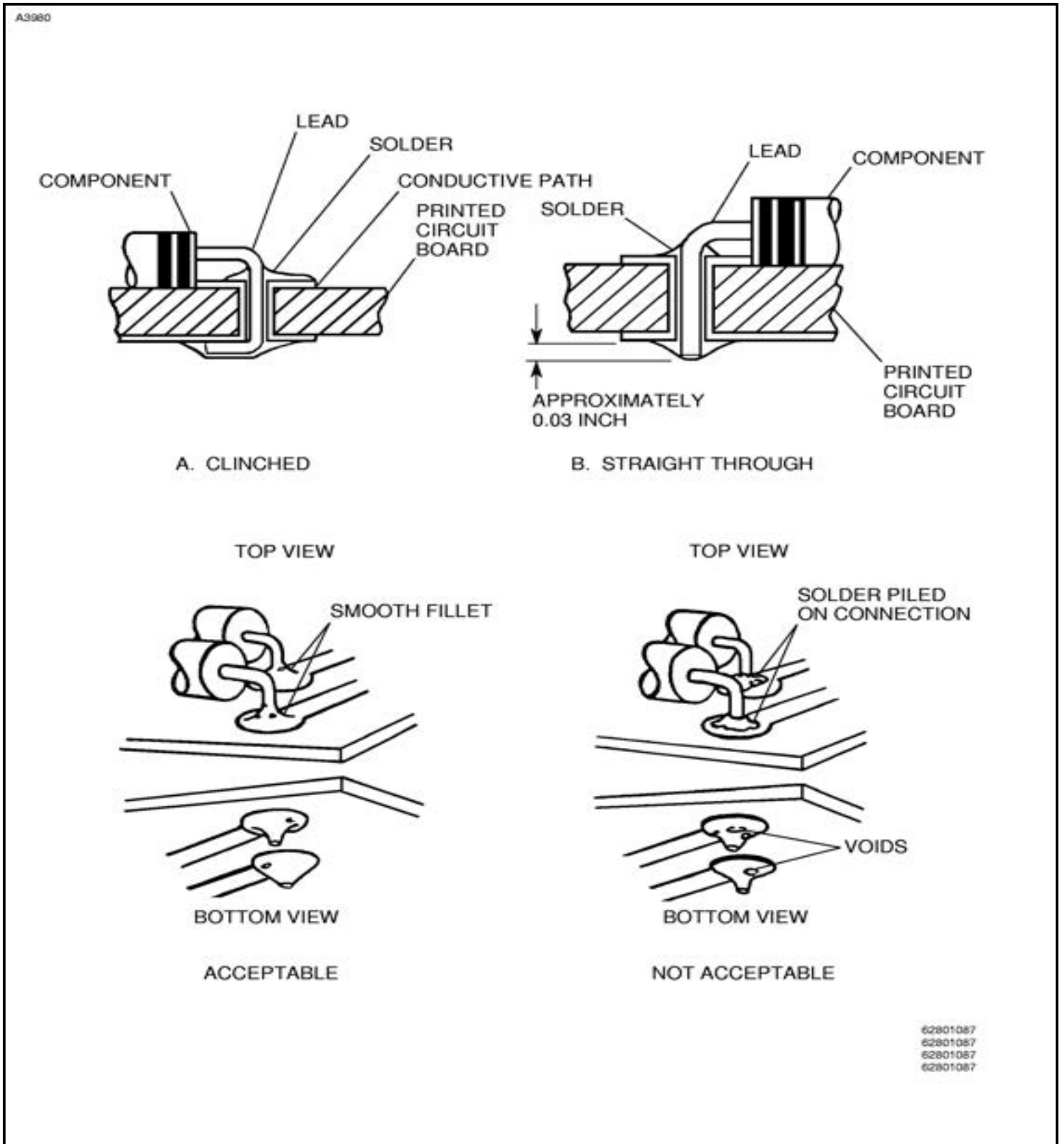


Figure 204 : Sheet 1 : Soldering Printed Circuit Boards With Plated-Thru-Holes

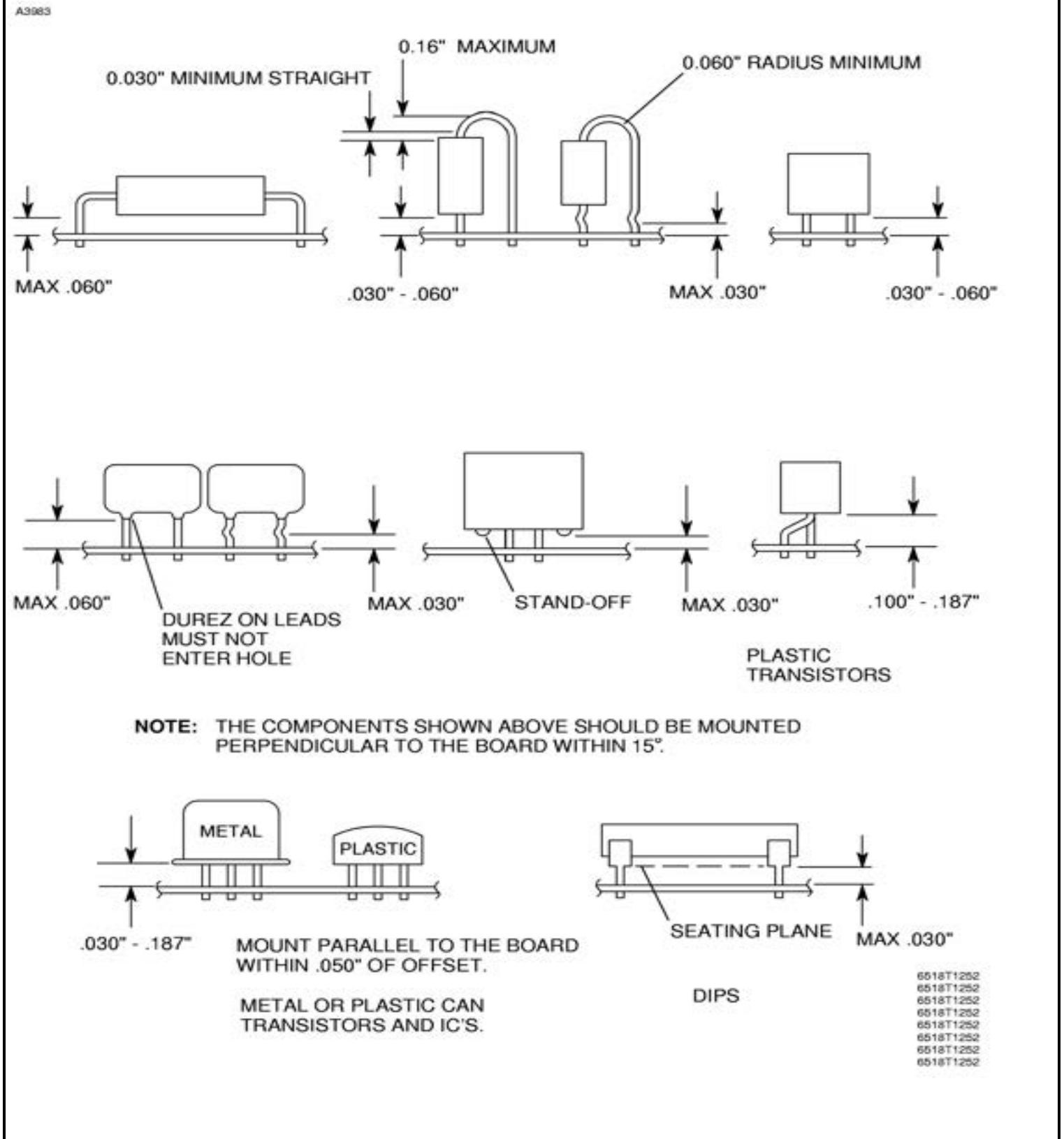
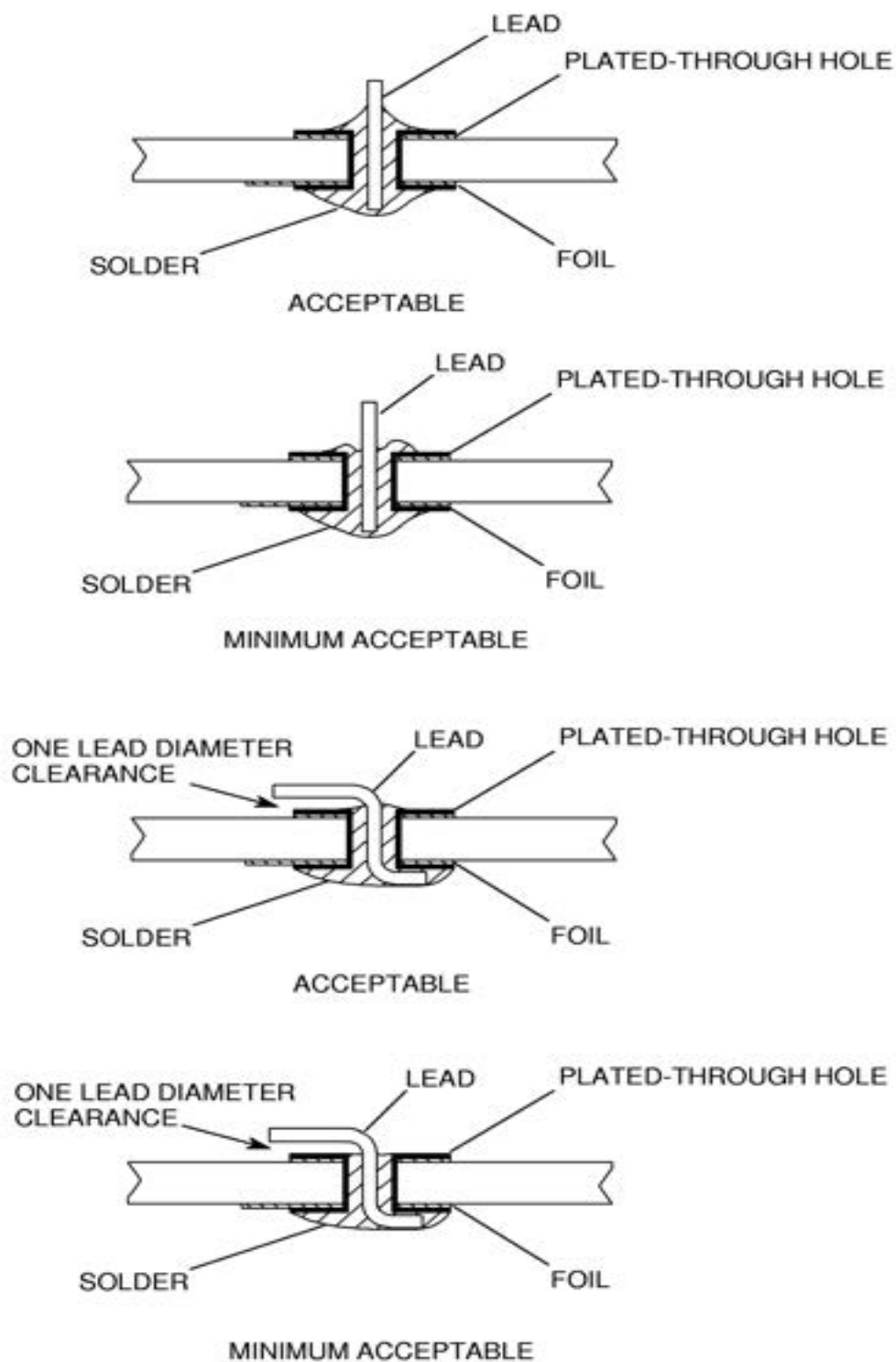


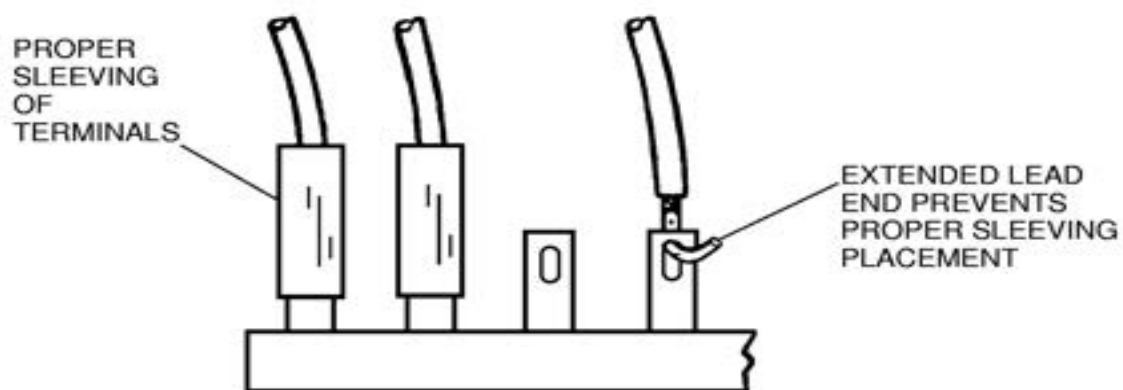
Figure 204 : Sheet 2 : Soldering Printed Circuit Boards With Plated-Thru-Holes

A3985



6518T1253
6518T1253
6518T1253
6518T1253

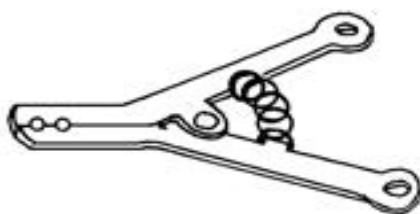
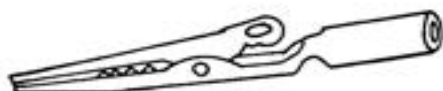
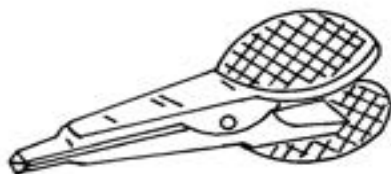
Figure 205 : Sheet 1 : Soldering and Sleeving of Insulated Terminals



62801088

Figure 206 : Sheet 1 : Typical Thermal Shunts

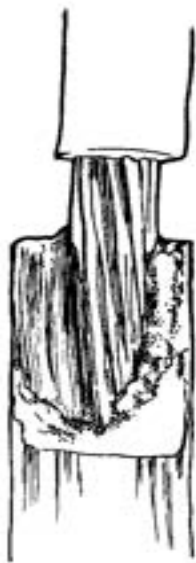
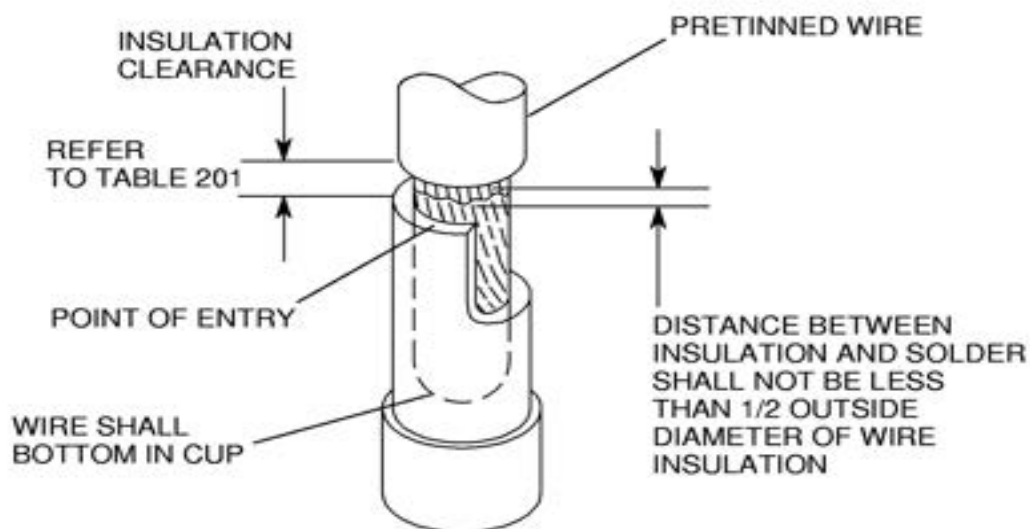
A3992



62801088
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62801088

Figure 207 : Sheet 1 : Soldering Solder Cup Terminals

A3995

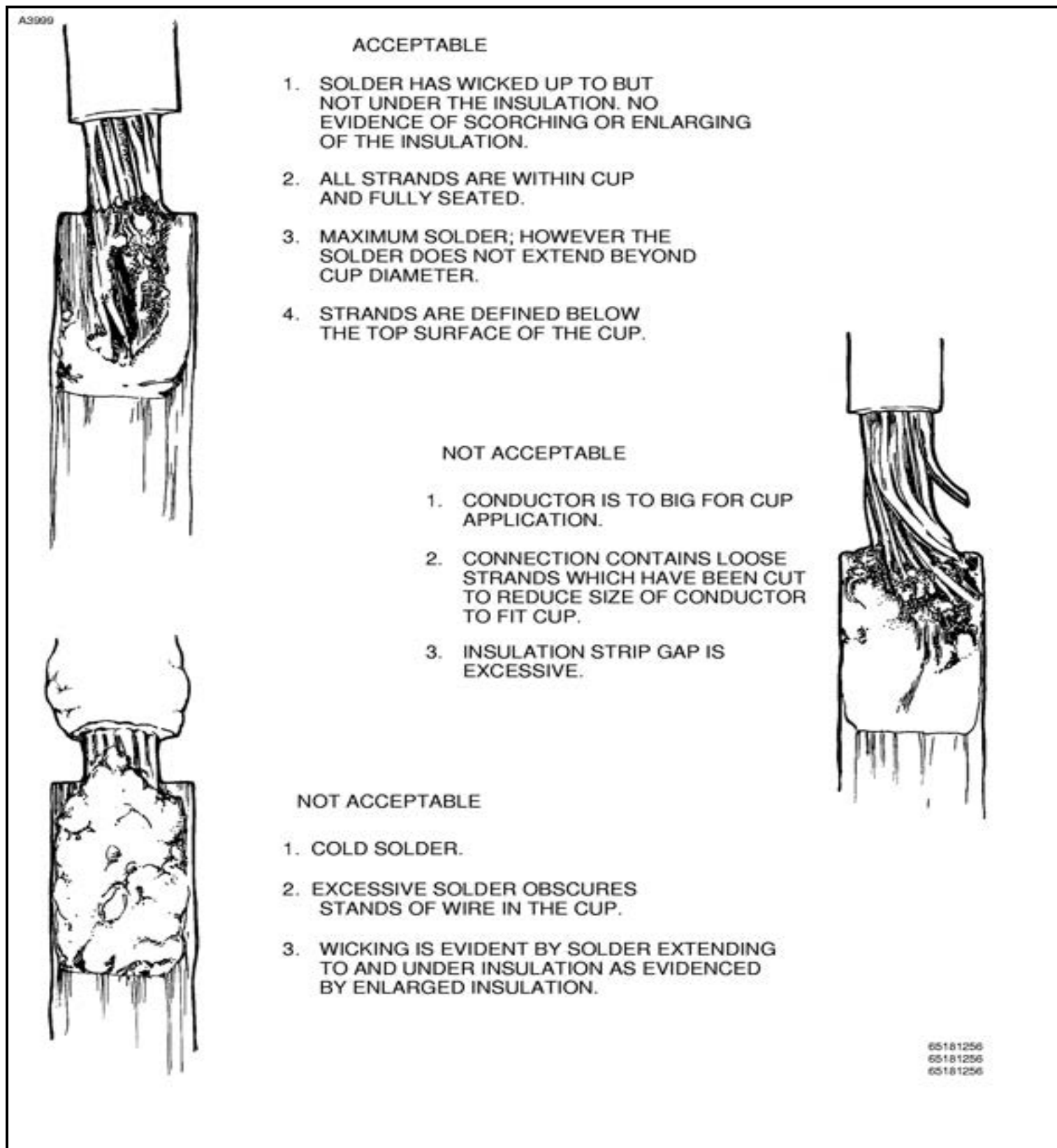


DESIRED

1. ONLY SUFFICIENT SOLDER HAS BEEN USED TO FILL THE CUP.
2. CONDUCTOR SHOWS NO SIGN OF WICKING. INDIVIDUAL STRANDS ARE VISIBLE.
3. CONDUCTOR IS CORRECT SIZE FOR CUP APPLICATION.

6518T1254
65181256

Figure 207 : Sheet 2 : Soldering Solder Cup Terminals



ELECTRICAL CONNECTORS - MAINTENANCE PRACTICES

1. General

- A. Electrical connectors are used to join airplane wire bundles, electronics wiring and antenna cables. This section provides information about contacts and insertion/extraction tools used with connectors. To locate a connector in this section refer to Table 201. For crimp tool and positioner information used with a contact, refer to Table 202.
- B. Electrical connectors may use solder-type or crimp-type contacts.
- C. Some typical tools used with crimp-type connectors are shown in [Figure 201](#). Refer to [Figure 205](#) for typical crimping instructions.

Table 201. Connector Information

03-06-XX		V27264	Refer to Figure 206	
			03-06 and 06-06 Series Molex Connectors	
AWG	Pin	Socket	Insertion Tool	Extraction Tool
18-24 (Gold Plate)	02-06-6103	02-06-5103	11-01-0001	11-03-0009
18-24 (Tin)	02-06-2103	02-06-1103	11-02-0001	11-03-0009
200838-2		V00779	Refer to Figure 208	
			AMP M Series Connector Kit	
AWG	Pin	Socket	Insertion Tool	Extraction Tool
20-24		S2099-4	91002-1	305183
LMD4001X		V49367	Refer to Figure 209	
			LMD4000 Series Connectors	
AWG	Pin	Socket	Insertion Tool	Extraction Tool
22	LMD-4022-36LJ	LMD-4122-96LD	MIL-I-81969/14-02	MIL-I-81969/14-02
M24308/2-X, M24308/4-X			Refer to Figure 210	
			M24308 Series Connectors	
AWG	Pin	Socket	Insertion Tool	Extraction Tool
18-20	330-5291-001	031-1007-001	None Required	CET-20-15
20-24	030-5291-000	031-1007-000	None Required	CET20-11 EXT-20HD
MS27467, MS2747X, MS27484, MS27497			Refer to Figure 211	
			Mil-C-38999 Series 1 and Series 2 Connectors	
AWG	Pin	Socket	Insertion Tool	Extraction Tool
20	M39029/58-363	M39029/57-357	MS27534-20	MS27534-20
22	M39029/58-360	M39029/57-354	MS27534-22D	MS27534-22D
S1637-1, S1637-2			Refer to Figure 207	
			AMP Commercial Mate-N-Lock Series Connectors	
AWG	Pin	Socket	Insertion Tool	Extraction Tool
14-20	60620-1	60619-1	465644-1	465644-1
18-24	60618-1	60617-1	465644-1	465644-1
22-24	61174-1	61173-1	465644-1	465644-1
S1638-1				
AWG	Pin	Socket	Insertion Tool	Extraction Tool
18-24 (Bronze)		S1636-1	455830-1	465644-1
S1638-2, S1638-4, S1638-6			Refer to Figure 207	
			AMP Commercial Mate-N-Lock Series Connectors	
AWG	Pin	Socket	Insertion Tool	Extraction Tool

14-20 (Gold)	60620-5	60619-5	465644-1	465644-1
18-24 (Brass)	60618-1	60617-1	455830-1	465644-1
18-24 (Bronze)	60618-4	60617-4	455830-1	465644-1
S1640-12, S1641-12			Refer to Figure 207	
AWG	Pin	Socket	AMP Commercial Mate-N-Lock Series Connectors Insertion Tool	Extraction Tool
14-20 (Gold)	60620-5	60619-5	465644-1	465644-1
18-24 (Brass)	60618-1	60617-1	455830-1	465644-1
18-24 (Bronze)	60618-4	60617-4	455830-1	465644-1
S1640-6				
AWG	Pin	Socket	Insertion Tool	Extraction Tool
18-24 (Bronze)	S1635-1		455830-1	465644-1
S1641-6				
AWG	Pin	Socket	Insertion Tool	Extraction Tool
18-24		S1636-1	455830-1	465644-1
S2035-1			Refer to Figure 207	
AWG	Pin	Socket	AMP Commercial Mate-N-Lock Series Connectors Insertion Tool	Extraction Tool
18-24	S1635-1		455830-1	1-305183-2
S2035-2			Refer to Figure 207	
AWG	Pin	Socket	AMP Commercial Mate-N-Lock Series Connectors Insertion Tool	Extraction Tool
14-20 (Gold)	60620-5	60619-5	465644-1	465644-1
18-24 (Brass)	60618-1	60617-1	455830-1	465644-1
18-24 (Bronze)	60618-4	60617-4	455830-1	465644-1
S2527-1			Refer to Figure 208	
AWG	Pin	Socket	AMP M Series Connector Kit Insertion Tool	Extraction Tool
20-24		S2099-4	91002-1	305183
S3070-9, S3070-10			Refer to Figure 209	
AWG	Pin	Socket	LMD4000 Series Connectors Insertion Tool	Extraction Tool
22	S3070-5	S3070-6	MIL-I-81969/14-02	MIL-I-81969/14-02

Table 202. Crimp Tools
Contact

	Crimp Tool	Positioner
02-06-1103	11-01-0008	
02-06-2103	11-01-0008	
02-06-5103	11-01-0008	
02-06-6103	11-01-0008	
030-5291-000	M22520/2-01	M22520/2-08
030-5291-000	MS3191-A	P20-3191-1
031-1007-000	M22520/2-01	M22520/2-08

Contact	Crimp Tool	Positioner
031-1007-000	MS3191-A	P20-3191-1
031-1007-001	M22520/1-01	TH25
031-1007-001	MS3191-1	P20-3191-17
330-5291-001	M22520/1-01	TH25
330-5291-001	MS3191-1	P20-3191-17
60617-1	90123-2	
60617-4	90123-2	
60618-1	90123-2	
60618-4	90123-2	
60619-1	90124-2	
60619-5	90124-2	
60620-1	90124-2	
60620-5	90124-2	
61173-1	90066-5	
61174-1	90066-5	
LMD-4022-36LJ	M22520/2-01	
LMD-4122-96LD	M22520/2-01	M22520/2-07
M39029/57-354	M22520/2-01	M22520/2-06
M39029/57-357	M22520/1-01	M22520/1-04
M39029/58-360	M22520/2-01	M22520/2-08
M39029/58-360	MS3191-A	P20-3191-1
M39029/58-363	M22520/1-01	M22520/1-04
S1635-1	90123-2	
S1636-1	90123-2	
S2099-4	90066	
S3070-5	M22520/2-01	
S3070-6	M22520/2-01	M22520/2-07

D. All environmentally sealed type connectors will have all empty cavities filled with unwired contacts (pins and sockets) and sealing plugs.

2. Assembling MS3106 Series Connectors

A. Inserting Contacts. Refer to [Figure 202](#).

- (1) Disassemble connector.
- (2) Slide clamping ring and compression sleeve on to wire bundle.
- (3) Feed wires through sealing grommet and rear insert.
- (4) Lock retaining ring into proper position by slipping silicone bushing toward receptacle or pin end of contact.
NOTE: Locking the retaining ring may be accomplished after crimping has been completed.
- (5) Strip insulation from wire ends.
- (6) Crimp contacts on to wires.
- (7) Install contacts in front insert.
- (8) After all contacts are properly positioned in front insert, slide rear insert over rear end of contacts until rear insert butts against forward insert.
- (9) Align keyway and install assembled inserts into connector shell.
- (10) Slide sealing grommet forward until grommet butts against rear insert.
- (11) Slide compression sleeve and clamping nut forward until clamping nut engages threads on connector shell. Make certain packing in clamping nut is seated properly.

- (12) Tighten clamping nut finger tight plus quarter turn.

NOTE: A strap wrench or a padded wrench may be used to tighten the clamping nut the additional quarter turn.

3. Assembling DBA-Type Connectors

NOTE: This is typical for all connectors with the contacts installed and removed from the rear.

A. Installing Contacts. Refer to [Figure 203](#) and [Figure 204](#).

- (1) Strip insulation from wire ends. For number 12 to number 20 contacts, strip 1/4 to 5/16 inch. For number 20 contacts, strip 5/32 to 7/32 inch.
- (2) Insert wire into contact until wire strands are visible in inspection hole.
- (3) Crimp contact with proper crimping tool.

B. Removing Contacts.

NOTE: For all crimp-type connectors, all unused wire cavities must be filled with plastic wire hole fillers designed for the type of connector being used.

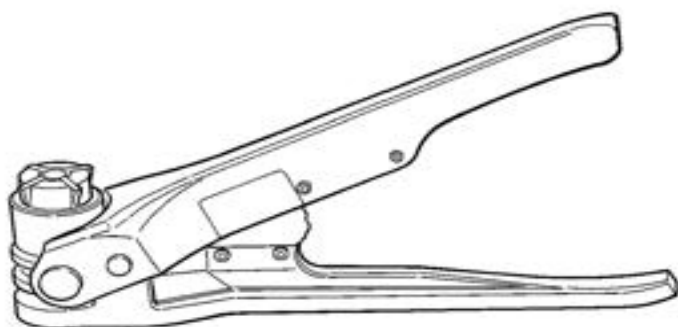
- (1) With the rear insert toward you, snap the white end of appropriate size insertion/removal tool over the wire of the contact to be removed.
- (2) Slowly slide the tool along the wire into the insert cavity until it engages the contact shoulder and a positive resistance is felt. At this time, the contact retaining clip is in the unlock position.
- (3) Press the wire against the serrations of the tool and pull both tool and contact-wire assembly from the connector.

C. Inserting Contacts.

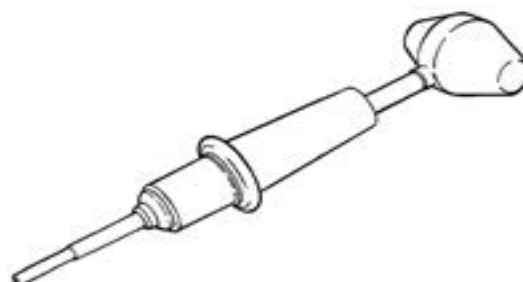
- (1) Snap the wire into the appropriate insertion/removal tool.
- (2) Pull the wire back through the tool until the tip of the tool seats against the back of the wire contact.
- (3) Holding the connector with the backshell removed, slowly push the contact straight into the connector insert.
- (4) A firm stop will be evident when the contact positively seats, then let go of the wire and pull out the tool.

Figure 201 : Sheet 1 : Typical Tools for Crimp-Type Connectors

A4004



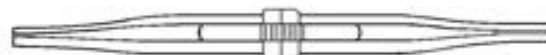
DEUTSCH
M15500-x-7
CONTACT CRIMPING TOOL



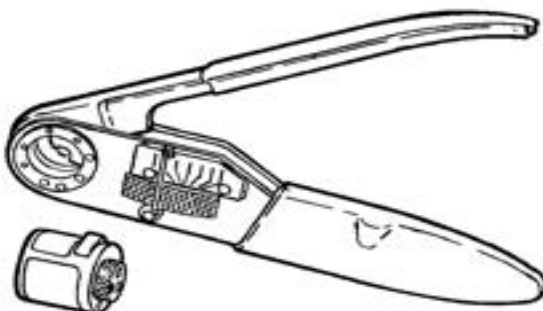
DEUTSCH
M15515-20
EXTRACTION TOOL



DEUTSCH
M15513-20
INSERTION TOOL



DEUTSCH
M15570-20
INSERTION / REMOVAL TOOL



MS3191-3
MS3191-4
WITH MS3191-3T

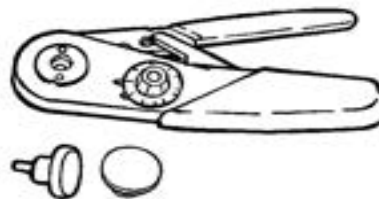
55981015
55801010
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55981014
55802009

Figure 201 : Sheet 2 : Typical Tools for Crimp-Type Connectors

A3978



MS3191-1



MS3198-1



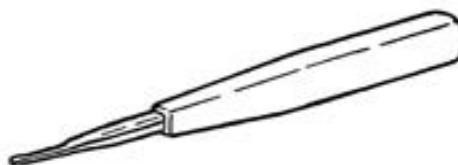
MS27495A20
INSERTION TOOL



MS27495R20
EXTRACTION TOOL



CANNON
CIT-20-18



MS24256A20



CANNON
CET-20-4



MS24256R20

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Figure 201 : Sheet 3 : Typical Tools for Crimp-Type Connectors

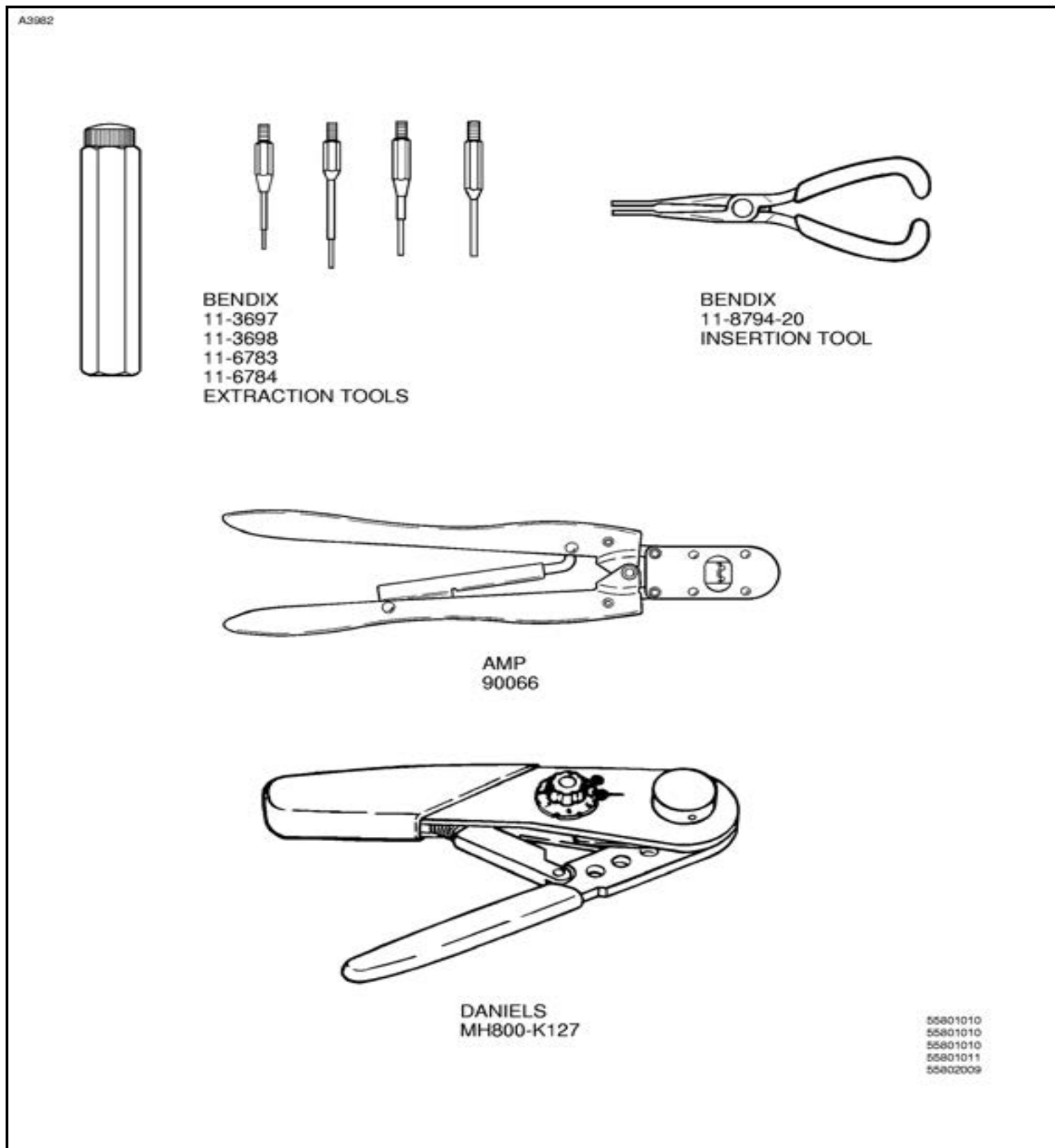


Figure 202 : Sheet 1 : Solder-Type Connectors

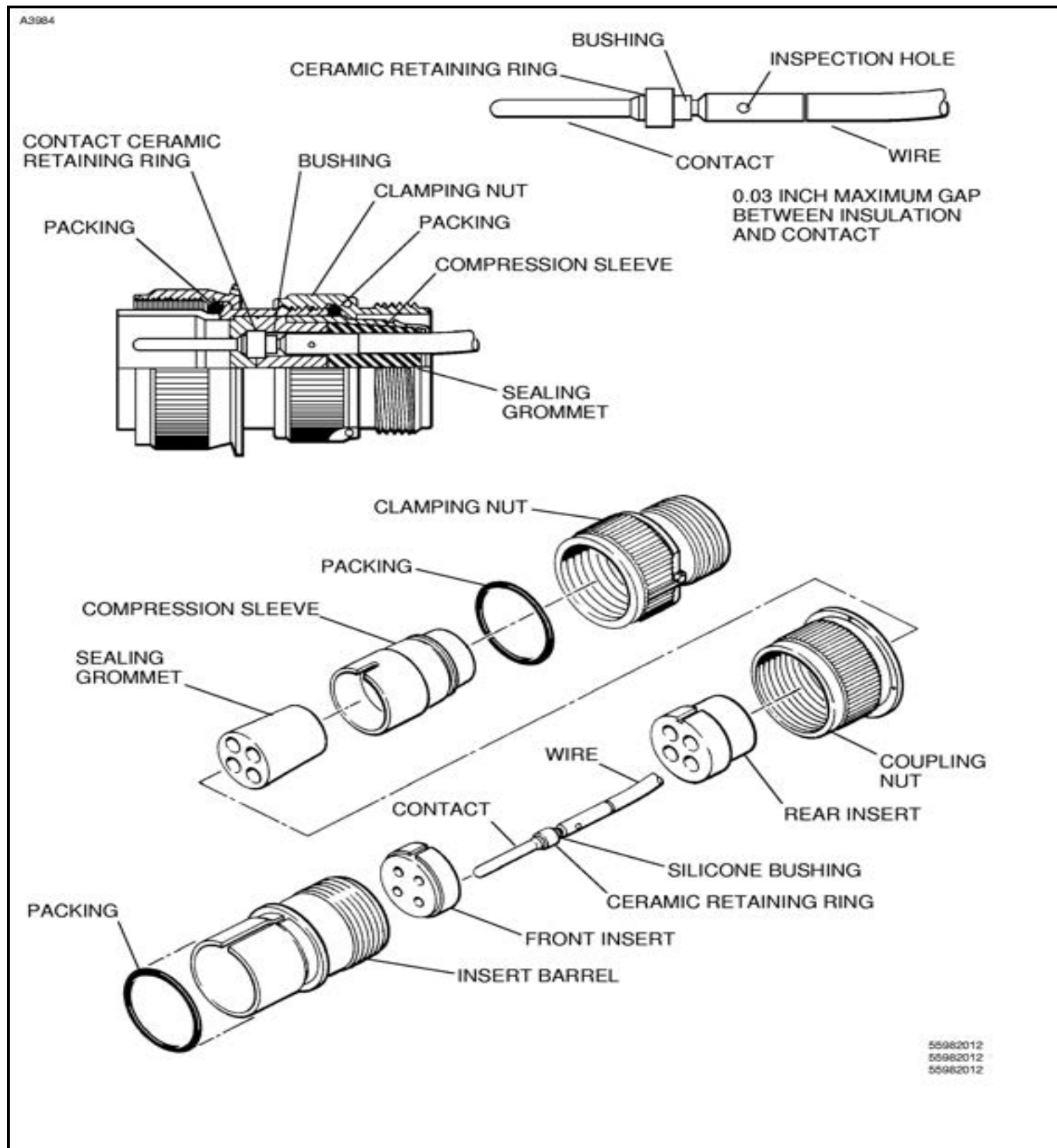
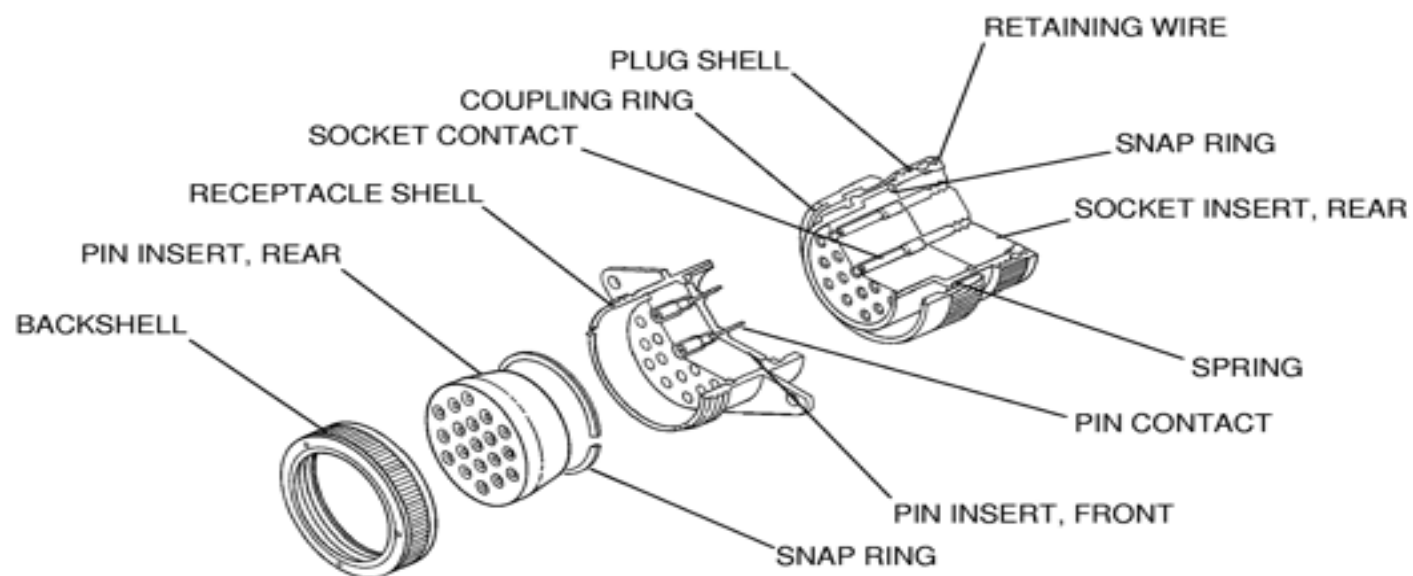


Figure 203 : Sheet 1 : Crimp-Type Connector Assembly

A3988

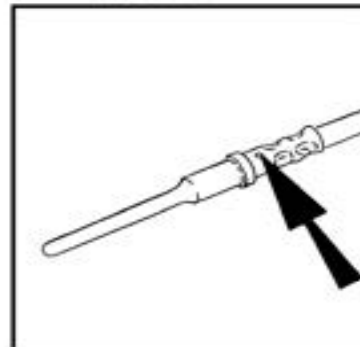
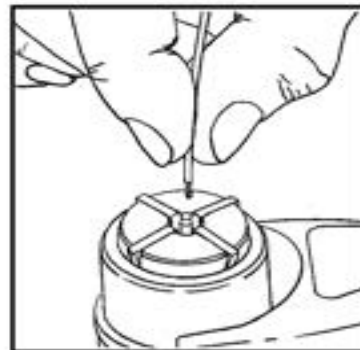


55981016

Figure 204 : Sheet 1 : Typical Removal and Installation of Rear-Release Contacts

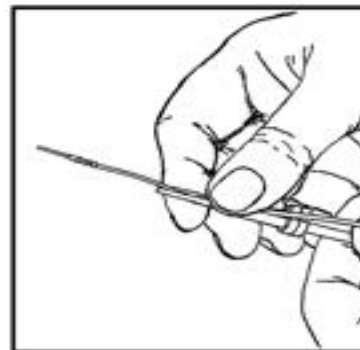
A3990

1. Drop either the pin or socket contact to be crimped into the crimping tool with the contact crimp barrel facing up. This tool features a universal crimp stop which is interchangeable with pins and sockets.
2. Insert the bare wire into the open end of the contact and squeeze the crimp tool. (The crimp tool will only release the contact when the full-crimping cycle has been performed.) Remove the crimped contact from the tool.
3. Visibility of the wire in the contact inspection hole (arrow) indicates that the wire is crimped into the contact at the proper depth and dimension.



TO INSERT

1. Hold the colored half of the appropriate insertion/removal tool between the thumb and forefinger and lay the wire to be inserted along the slot leaving about 0.50 inch of wire protruding. Then snap the wire into the tool. (Size 8 contacts do not require a tool.)



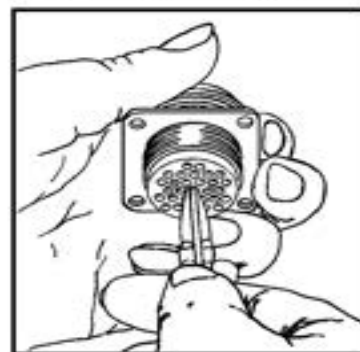
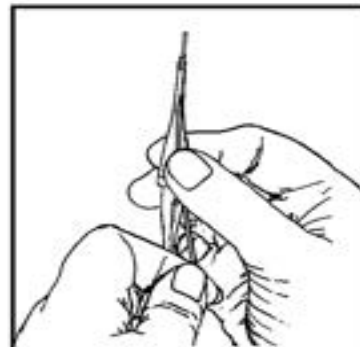
55802010

Figure 204 : Sheet 2 : Typical Removal and Installation of Rear-Release Contacts

A3996

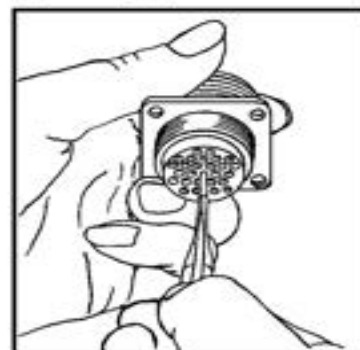
TO INSERT (Continued)

2. Pull the wire back through the tool until the tip of the tool seats against the shoulder.
3. Holding the connector with the backshell removed and the rear insert facing you, slowly push the contact straight into the connector insert.
4. A firm stop will be evident when the contact positively seats in the connector insert. Then let go of the wire and pull out the tool.



TO REMOVE

1. With the rear insert toward you, snap the white end of the appropriate size double-ended plastic tool over the wire of the contact to be removed.



55802010

Figure 204 : Sheet 3 : Typical Removal and Installation of Rear-Release Contacts

A4000

TO REMOVE (Continued)

2. Slowly slide the tool along the wire into the insert cavity until it engages the contact rear and a positive resistance is felt. At this time, the contact retaining clip is in the unlock position.

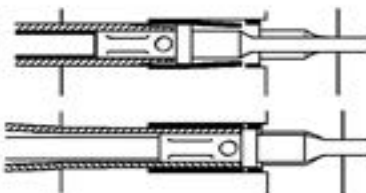


3. Press the wire of the contact to be removed against the serrations of the plastic tool and pull both the tool and the contact wire assembly out of the connector.

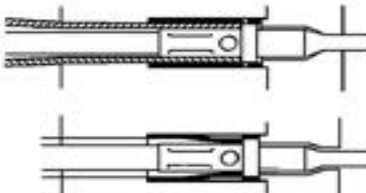


CONTACT INSERTION

Contact partially inserted with insertion end of tool.



Contact fully inserted as tool expands tines.



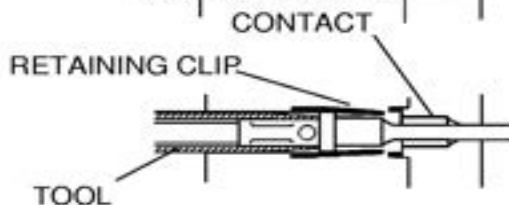
Tines snap behind contact shoulder when tool is removed.

CONTACT EXTRACTION

Tines expanded beyond contact shoulder with extraction end of tool, ready for release.



Contact partially removed.



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55801012
55801012

Figure 205 : Sheet 1 : Typical Removal and Installation of Front-Release Contacts

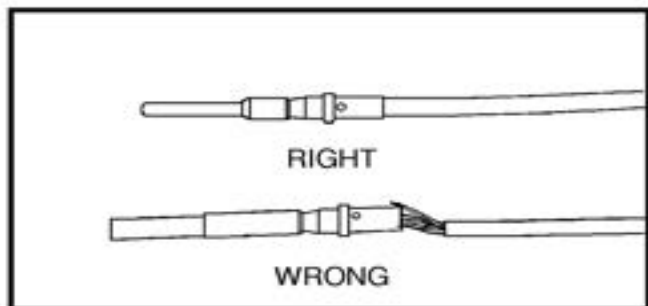
A4010

CRIMPING CONTACTS

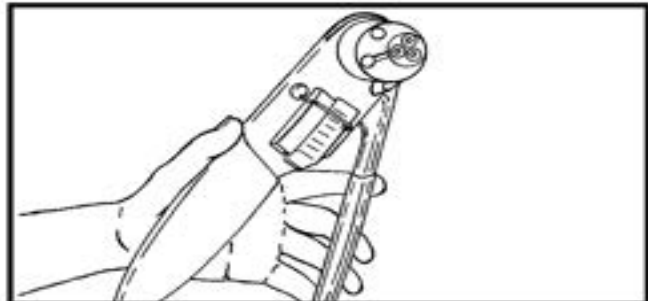
1. Strip wires according to the table, taking care not to cut or nick strands.

Contact Size	Wire Size AWG	Strip Insulation
20	Number 20 - 24	0.18
16	Number 16 - 20	0.25

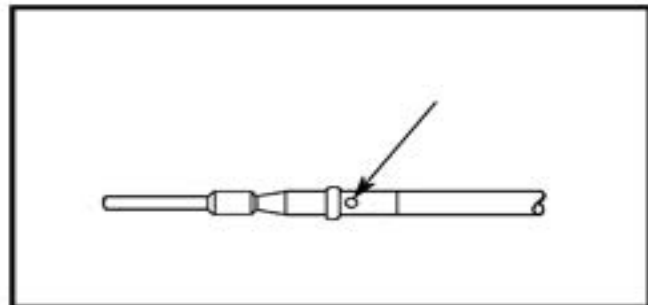
2. Insert stripped wire into contact crimp pot. Wire must be visible through inspection hole



3. Using correct crimp tool and locator, cycle the tool once to be sure the indentors are open. Insert contact and wire into locator. Squeeze tool handles firmly and completely to ensure a proper crimp. The tool will not release unless the crimp indentors in the tool head have been fully actuated.



4. Release crimped contact and wire from tool. Be certain the wire is visible through inspection hole in contact.



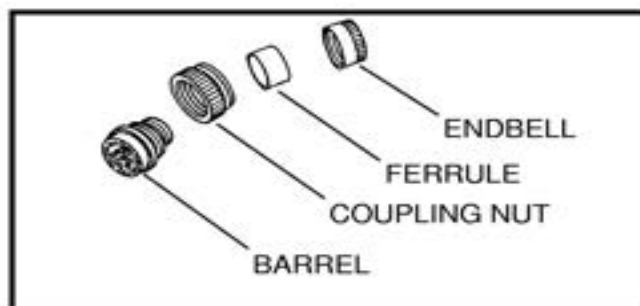
55801008
55801009

Figure 205 : Sheet 2 : Typical Removal and Installation of Front-Release Contacts

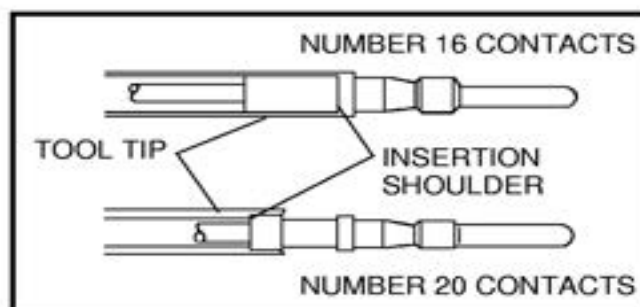
A4016

CONTACT INSERTION

5. Remove hardware from plug and receptacle. Slide hardware over wire bundle in proper order for reassembly.



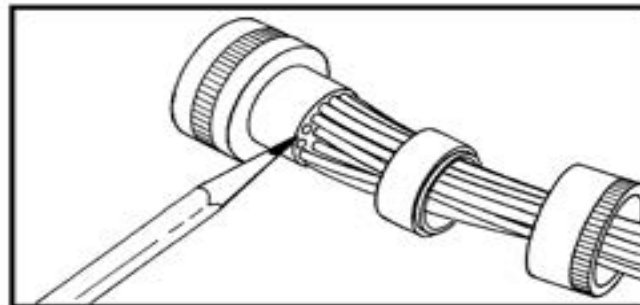
6. Use the proper contact insertion tool, and slide the tool over the terminal end of the contact. The size 16 contact lies in the tool and the tool tip butts against the contact shoulder. The rear, or insulation support of the size 20 contact butts against an internal shoulder in the tool tip.



7. Beginning from center cavity and working outward, insert wired contacts into rear of connector by hand until the front of the contact shoulder is no more than 0.12 inch from the grommet. Holding the connector securely, position tool behind contact. Push tool straight into contact cavity until contact snaps into position. A light pull on the wire will assure that contact is locked securely. Repeat for remaining contacts.



8. Use wire hole fillers or grommet sealing plugs to fill any empty cavities and assemble hardware to rear of plug or receptacle.



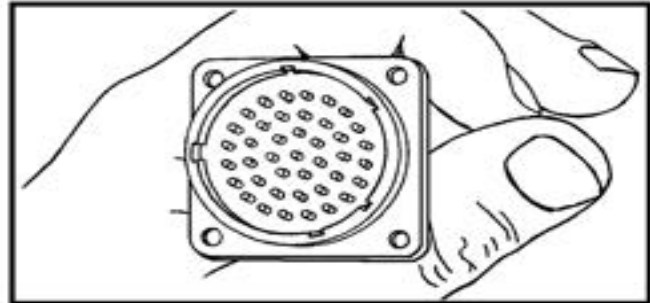
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55801008

Figure 205 : Sheet 3 : Typical Removal and Installation of Front-Release Contacts

A4021

COMPLETION

9. Check face of plug or receptacle for proper contact installation.



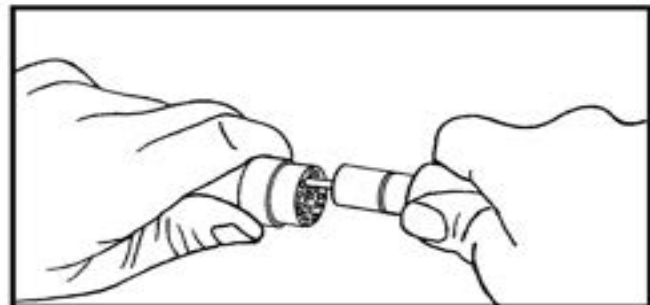
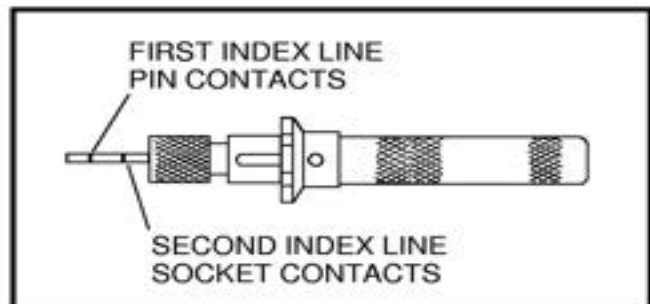
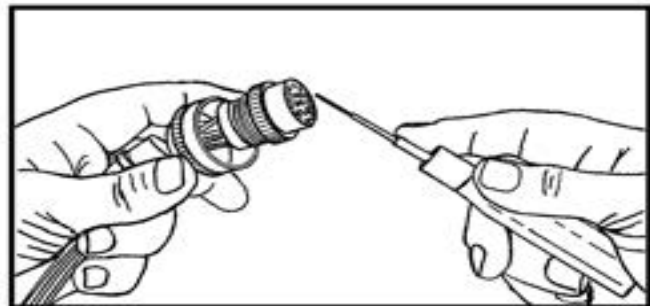
CONTACT EXTRACTION

10. Slide hardware back over wire bundle. Using proper extraction tool or extraction end of proper insertion/extraction tool, proceed as follows:

KPTM: Make sure reversible tool tip is set for pin or socket contacts. Place tool tip over contact from front of insulator and, with slow and even pressure, push contact out of back of insulator.

MS3126F-xx-xxx: Use the proper extraction tool. There are two lines on the clip sleeve which are vital to the contact removal process. The first index line is used for removing pin contacts while the second index line is for removing socket contacts.

Carefully place the tool over the contact to be extracted until the tool tip touches the insulator face. Carefully rotate the tool until the index line is slightly below the insulator face. Keep an even pressure against tool body; push plunger forward with thumb and index finger, and push the contact out through the clip. Carefully remove extraction tool from connector. Pull the wire by hand to complete the removal of the contact.



55801008
55801009
55801008

Figure 206 : Sheet 1 : 03-06 and 06-06 Series Molex Connectors

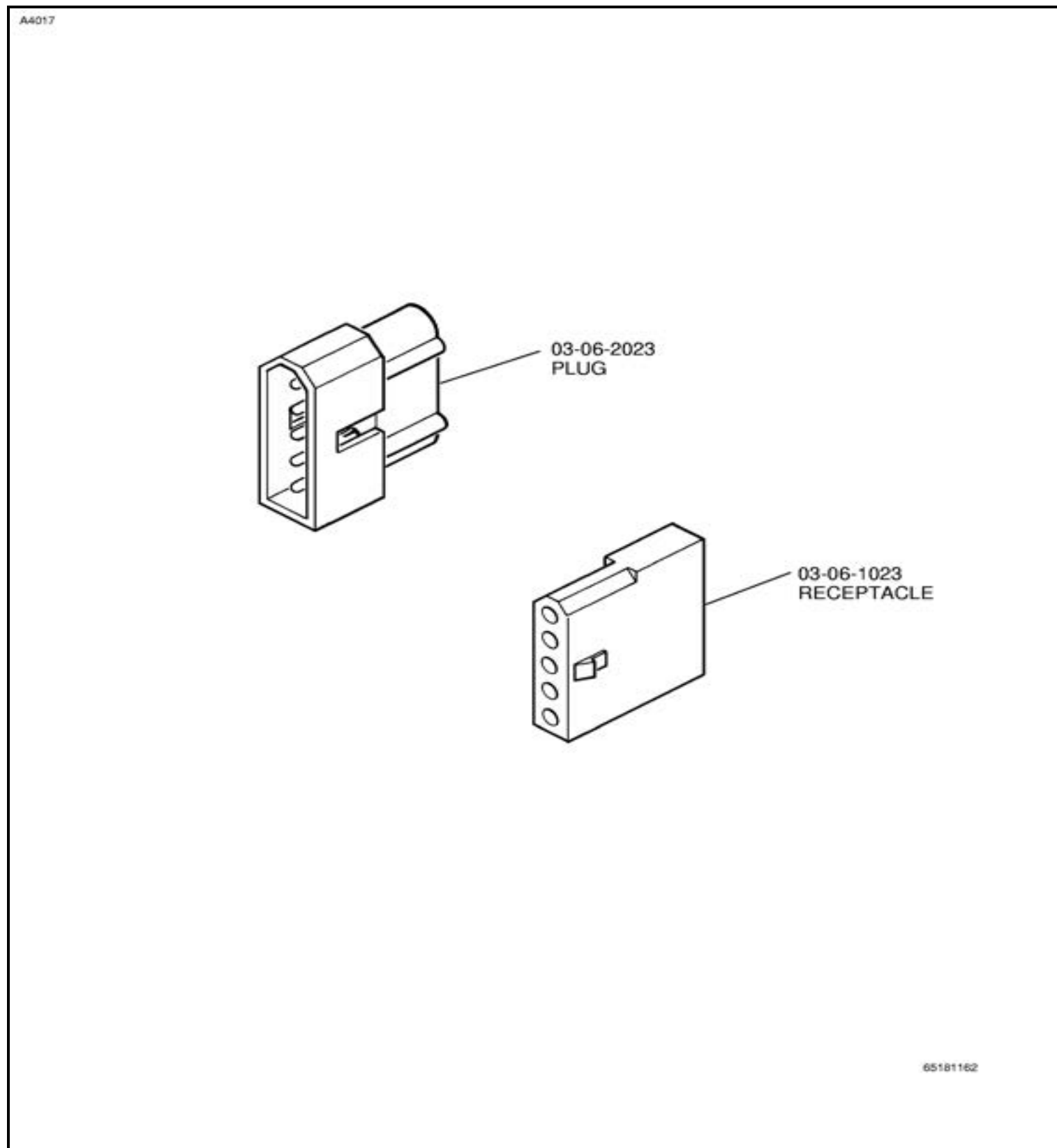


Figure 207 : Sheet 1 : AMP Commercial Mate-N-Lock Series Connectors

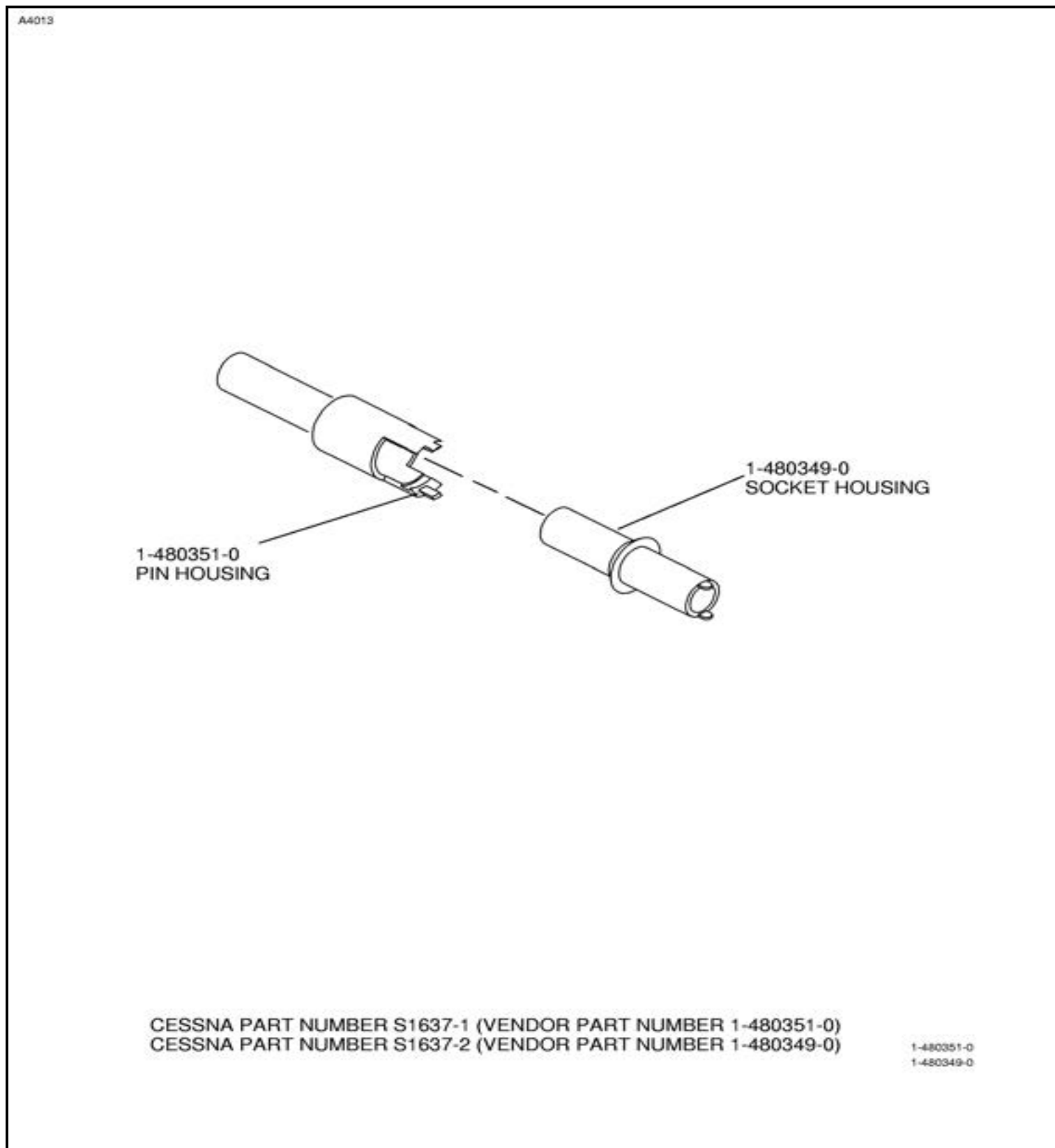
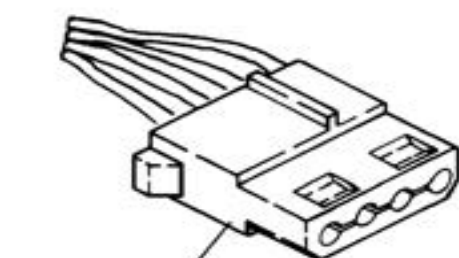
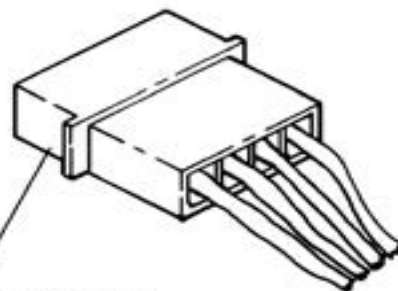


Figure 207 : Sheet 2 : AMP Commercial Mate-N-Lock Series Connectors

A3986



1-480303-0
(3 CONTACT, SIMILAR)
1-480424-0
(4 CONTACT, SHOWN)
1-480275-0
(12 CONTACT, SIMILAR)
SOCKET HOUSING
(PLUG)



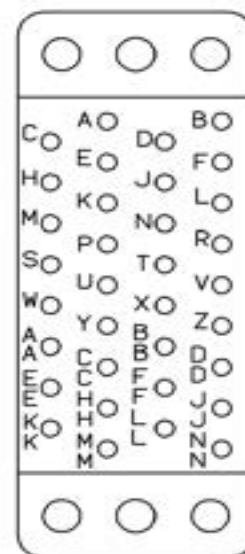
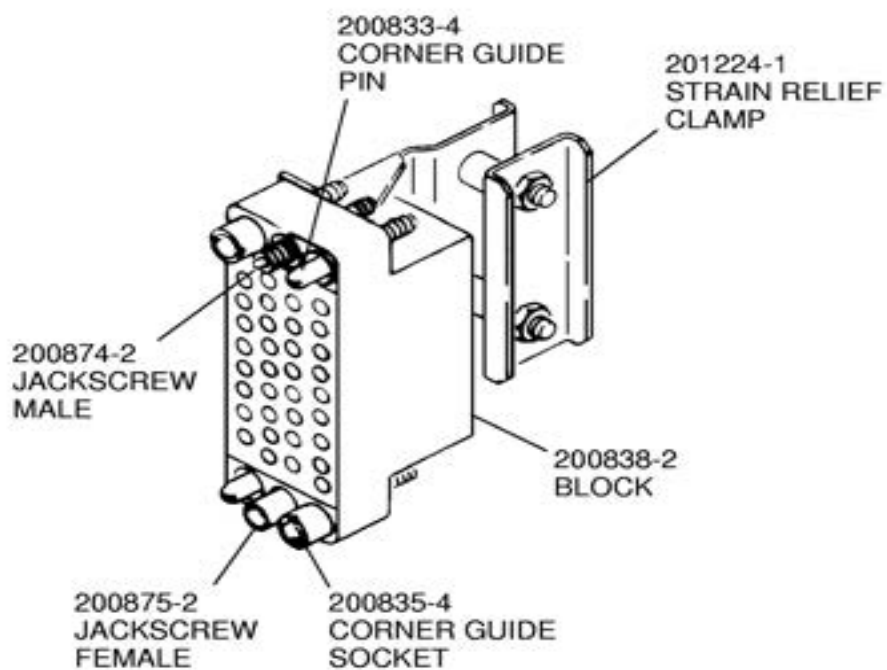
1-480305-0
(3 CONTACT, SIMILAR)
1-480426-0
(4 CONTACT, SHOWN)
1-480278-0
(12 CONTACT, SIMILAR)
PIN HOUSING
(CAP)

CESSNA PART NUMBER S1638-1 (Vendor Part Number 1-480303-0)
CESSNA PART NUMBER S1638-2 (Vendor Part Number 1-480305-0)
CESSNA PART NUMBER S1638-4 (Vendor Part Number 1-480426-0)
CESSNA PART NUMBER S1638-6 (Vendor Part Number 1-480424-0)
CESSNA PART NUMBER S1640-12 (Vendor Part Number 1-480278-0)
CESSNA PART NUMBER S1641-12 (Vendor Part Number 1-480275-0)

60181026

Figure 208 : Sheet 1 : AMP M Series Connector Kit

A4012



FACE VIEW
PIN INSERT

3-203736-9
0018T6003-3 (2)

Figure 209 : Sheet 1 : LMD4000 Series Connectors

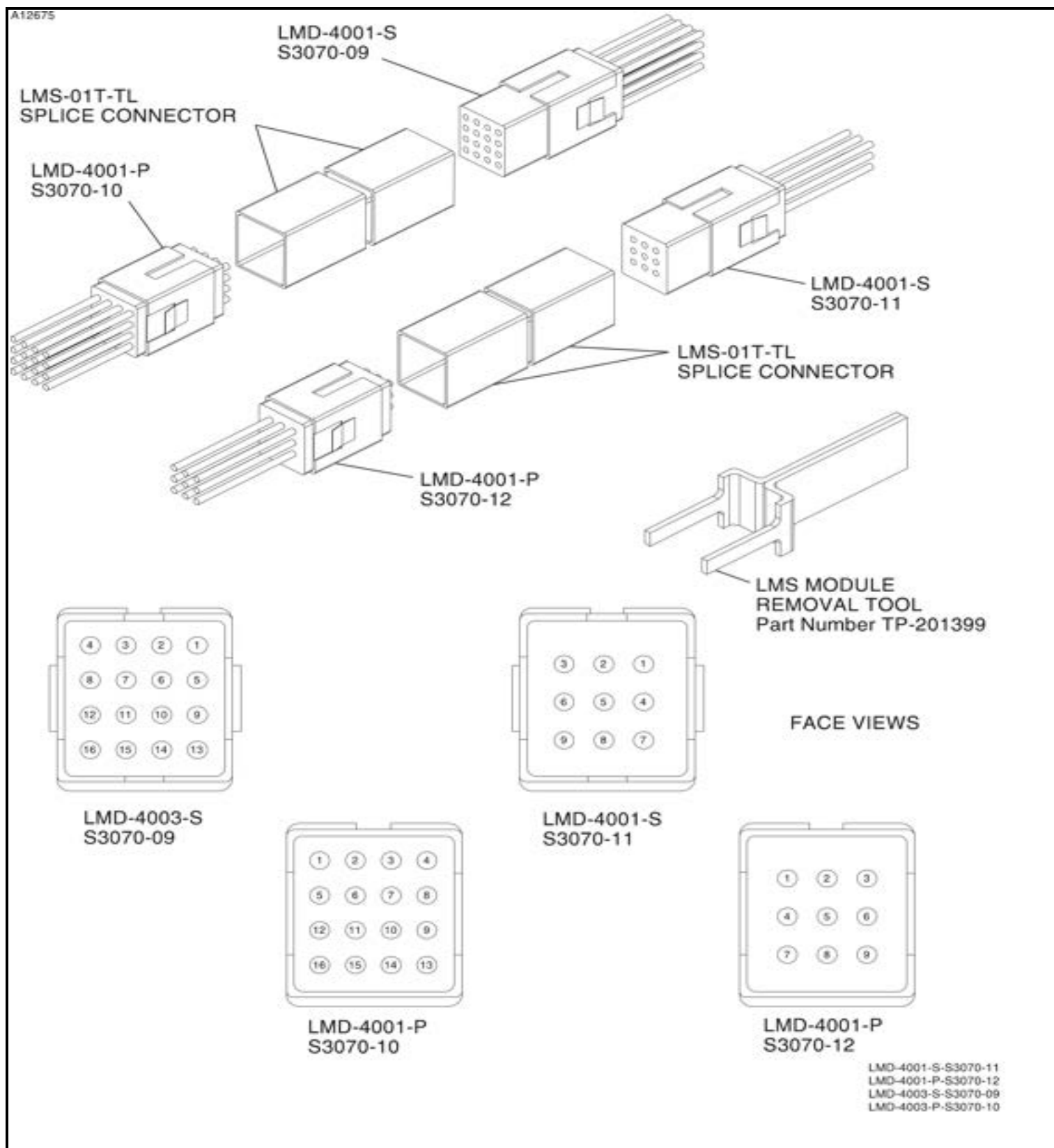


Figure 210 : Sheet 1 : M24308 Series Connectors

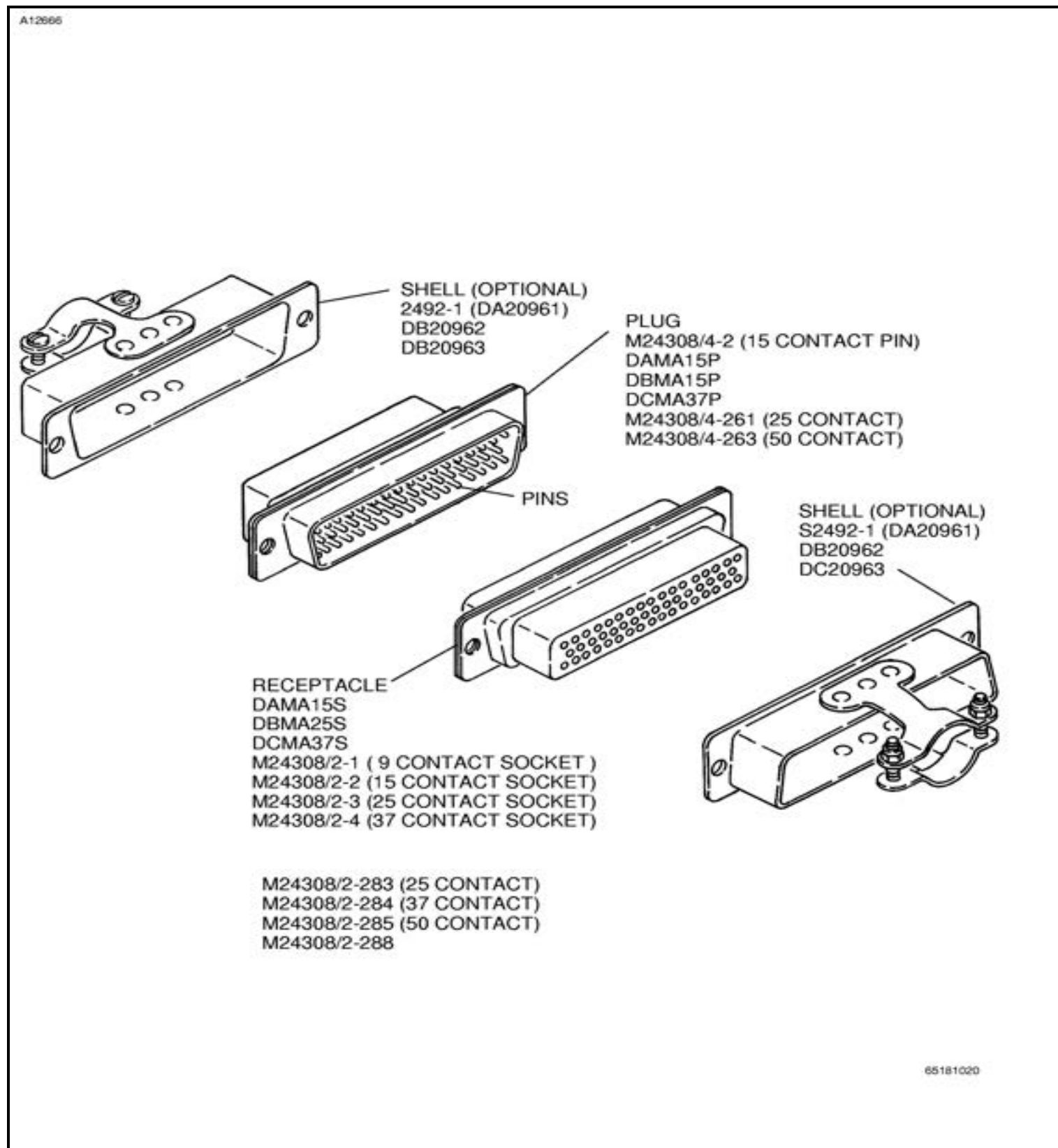


Figure 210 : Sheet 2 : M24308 Series Connectors

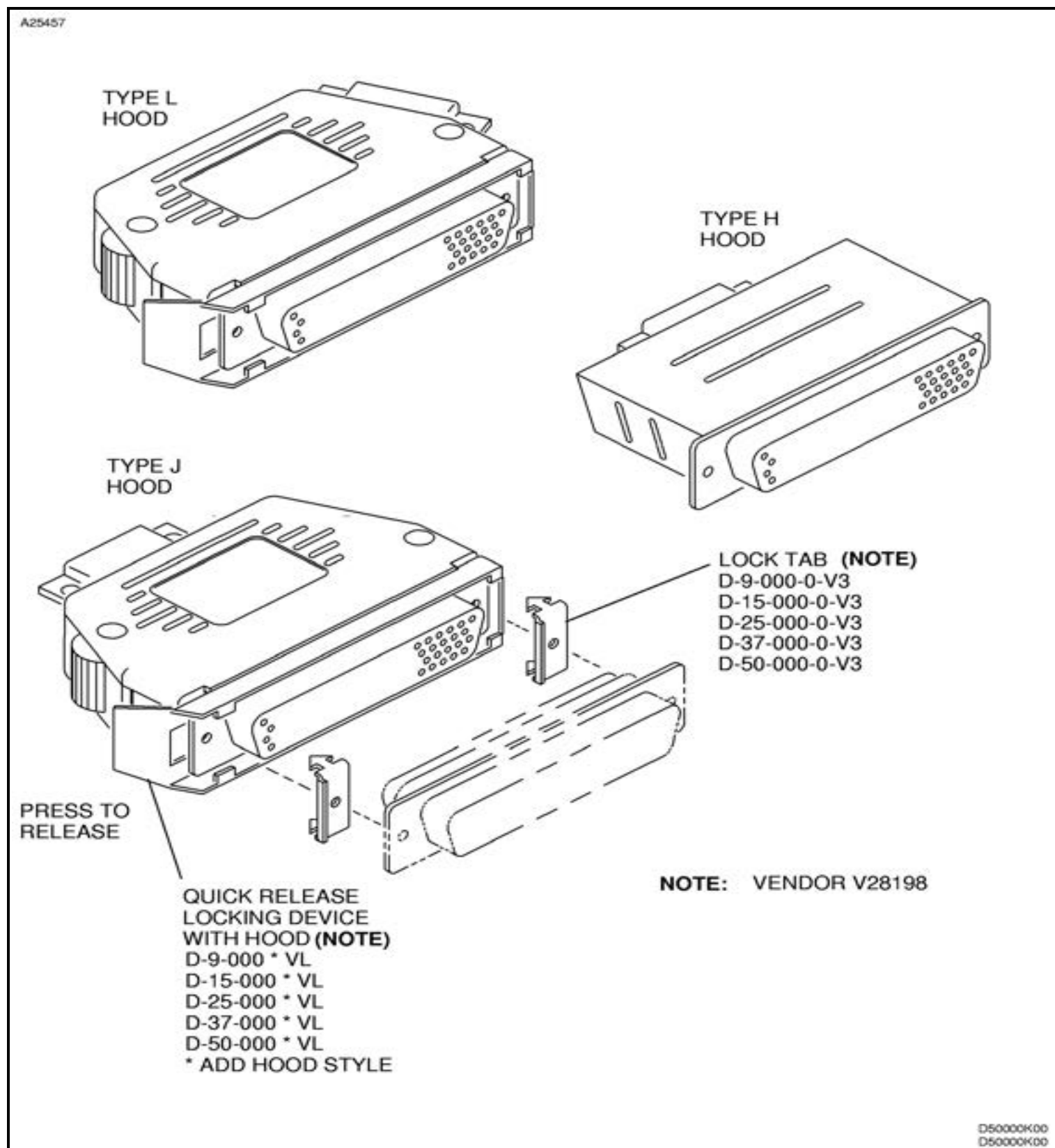
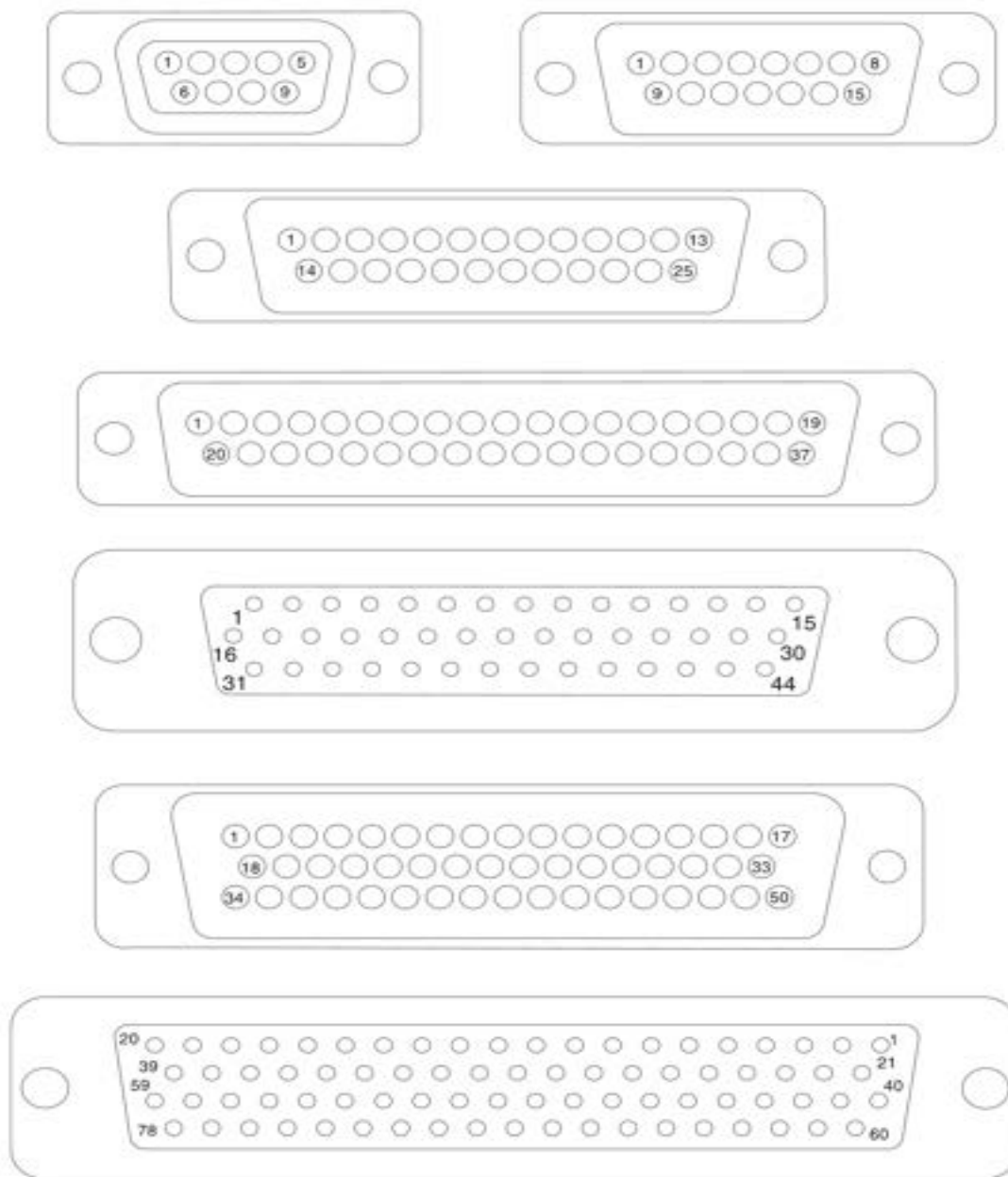


Figure 210 : Sheet 3 : M24308 Series Connectors

A25458

FACE VIEW PIN INSERT



MS18273-1
MS18274-1
MS18275-1
MS18276-1
MS18275-2
MS18277-1
MS18277-2

Figure 211 : Sheet 1 : Mil-C-38999 Series 1 and Series 2 Connectors

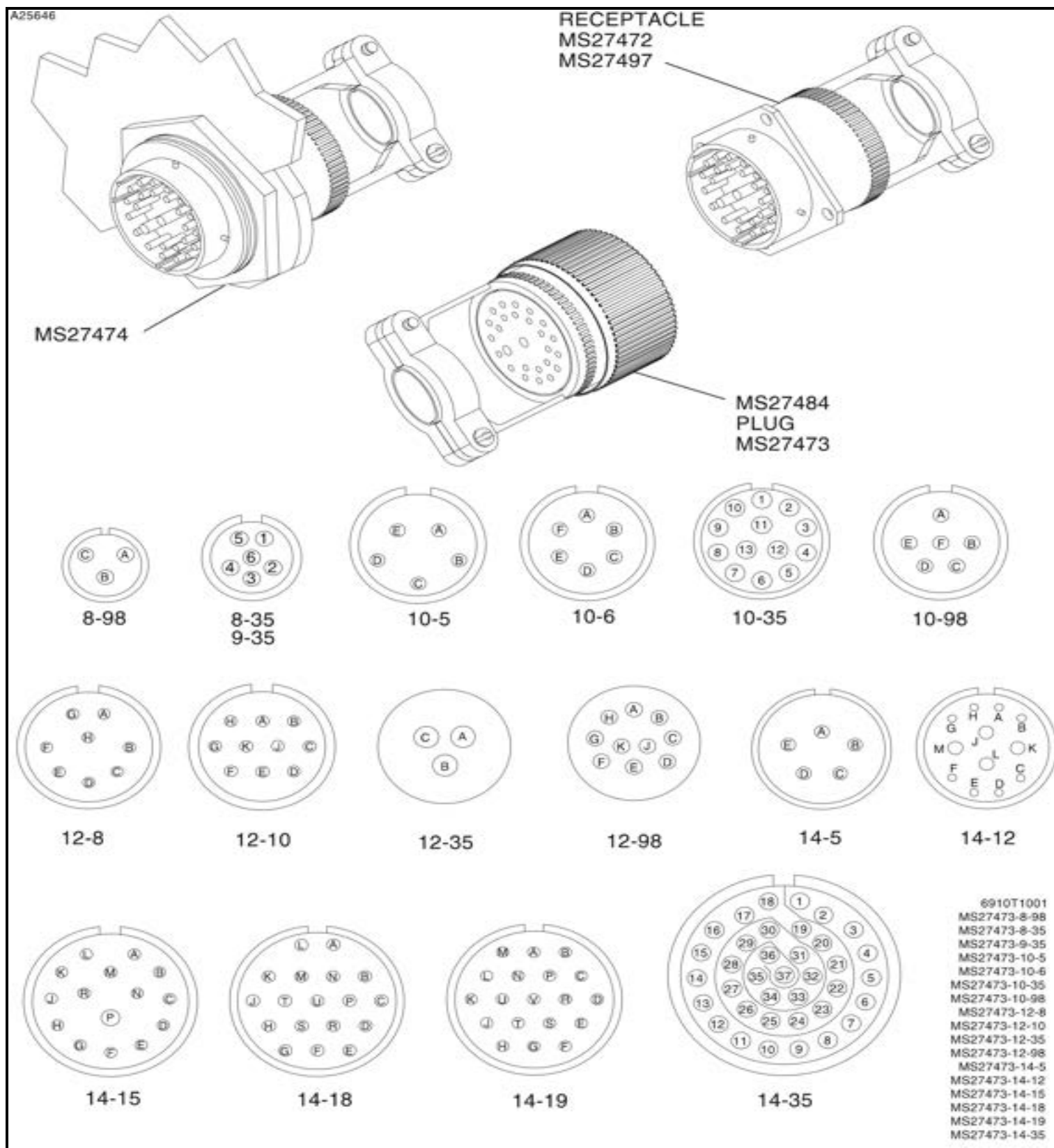


Figure 211 : Sheet 2 : Mil-C-38999 Series 1 and Series 2 Connectors

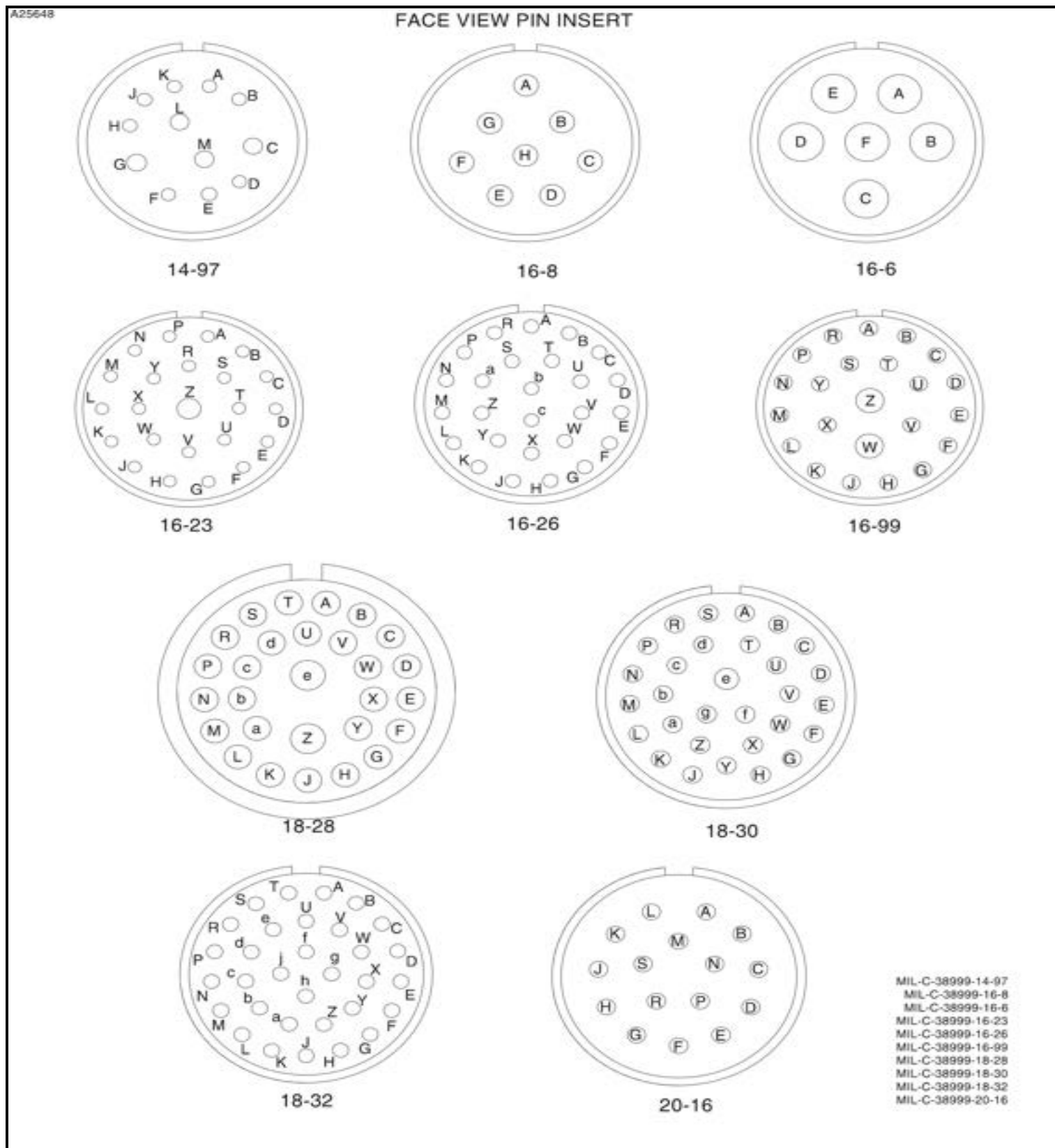
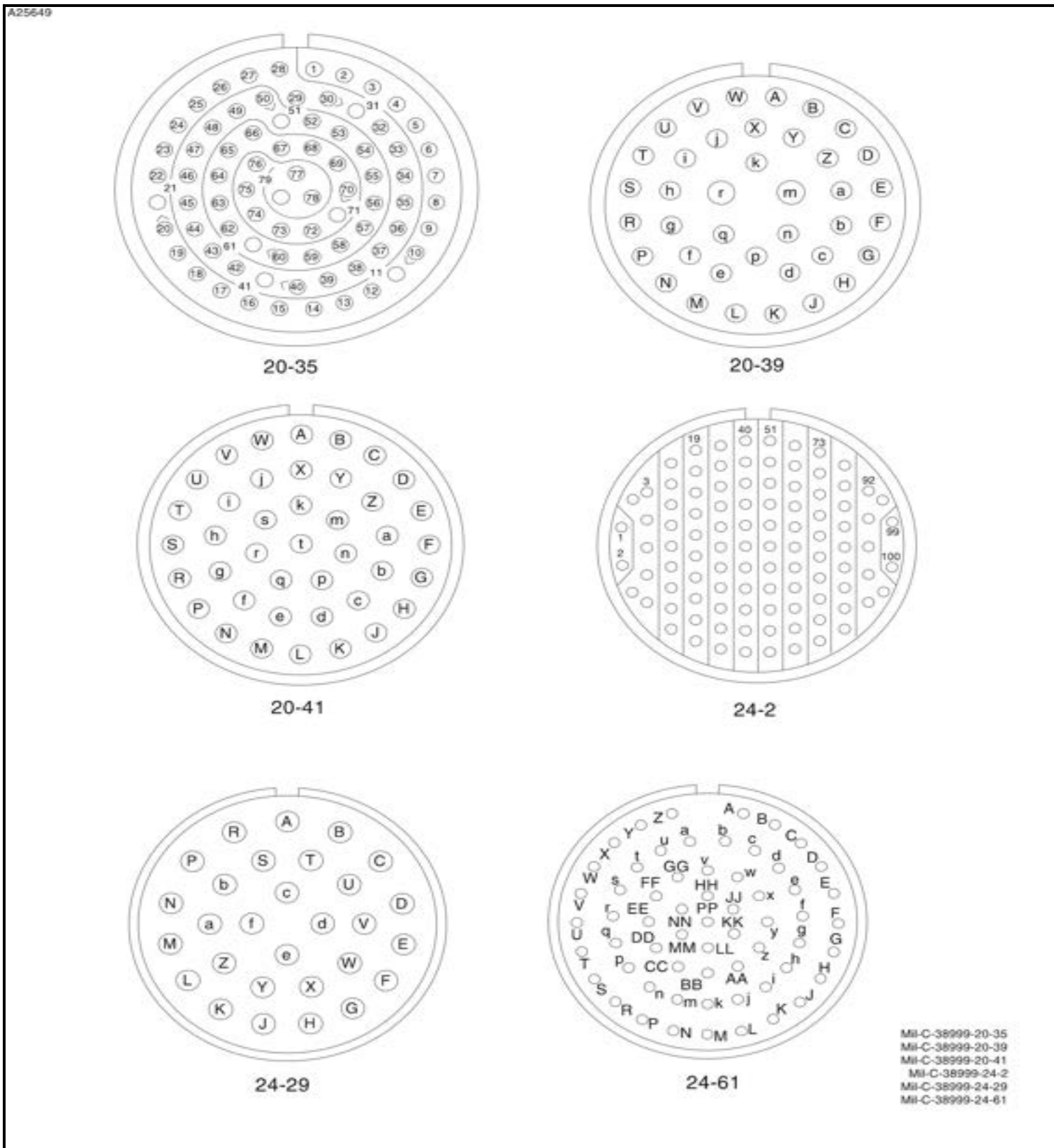


Figure 211 : Sheet 3 : Mil-C-38999 Series 1 and Series 2 Connectors



COAX CABLE CONNECTORS - MAINTENANCE PRACTICES

1. General

- A. The following information is intended for replacement of coax cable connectors in general. Instructions given are typical for coax cable connectors.
- B. Coax cable connectors described herein are of two types: one utilizing a threaded-type braid clamp, the other a swaged-type braid clamp.

2. Installation/Assembly Coax Cable Connectors (Threaded Type)

- A. Assembly Procedures. Refer to [Figure 201](#).
 - (1) Cut coax cable to length.
 - (2) Trim jacket approximately 5/16 inch from end of cable.
 - (3) Slip clamp nut, washer, gasket and braid clamp onto cable.
 - (4) Flare braid over braid clamp.
 - (5) Strip insulation from center conductor to depth of contact solder pot.
 - (6) Install and solder contact to center conductor.

NOTE: Nuts having captivated contacts, washer and insulator are assembled before soldering contacts.

 - (7) Insert complete assembly into connector body so contact enters hold in insulator properly.
 - (8) Start connector nut by hand and tighten to 40 inch pounds +10, -10 inch-pounds, torque.

3. Installation/Assembly Connectors with K-Grips (Swaged Type)

- A. Assembly Procedures. Refer to [Figure 202](#).
 - (1) Disassemble nut, gasket and braid clamp from connector body. Remove K-Grip and sleeve from individual package.
 - (2) Slip K-Grip sleeve and connector nut onto cable.
 - (3) Remove outer jacket to dimension A. [Refer to Table 201](#).

Table 201. K-Grip Assembly

Connector	Dimension A Inches	Dimension B Inches	Dimension C Inches	K-Grip	Tool
UG-913A/U	1.18	0.3	0.111	KS-89-05	683-51470-1
UG-88C/U	1.18	0.3	0.111	KS-89-05	683-51470-1

CAUTION: DO NOT NICK OR CUT THE BRAID.

- (4) Trim braid to dimension B with small scissors or fingernail clippers. [Refer to Table 201](#).
 - (5) Slide grooved slotted end of K-Grip barrel over dielectric and under braid until braid touches step of barrel.
 - (6) Slide connector nut in place so that nut butts against collar of K-Grip barrel.
- NOTE: Nut must be correctly positioned before crimping.**
- (7) Hold K-Grip barrel in position and slide K-Grip sleeve until forward edge of sleeve is even with step of barrel and the braid is visible between sleeve and step.
 - (8) Crimp K-Grip sleeve as shown using tool specified in [Table 201](#). If an alternate tool is used, crimp sleeve twice to utilize full length of sleeve, yet leave a flare at each end.
 - (9) Trim dielectric to dimension C in [Table 201](#).

CAUTION: DO NOT NICK OR CUT CENTER CONDUCTOR.

- (10) Trim center conductor to depth of contact solder pot so contact is flush with dielectric.
- (11) Tin center conductor lightly.
- (12) Install and solder contact on center conductor.
- (13) Install gasket and braid clamp.
- (14) Insert complete assembly into connector body so contact enters hole in insulator and braid clamp seats properly. Push assembly into body as far as possible. Start connector nut by hand and tighten moderately with wrench.
- (15) Hold connector body and tighten to torque value of 40 inch-pounds +10, -10 inch-pounds.

4. Assembly MIL-C-25516 (M25516/20-XX-XX) Connectors

- A. Assembly Procedures. Refer to [Figure 203](#).
- B. Instructions also cover Ted Manufacturing Corporation Series 59 and 69 connectors for shielded cables.

5. Assembly 2755-2-9 King K-Grip Connectors

- A. Assembly Procedures. Refer to [Figure 204](#).

Figure 201 : Sheet 1 : Coax Cable Termination Installation

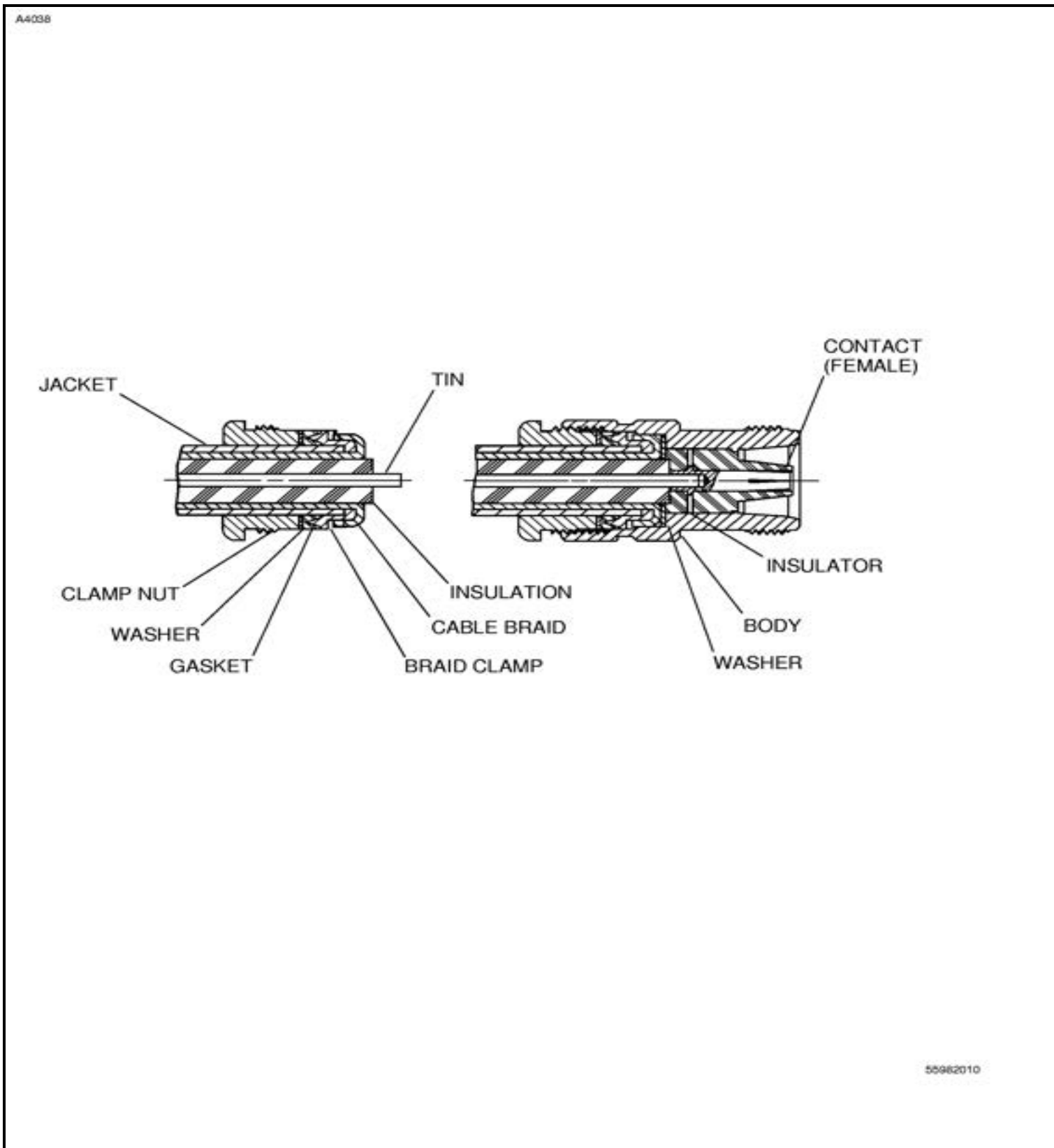


Figure 202 : Sheet 1 : Connector With K-Grip (Typical)

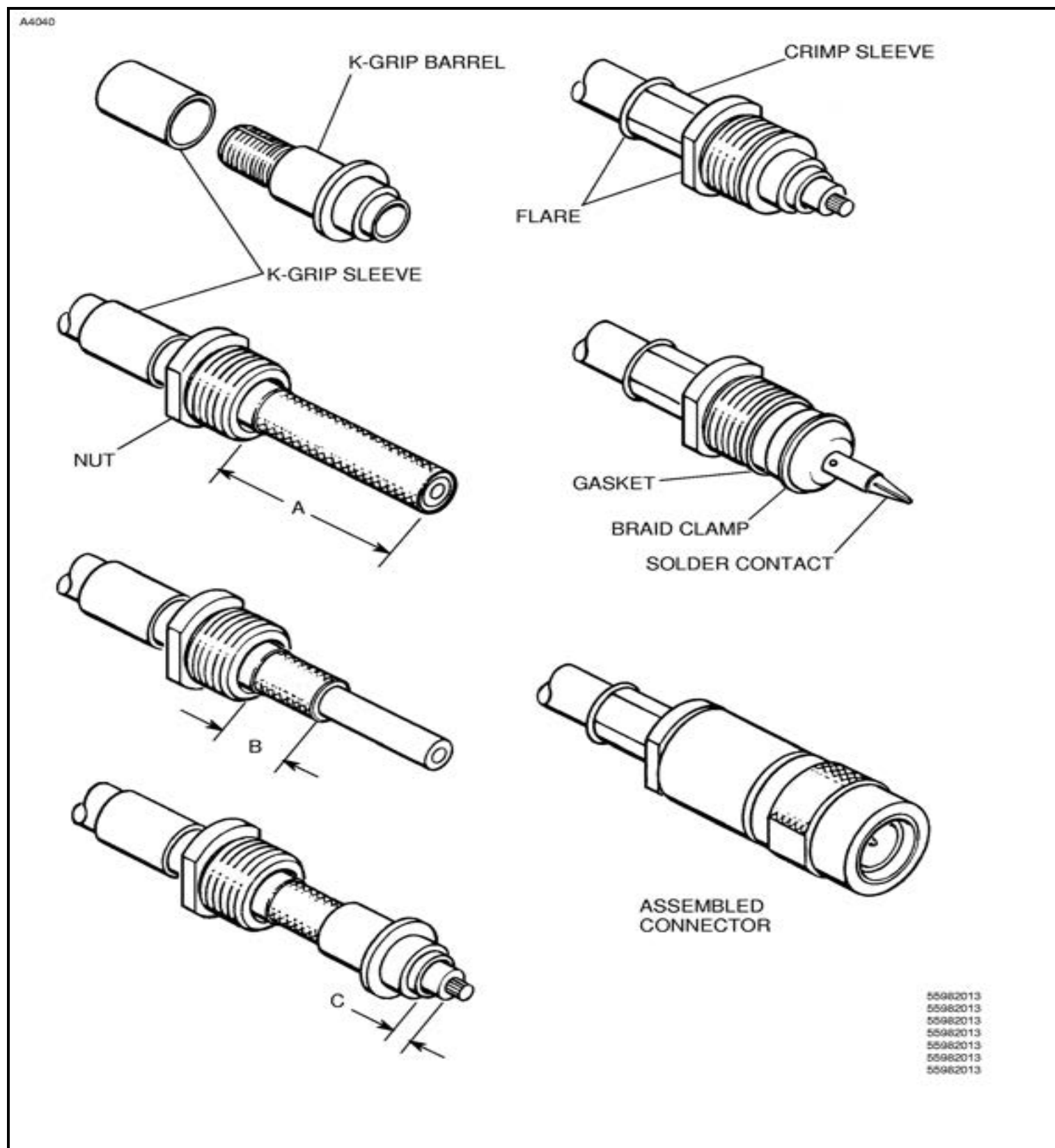


Figure 203 : Sheet 1 : Assembly Mil-C-25516 (M25516/20-XX-XX) Connectors

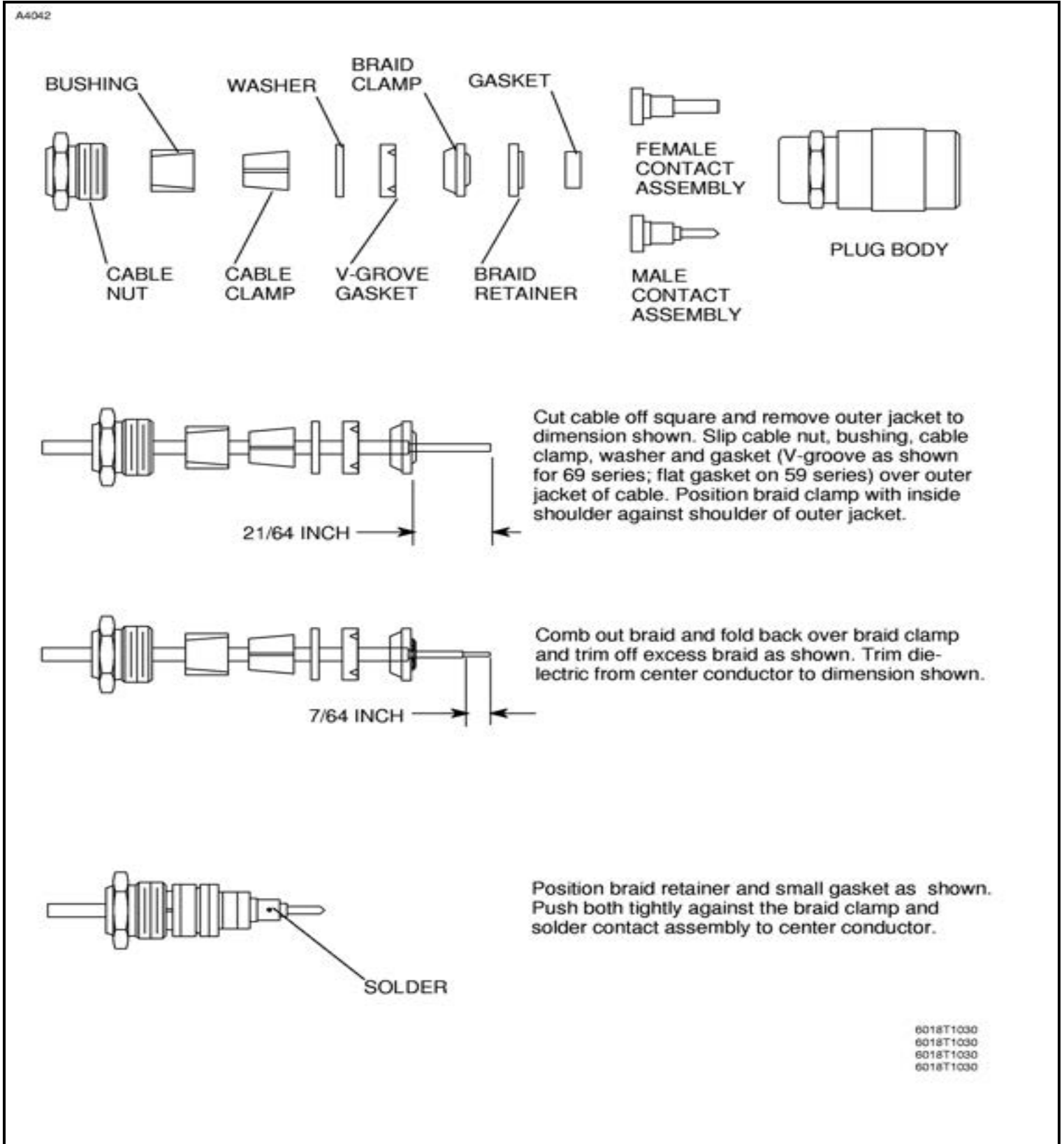


Figure 204 : Sheet 1 : 2755-2-9 King K-Grip Connectors

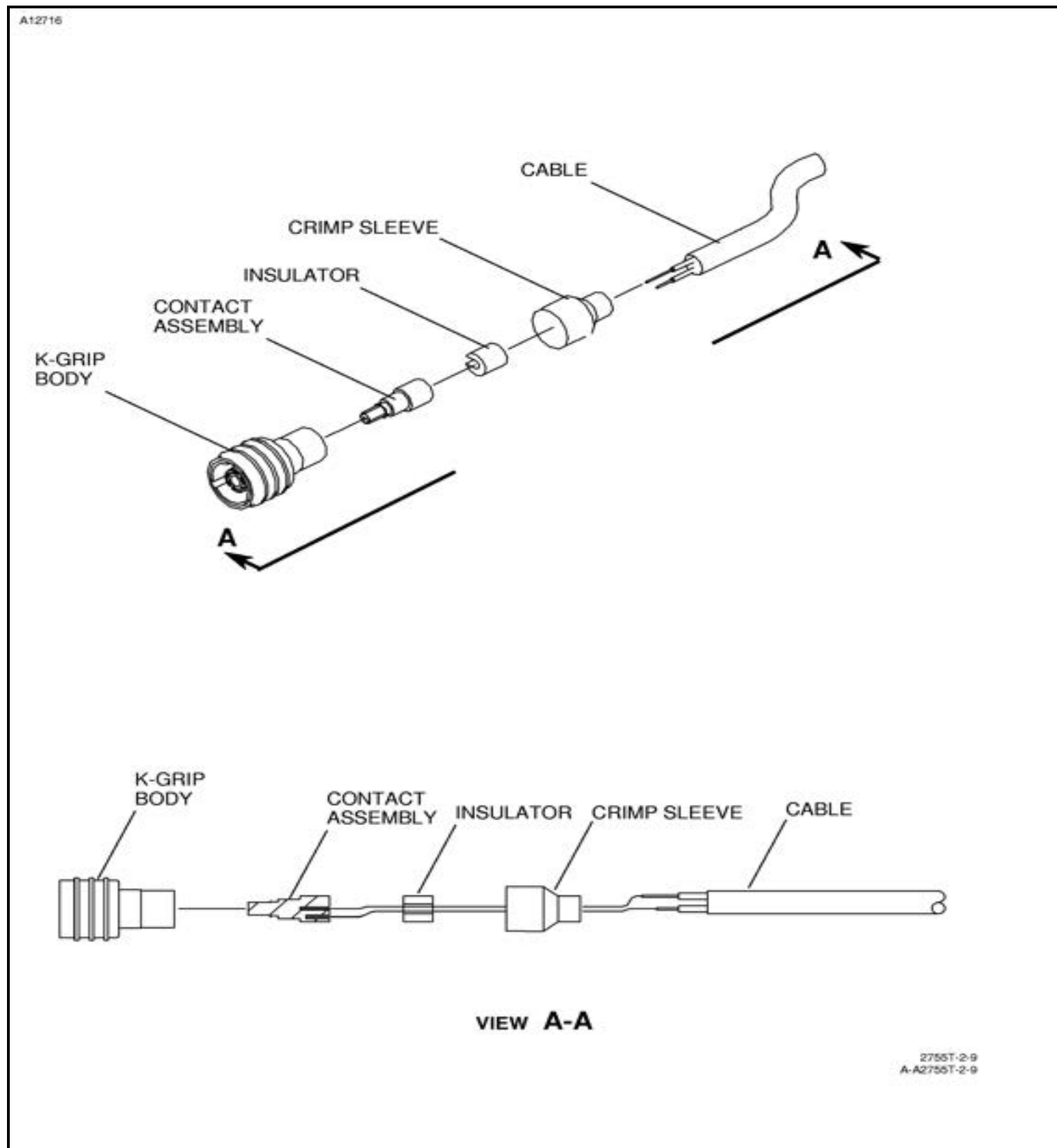
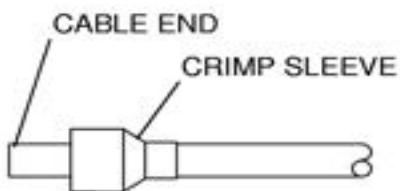
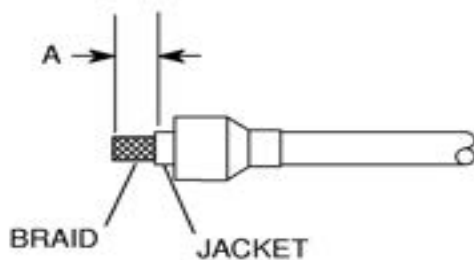


Figure 204 : Sheet 2 : 2755-2-9 King K-Grip Connectors

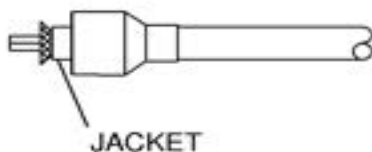
A12717



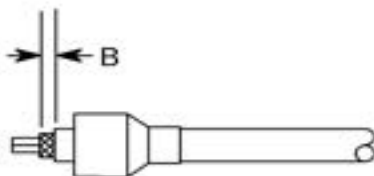
CUT CABLE END SQUARE AND SLIDE CRIMP SLEEVE OVER CABLE END AS SHOWN.



REMOVE JACKET TO "A" DIMENSION



FLARE OR BULGE BACK BRAID AND TRIM WITH SCISSORS AT EDGE OF JACKET

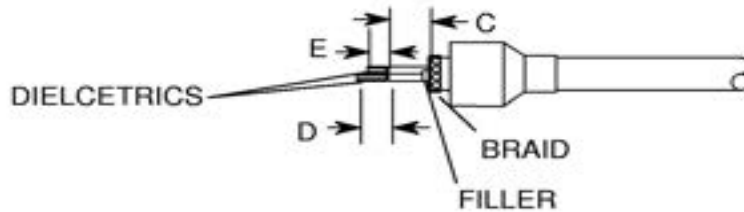


REMOVE JACKET TO "B" DIMENSION, TAKING CARE NOT TO NICK BRAID.

2755T-2-9
2755T-2-9
2755T-2-9
2755T-2-9

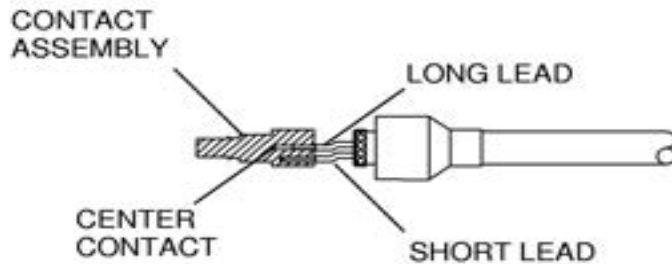
Figure 204 : Sheet 3 : 2755-2-9 King K-Grip Connectors

A12718



FOLD BACK BRAID AND TRIM BOTH FILLERS FLUSH WITH FOLD. THEN CUT THRU BOTH DIELECTRICS AT "D" DIMENSION. DO NOT NICK CONDUCTORS AND DO NOT REMOVE DIELECTRICS.
NEXT, TRIM ONE OF THE LEADS TO THE "E" DIMENSION, THE REMAINING LONG LEAD WILL BE INSERTED INTO THE CENTER CONTACT IN THE NEXT STEP.

DASH NO.	A	B	C	D	E
-1	.200	.391	.279	.312	.172
-2	-	-	-	.312	.172

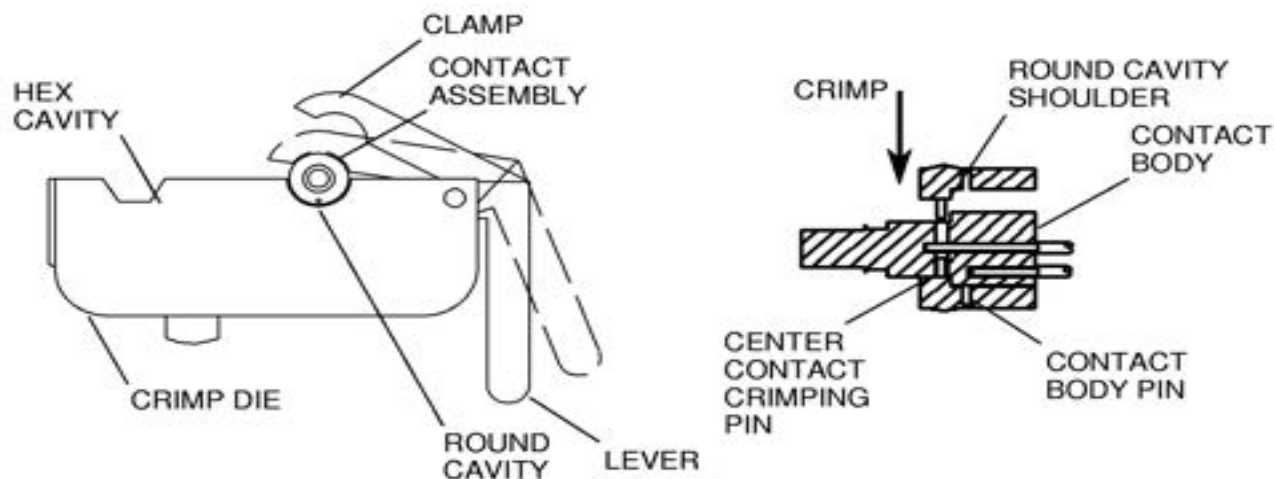


REMOVE THE DIELECTRICS AND INSERT CENTER CONDUCTORS (LONG LEAD IN CENTER, SHORT LEAD IN CONTACT BODY) INTO CONTACT ASSEMBLY. A GENTLE ROCKING MOTION OF THE CABLE WILL FACILITATE ENTRY OF THE LEADS.

2755T-2-9
2755T-2-9

Figure 204 : Sheet 4 : 2755-2-9 King K-Grip Connectors

A12720

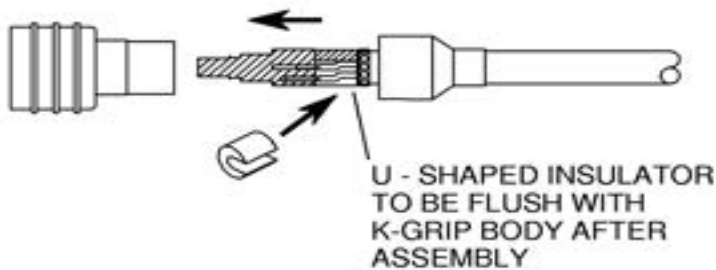


PLACE APPROPRIATE CRIMP DIE INTO CRIMPING TOOL. PUSH DOWN ON LEVER TO OPEN CLAMP. INSERT CONTACT ASSEMBLY, WITH CABLE CONDUCTORS IN PLACE, AGAINST THE ROUND DIE CAVITY SHOULDER. LINE UP CENTER CONTACT CRIMPING PINS WITH CLEARANCE HOLES (MAKE SURE THAT THE CONDUCTOR INSERTED IN THE CONTACT BODY IS IN LINE WITH THE CONTACT BODY PIN.) RELEASE THE CLAMP LEVER, LOCKING CONTACT ASSEMBLY IN PLACE AND CRIMP CAREFULLY.

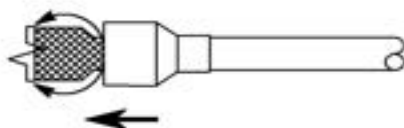
2755T-2-9
2755T-2-9

Figure 204 : Sheet 5 : 2755-2-9 King K-Grip Connectors

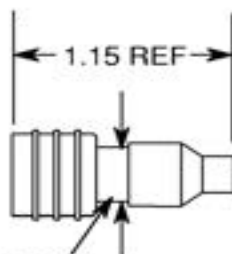
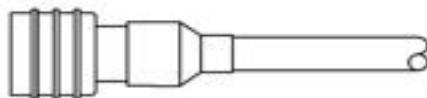
A12721



SLIDE U-SHAPED INSULATOR INTO GAP
BETWEEN CONTACT ASSEMBLY AND
BRAID. USING INSULATOR SNAP IN
CONTACT ASSEMBLY INTO K-GRIP BODY.



FOLD BRAID BACK OVER K-GRIP BODY,
SLIDE CRIMP SLEEVE OVER BRAID AND
BODY. CRIMP WITH HEX CAVITY OF DIE.



STAMP: KINGS 2755-2-9

2755T-2-9
2755T-2-9
2755T-2-9
2755T-2-9

SPLICES AND TERMINALS - MAINTENANCE PRACTICES

1. General

- A. This section contains information for replacement of splices and terminals.
- B. The splices covered are of two types: one a permanent crimp-type splice that must be destroyed to separate the wires, the other a quick-disconnect that can be connected and disconnected repeatedly.
- C. The terminals covered are crimp-type in straight and flag type.
- D. All wire sizes referenced are American Wire Gauge (AWG).

2. Splices - Quick Disconnect Non-environmental

- A. Refer to Table 201 for splice part numbers.
- B. For installation, use WT110M crimp tool available through Thomas and Betts

Table 201. Quick Disconnect Non-environmental Splices

WIRE SIZE	PART NUMBER
22 Thru 18	S341-2
16 Thru 14	S341-1

3. Splices - Permanent Non-environmental

- A. Permanent crimp non-environmental splices may be used on various wire sizes or combinations of wires. Refer to table 203 for splice wire size information.
- B. The crimp tools listed in Table 202 or their equivalent are required to install these splices. All crimp tools listed are available through AMP Inc. [V00779](#).

NOTE: The splice crimping tool has an insulation crimping adjustment set to 1, 2, 3 or 4 depending on the thickness of insulation. The splice should have a firm crimp on the insulation without damage.

Table 202. Tools for Permanent Crimp Non-environmental Splices

AWG	SPLICE	CRIMPING TOOL
22-16	320559	59250
14-16	320562	59250
10-12	320570	59239-4
22-16	S1370-1	59250
14-16	S1370-2	59250
10-12	S1370-3	59239-4

Table 203. Permanent Non-environmental Splices

S1370-1 or 320559 *		S1370-2 or 320562 *		S1370-3 or 320570 *	
RED		BLUE		YELLOW	
WIRE SIZE 22 THRU 16		WIRE SIZE 16 AND 14		WIRE SIZE 12 AND 10	
NUMBER OF WIRES	WIRE SIZE	NUMBER OF WIRES	WIRE SIZE	NUMBER OF WIRES	WIRE SIZE
1	22	1	16	1	14
1	20	1	14	1	12
2	22	2	20	1	10
2	20	1	20 and 18	2	14
3	22	2	18	1	14 and 12
		2	16	2	12
		3	20		

4. Splices - High Temperature

- A. Refer to Table 204 for splice part numbers and crimp tool information.

Table 204. High Temperature Splices

WIRE SIZE	PART NUMBER *	CRIMP TOOL
22 Thru 20	330377-1	69710-1 Handle 69327 Crimp Head
18 Thru 16	330378-1	69710-1 Handle 69328 Crimp Head

5. Splices - Quick Disconnect Environmental

- A. Table 205 contains contact information and installation tools for use with quick disconnect environmental resistant splices.

Table 205. Quick Disconnect Environmental Resistant Splices

TSE12-01 (2 wire disconnect splice)

Contact (wire sizes 12 and 14)	1841-1-5612	Deutsch Co. V11139
Crimping Tool	MS3191	Commercially Available
Insertion/Removal Tool	M15570-12	Deutsch Co. V11139

TSE16-01 (2 wire disconnect splice)

Contact (wire sizes 16, 18, 20)	1841-1-5616	Deutsch Co. V11139
Crimping Tool	MS3191	Commercially Available
Insertion/Removal Tool	M15570-16	Deutsch Co. V11139

M81714/65-20-1 replaces TSE20-01 (2 wire disconnect splice)

Contact (wire sizes 20, 22, 24)	1841-1-5620	Deutsch Co. V11139
Crimping Tool	MS3191	Commercially Available
Insertion/Removal Tool	M15570-20	Deutsch Co. V11139

TSE22-01 (2 wire disconnect splice)

Contact (wire sizes 22 and 24)	100060-56	Deutsch Co. V11139
Crimping Tool	MS3191	Commercially Available
Insertion/Removal Tool	M15570-22-1	Deutsch Co. V11139

CTL-12 (2 wire disconnect splice) and CTM-12 (4 Wire disconnect splice)

Contact (wire sizes 12 and 14)	CTS-S12/12	Deutsch Co. V11139
	AFLC-8027520-2-1	Commercially Available
Crimping Tool	M22520/1-01	Commercially Available
Positioner	TP405	Commercially Available
Insertion/Removal Tool	M15570-12	Commercially Available
	81515-12	
Sealing Plug for unused holes	M81511/39-12	Commercially Available

DME-12 and DME12B

Contact (wire size 12)	M39029/22-605	DME Electronics
Crimping Tool	M22520/7-01	Commercially Available
Positioner	M22520/7-11	Commercially Available
Insertion/Removal Tool	M81969/14-04	Commercially Available

DME-16 and DME16B

Contact (wire size 16)	M39029/22-193	DME Electronics
------------------------	---------------	-----------------

Crimping Tool	M22520/7-01	Commercially Available
Positioner	M22520/7-11	Commercially Available
Insertion/Removal	M81969/14-03	Commercially Available
M81714/65-20-1 replaces DME-20 and DME20B		
Contact 20 AWG	M39029/22-192	DME Electronics
Crimping Tool	M22520/7-01	Commercially Available
Positioner	M22520/7-11	Commercially Available
Insertion/Removal Tool 20 AWG	M81969/14-11	Commercially Available
DME-22 and DME22B		
Contact (wire sizes 22 and 24)	M39029/22-191	DME Electronics
Crimping Tool	M22520/7-01	Commercially Available
Positioner	M22520/7-11	Commercially Available
Insertion/Removal Tool	M81969/14-01	Commercially Available
CTL-16 (2 wire disconnect splice) and CTM-16 (4 Wire disconnect splice)		
Contact (wire sizes 16 and 20)	CTS-S16/16	Deutsch Co. V11139
	M39029/22-193	Commercially Available
Crimping Tool	M22520/7-01	Commercially Available
Positioner	M22520/7-13	Commercially Available
Insertion/Removal Tool	M83723/31-16	Commercially Available
	M15570-16	Deutsch Co. V11139
Sealing Plug for unused holes	M81511/39-16	Commercially Available
CTL-20 (2 wire disconnect splice) and CTM-20 (4 Wire disconnect splice)		
Contact (wire sizes 20 and 24)	CTS-S20/20	Deutsch Co. V11139
	M39029/22-192	Commercially Available
Crimping Tool	M22520/7-01	Commercially Available
Positioner	M22520/7-12	Commercially Available
Insertion/Removal Tool	M83723/31-20	Commercially Available
	M15570-20	Deutsch Co. V11139
Sealing Plug for unused holes	M81511/39-20	Commercially Available
CTL-22 (2 wire disconnect splice) and CTM-22 (4 Wire disconnect splice)		
Contact (wire sizes 22 and 24)	CTS-S22/22	Deutsch Co. V11139
	M39029/22-191	Commercially Available
Crimping Tool	M22520/7-01	Commercially Available
Positioner	M22520/7-11	Commercially Available
Insertion/Removal Tool	M15570-22-1	Commercially Available
	81515-23	Deutsch Co. V11139
Sealing Plug for unused holes	8027520-2-2	Deutsch Co. V11139
M81714/12-20B2 Double Splice		
Contact (wire sizes 20 and 24)	M39029/1-101	Commercially Available
Crimping Tool	M22520/1-01	Commercially Available
Positioner	M22520/1-02	Commercially Available

Insertion/Removal Tool

M81969/14-02

Commercially Available

6. Splices - Permanent Crimp, Environmental Resistant Splices

A. Permanent crimp environmental resistant splices may be used on various wire sizes or combinations of wires. Refer to Table 207 for splice wire size information.

B. Tools used with permanent crimp environmental resistant splices.

NOTE: The following tools (or equivalent) are required.

(1) Heat gun part number CV5700 and reflector part number MG7 are available through Raychem Corp. [V06090](#).

(2) For crimp tool information refer to Table 206.

Table 206. Permanent Crimp Environmental Resistant Splice Installation Tools

M81824/1-1, M81824/1-2, D436-36, D436-37, D436-52, D436-110

CRIMP TOOL	DIE	MANUFACTURER
M22520/5-01	M22520/5-103	Commercially Available
M22520/10-01	M22520/10-104	Commercially Available
AD1377	none	Raychem Corp. V06090

M81824/1-3, D436-38, D436-53

CRIMP TOOL	DIE	MANUFACTURER
M22520/5-01	M22520/5-102	Commercially Available
M22520/10-01	M22520/10-103	Commercially Available
AD1377	none	Raychem Corp. V06090

C. Installation of permanent crimp environmental resistant splices.

(1) MIL-S-81824 Type Splices.

(a) Slide the insulating/sealing sleeve onto the wire(s) that will be located at one end of the sleeve.

(b) Strip 0.312 to 0.343 of insulation from the wires.

(c) Insert the wires into crimp barrel and crimp with crimp tool.

(d) Slide the insulating/sealing sleeve to center the crimp barrel between the sealing rings.

(e) Using a heat gun, shrink the insulating/sealing sleeve over the crimp barrel and wires. Continue to heat the ends of the sealing sleeve until the meltable inserts flow from the ends of the sleeve.

(2) 3-Wire Guide Type Splices Sealing Insert.

(a) Slide the insulating/sealing sleeve onto the wires that will be located on the 3-wire guide end of splice, maximum of 2 wires in each hole in wire guide.

(b) Repeat Steps 6.C.1 (b) through (e) for MIL-S-81824 type splices.

Table 207. Permanent Crimp Environmental Resistant Splices

WIRE END 1		SPLICE * PART NUMBER	APPROVED TO MIL. SPEC. PART NUMBER	WIRE END 2	
NUMBER OF WIRES	WIRE SIZE	SINGLE WIRE SPLICING		NUMBER OF WIRES	WIRE SIZE
1	24	D436-36 RED	M81824/1-1	1	24
1	22	D436-36 RED	M81824/1-1	1	22
1	20	D436-36 RED	M81824/1-1	1	20
1	18	D436-37 BLUE	M81824/1-2	1	18
1	16	D436-37 BLUE	M81824/1-2	1	16
1	14	D436-38 YELLOW	M81824/1-3	1	14
1	12	D436-38 YELLOW	M81824/1-3	1	12
NUMBER OF WIRES	WIRE SIZE	MULTIPLE WIRE SPLICING		NUMBER OF WIRES	WIRE SIZE
2	24	D436-36 RED	M81824/1-1	1	22
2	24	D436-36 RED	M81824/1-1	1	24

WIRE END 1		SPLICE * PART NUMBER	APPROVED TO MIL. SPEC. PART NUMBER	WIRE END 2	
2	22	D436-36 RED	M81824/1-1	1	22
2	22	D436-36 RED	M81824/1-1	1	20
2	22	D436-36 RED	M81824/1-1	2	22
2	20	D436-37 BLUE	M81824/1-2	1	20
2	20	D436-37 BLUE	M81824/1-2	1	18
2	20	D436-37 BLUE	M81824/1-2	2	20
1	18 and 20	D436-38 YELLOW	M81824/1-3	1	18 and 20
2	18	D436-38 YELLOW	M81824/1-3	1	16
2	18	D436-38 YELLOW	M81824/1-3	2	20
2	18	D436-38 YELLOW	M81824/1-3	2	18
2	18	D436-38 YELLOW	M81824/1-3	1	18
2	16	D436-38 YELLOW	M81824/1-3	2	18
2	16	D436-38 YELLOW	M81824/1-3	2	16
2	16	D436-38 YELLOW	M81824/1-3	1	16
2	16	D436-38 YELLOW	M81824/1-3	1	14
3	24	D436-0110 RED		1	24
3	24	D436-0110 RED		2	24
3	24	D436-0110 RED		2	22
3	22	D436-52 BLUE		1	22 and 20
3	22	D436-52 BLUE		2	20
3	22	D436-52 BLUE		2	22
3	20	D436-53 YELLOW		2	20
3	20	D436-53 YELLOW		2	18
2	20 and 18	D436-53 YELLOW		2	20
3	18	D436-53 YELLOW		1	18
3	18	D436-53 YELLOW		2	18

D. Combinations of wire splicing not shown in Table 207, may be determined by the following procedure:

- (1) Calculate the Circular Mil Area (CMA) for each end of the splice. Refer to Table 208.

EXAMPLE: Splicing three AWG 22 wires to one AWG 16 wire:

Wire End 1

CMA = 3 X 754 = 2262

Wire End 2

CMA = 2426

Table 208. CMA (Circular Mill Area) Of Common Conductors

WIRE SIZE (AWG)	24	22	20	18	16	14	12
STRANDS	19	19	19	19	19	19	37
CMA	475	754	1216	1900	2426	3831	5874

- (2) Determine, from Table 209, which splice part numbers will accommodate the CMA and the number of wires of End 1. Note that a maximum of two wires can be sealed in any one hole in a sealing insert. (In the chart, refer to the MAXIMUM NUMBERS OF WIRES, END 1 and END 2 columns, and CMA RANGE OF BARREL, MINIMUM and MAXIMUM columns)

Example: Three AWG 22 wires
2262 CMA

Possible splices include Part Numbers
D436-52 and D436-53

- (3) Determine which part numbers will accommodate the CMA and the number of wires of End 2.

Example: One AWG 16 wire
2426 CMA
Possible splices include Part Numbers
D436-52 and D436-53

- (4) Select the part number for the smallest splice that will accommodate both ends.

Example: D436-52 for three AWG 22 to one AWG 16.

Table 209. CMA (Circular Mill Area) Limits of Splices

SPLICE		CMA RANGE OF BARREL		MAXIMUM NUMBER OF WIRES	
PART NUMBER	COLOR	MINIMUM	MAXIMUM	END 1	END 2
D436-36	RED	304	1510	2	2
D436-37	BLUE	779	2680	2	2
D436-38	YELLOW	1900	6755	2	2
D436-0110	RED	304	1510	6 *	2
D436-52	BLUE	779	2680	6 *	2
D436-53	YELLOW	1900	6755	6 *	2

7. Environment Resistant Splices for Shielded Cable

- A. Refer to Table 210 for splice information.
B. Tools used with permanent crimp environmental resistant splices.

NOTE: The following tools are (or equivalent) are required.

- (1) Heat gun part number CV5000 and reflector part number TG135 are available through Raychem Corp.. [V06090](#)
(2) Crimp tool part number AD1377 is available through Raychem Corp.. [V06090](#)

- C. Installation of environment resistant splices for shielded cable

NOTE: The braided solder sleeve, splice sleeve and crimp barrel referred to in the following instructions are all part of the D150-01XX kit. Refer to Table 210.

- (1) Cut shielded cable at area to be spliced.
- (2) Slide braided solder sleeve over one end of the cable.
- (3) Remove cable jacket and shield.
 - (a) For single conductor shielded cable, remove cable jacket and shield 0.700 inches from both ends of the cable.
 - (b) For multiconductor shielded cable, remove cable jacket and shield 1.825 inches from both ends of the cable.
- (4) Remove cable jacket so as to expose 0.375 inches of shield on both ends of the cable.
- (5) Splice wires. Accomplish the following instructions for each wire in the cable.
 - (a) For multiconductor shielded cable, cut each wire 0.675 inches from the end of the shield at one end of the cable. Stagger wire cuts as follows;

For 2 conductor cable, cut one wire at one end of the cable and the second wire at the opposite end of the cable.
For 3 conductor cable, cut two wires at one end of the cable and the third wire at the opposite end of the cable.

- (b) Strip insulation 0.275 inches from both ends of the wire.
- (c) Slide the splice sleeve onto one end of the wire.
- (d) Insert both ends of the wire into the crimp barrel and crimp.
- (e) Center the splice sleeve over the crimp barrel and apply heat until the sealing rings melt and flow along the wire.
- (6) Install braided solder sleeve.
 - (a) Slide the braided solder sleeve over the wire splice(s).
 - (b) Starting at the center of the braided solder sleeve and working toward the ends, apply heat until the solder melts and the insulating sleeve shrinks.
 - (c) Apply sufficient heat to the area of the cable shield to ensure a good solder joint between the braided solder sleeve and the cable shield.

- (d) Apply heat to the ends of the braided solder sleeve until rings melt and flow along the cable jacket.
- (e) After installing the braided solder sleeve, the braided solder sleeve must not be cut or split. Shield strands must not extend through the braided solder sleeve.

Table 210. Environmental Resistant Shielded Cable Splices

NUMBER OF CONDUCTORS	WIRE SIZE (AWG)	PART NUMBER *
1 (Shielded Single)	20 - 26	D150-0168
	16 - 20	D150-0169
	12 - 16	D150-0170
2 (Shielded Pair)	20 - 26	D150-0174
	16 - 18	D150-0175
	14	D150-0176
	12	D150-0177
3 (Shielded Triple)	24 - 26	D150-0178
	20 - 22	D150-0179
	16 - 18	D150-0180
	12 - 14	D150-0181

8. Terminals - General

- A. The crimped impression shall be centered on the portion of the barrel intended to grip the conductor.
- B. The wire shall be inserted into the barrel the full length of the barrel.
- C. The wire shall not protrude beyond the end of the barrel more than 0.05 inch and shall not interfere with installation of washers, nuts, or screws.
- D. The following terminals are used on the engine starter/generator: For 16 gage wires used on starter/generator terminals A and D, use MS20659-104. For 16 and 20 gage wires used on starter/generator terminal E, use AMP 50848 (both wires are inserted into one terminal).

9. Standard Insulated Terminals

- A. On standard insulated terminals, the insulation shall be fully within the insulation grip.
- B. Refer to Table 211 for standard insulated terminal information.

Table 211. Standard Insulated Terminals

WIRE SIZE (AWG)	COLOR	STUD SIZE	PART NUMBER
22-18	RED	4	MS25036-148
22-18	RED	6	MS25036-102
22-18	RED	8	MS25036-149
22-18	RED	10	MS25036-103
22-18	RED	1/4	MS25036-150
22-18	RED	5/16	MS25036-104
22-18	RED	3/8	MS25036-105
16-14	BLUE	4	MS25036-152
16-14	BLUE	6	MS25036-106
16-14	BLUE	6	MS25036-107
16-14	BLUE	8	MS25036-153
16-14	BLUE	10	MS25036-108
16-14	BLUE	1/4	MS25036-154
16-14	BLUE	5/16	MS25036-109
16-14	BLUE	3/8	MS25036-110

WIRE SIZE (AWG)	COLOR	STUD SIZE	PART NUMBER
12-10	YELLOW	6	MS25036-111
12-10	YELLOW	8	MS25036-156
12-10	YELLOW	10	MS25036-112
12-10	YELLOW	1/4	MS25036-157
12-10	YELLOW	5/16	MS25036-113
12-10	YELLOW	3/8	MS25036-114
8	RED	10	MS25036-115
8	RED	1/4	MS25036-116
8	RED	5/16	MS25036-117
8	RED	3/8	MS25036-118
6	BLUE	10	MS25036-119
6	BLUE	1/4	MS25036-120
6	BLUE	5/16	MS25036-121
6	BLUE	3/8	MS25036-122
4	YELLOW	10	323052 *
4	YELLOW	1/4	MS25036-123
4	YELLOW	5/16	MS25036-124
4	YELLOW	3/8	MS25036-125
2	RED	1/4	MS25036-126
2	RED	5/16	2-328942-1 *
2	RED	3/8	MS25036-127

10. Insulation Restricting Terminals

- On insulation restricting terminals, the insulation shall be bottomed-out against the restrictor fully within the insulation grip.
- Refer to Table 212 for insulation restricting terminal information.

Table 212. Insulation Restricting Terminals

WIRE SIZE (AWG)	INSULATING SLEEVE COLOR	IDENT COLOR CODE	STUD SIZE	LOOSE PIECE * PART NUMBER
22	RED	GREEN	4	52273
22	RED	GREEN	6	51863-2
22	RED	GREEN	8	1-320551-2
22	RED	GREEN	10	2-36153-3
22	RED	GREEN	1/4	2-320571-3
22	RED	GREEN	5/16	2-320572-2
22	RED	GREEN	3/8	2-320573-1
20	RED	RED	4	52273-1
20	RED	RED	6	51863-3
20	RED	RED	8	1-320551-3
20	RED	RED	10	2-36153-4
20	RED	RED	1/4	2-320571-4
20	RED	RED	5/16	2-320572-3

WIRE SIZE (AWG)	INSULATING SLEEVE COLOR	IDENT COLOR CODE	STUD SIZE	LOOSE PIECE * PART NUMBER
20	RED	RED	3/8	2-320573-2
18	RED	WHITE	4	52273-2
18	RED	WHITE	6	51863-4
18	RED	WHITE	8	1-320551-4
18	RED	WHITE	10	2-36153-5
18	RED	WHITE	1/4	2-320571-5
18	RED	WHITE	5/16	2-320572-4
18	RED	WHITE	3/8	2-320573-3
16	BLUE	BLUE	6	51864-6
16	BLUE	BLUE	8	1-51864-0
16	BLUE	BLUE	10	51864-7
16	BLUE	BLUE	1/4	2-320563-3
16	BLUE	BLUE	5/16	2-320575-2
16	BLUE	BLUE	3/8	2-320564-1
14	BLUE	GREEN	6	51864-8
14	BLUE	GREEN	8	1-51864-1
14	BLUE	GREEN	10	51864-9
14	BLUE	GREEN	1/4	2-320563-4
14	BLUE	GREEN	5/16	2-320575-3
14	BLUE	GREEN	3/8	2-320564-2
12	YELLOW	YELLOW	6	2-36161-5
12	YELLOW	YELLOW	8	2-320568-2
12	YELLOW	YELLOW	10	2-36161-3
12	YELLOW	YELLOW	1/4	2-320569-5
12	YELLOW	YELLOW	5/16	2-320576-2
12	YELLOW	YELLOW	3/8	2-320577-1
10	YELLOW	BROWN	6	2-36161-6
10	YELLOW	BROWN	8	2-320568-3
10	YELLOW	BROWN	10	2-36161-4
10	YELLOW	BROWN	1/4	2-320569-6
10	YELLOW	BROWN	5/16	2-320576-3
10	YELLOW	BROWN	3/8	2-320577-2

11. Flag Terminals

- A. For standard flag terminals refer to Table 213. For terminals used on fuel quantity probes in the fuel cell refer to Table 214.

Table 213. Standard Flag Terminals

WIRE SIZE (AWG)	STUD SIZE	PART NUMBER
8	8	MS25189-1
8	10	MS25189-2
8	1/4	MS25189-3

WIRE SIZE (AWG)	STUD SIZE	PART NUMBER
8	5/16	MS25189-4
8	3/8	MS25189-5
8	1/2	MS25189-6
6	10	MS25189-7
6	1/4	MS25189-8
6	5/16	MS25189-9
6	3/8	MS25189-10
6	1/2	MS25189-11
4	10	MS25189-12
4	1/4	MS25189-13
4	5/16	MS25189-14
4	3/8	MS25189-15
4	1/2	MS25189-16
2	10	MS25189-17
2	1/4	MS25189-18
2	5/16	MS25189-19
2	3/8	MS25189-20
2	7/16	MS25189-21
2	1/2	MS25189-22

NOTE: The flag terminals listed in Table 214 are for use in fuel cells.

Table 214. Fuel Quantity Probe Flag Terminals

NAME	PART NUMBER	MANUFACTURER
#6 Terminal	36195	AMP Inc. V00779
#8 Terminal	34117	AMP Inc. V00779
#10 Terminal	34118	AMP Inc. V00779
Crimper	WT111M	Thomas and Betts
#6 Terminal	AB51	Thomas and Betts
#8 Terminal	AB52	Thomas and Betts
#10 Terminal	AB53	Thomas and Betts

12. CHECKING TERMINALS AND SPLICES

A. Electrical Resistance.

- (1) Properly installed terminals and splices shall offer no more resistance across the terminal than an equivalent length of wire of the same gage to which the terminal is attached.

B. Tension Load Testing.

- (1) To test crimping tools used for installing terminals and splices, a sample wire and terminal or splice should withstand the tension loads in Table 215.

CAUTION: TENSION LOADS ARE FOR A TEST SAMPLE. DO NOT PERFORM TENSION LOAD TEST ON WIRING INSTALLED IN AN AIRPLANE.

Table 215. Minimum Tension Load for Installed Terminals and Splices

ALUMINUM WIRE AND TERMINALS

WIRE SIZE	8	6	4	2	1	0	00	000	0000
LOAD IN POUNDS	130	200	300	500	700	900	1100	1300	1500

OTHER TYPE WIRE AND TERMINALS

WIRE SIZE	24	22	20	18	16	14	12	10	8	6	4	2	0
LOAD IN POUNDS	10	15	19	38	50	70	110	15	220	300	400	550	700

HEAT SHRINKABLE TUBING - MAINTENANCE PRACTICES

1. General

- A. Heat shrink tubing may be used to cover splices, terminals and short sections of wire where the insulation has been damaged.
- B. Some types of shrink tubing are coated inside with sealant, which melts when the tube shrinks, to provide moisture resistant seal to prevent corrosion.
- C. Heat shrink tubing shrinks to approximately one-half diameter when heated to approximately 250°F for a few seconds.

2. Tools and Equipment

- A. A heat gun part number CV5600 (or equivalent) is required and is available through Raychem Corp. [V06090](#)

3. Use of Shrink Tubing

- A. Place shrink tubing on wire away from splice or terminal area.
- B. Install splice or terminal in normal way.
- C. Slide shrink tubing over splice or terminal as required.
- D. Heat shrink tubing with heat gun until tubing has shrunk firmly around splice or terminal.

CAUTION: PROTECT ADJACENT AREAS FROM HEAT AS HEAT GUN PRODUCES IN EXCESS OF 250°F AIRFLOW.

4. Heat Shrink tubing

- A. Heat shrink tubing with sealant is available through AMP Inc.. [V00779](#)

Part number 54081-1 can be used for wire diameters of 0.18 thru 0.3 inches.
Part number 54021-1 can be used for wire diameters of 0.26 thru 0.6 inches.

- B. Heat Shrink tubing without sealant (Mil-I-23053/5) is available through Raychem Corp. [V06090](#) Class 1 tubing is flame resistant and class 3 tubing is highly flame resistant. Refer to Table 201 to determine the correct base part number, then refer to Table 202 to determine the correct color code.

Table 201. Class 1 and Class 3 Tubing

PART NUMBER	AS SUPPLIED ID MINIMUM	ID MAXIMUM (AFTER SHRINKAGE)
Class 1		
M23053/5-101-*	0.046	0.023
M23053/5-102-*	0.063	0.031
M23053/5-103-*	0.093	0.046
M23053/5-104-*	0.125	0.062
M23053/5-105-*	0.187	0.093
M23053/5-106-*	0.250	0.125
M23053/5-107-*	0.375	0.187
M23053/5-108-*	0.500	0.250
M23053/5-109-*	0.750	0.375
M23053/5-110-*	1.000	0.500
M23053/5-111-*	1.500	0.750
M23053/5-112-*	2.000	1.000
M23053/5-113-*	3.000	1.500
M23053/5-114-*	4.000	2.000
Class 3		
M23053/5-301-*	0.046	0.023
M23053/5-302-*	0.063	0.031
M23053/5-303-*	0.093	0.046
M23053/5-304-*	0.125	0.062

PART NUMBER	AS SUPPLIED ID MINIMUM	ID MAXIMUM (AFTER SHRINKAGE)
M23053/5-305-*	0.187	0.093
M23053/5-306-*	0.250	0.125
M23053/5-307-*	0.375	0.187
M23053/5-308-*	0.500	0.250
M23053/5-309-*	0.750	0.375
M23053/5-310-*	1.000	0.500
M23053/5-311-*	1.500	0.750

* The asterisk in the part number shall be replaced by color code designations.

Table 202. Color for Class 1 and 3 Tubing

Designator	Color	Designator	Color
0	Black	5	Green
1	Brown	6	Blue
2	Red	7	Violet (Purple)
3	Orange	8	Gray (Slate)
4	Yellow	9	White

5. End Caps

- A. End caps should be used to terminate a wire or coax cable when not in use. Table 203 lists part numbers for end caps available through Raychem Corp. [V06090](#)

Table 203. End Caps

SIZE	PART NUMBER
0.75 long	TC4001
1.0 long	TC4003
1.125 long	TC4005

RESISTORS - MAINTENANCE PRACTICES

1. General

- A. This section provides a chart for determining the value of resistors, and shows some typical part numbers and how to determine the value from the part number.
- B. When a resistor burns out, the cause frequently will be a malfunction in some other part of the circuit. Check for shorted wires or other malfunction that could cause excessive current.
- C. Color codes for resistors. Refer to [Figure 201](#).
- D. Part number value guide.
 - (1) CM3527 is 0.5 watt. CM3526 is 1 watt. These are Cessna engineering standards which are followed by a dash number for the complete part number.
 - (a) The first number after the dash is the first digit.
 - (b) The second number after the dash is the second digit.
 - (c) The third number after the dash is the number of zeros.
 - (d) The fourth letter is the tolerance: G = plus or minus 5 percent S = plus or minus 10 percent.

EXAMPLE: CM3527-430G is 43 ohms, one-half watt, plus or minus 5 percent.

- (e) For values less than 10 ohms, R is used in place of the second number and represents a decimal for the value.

Example: CM3527- 2R7G is 2.7 ohms, one-half watt, plus or minus 5 percent.

Figure 201 : Sheet 1 : Resistor Part Numbers

A4043

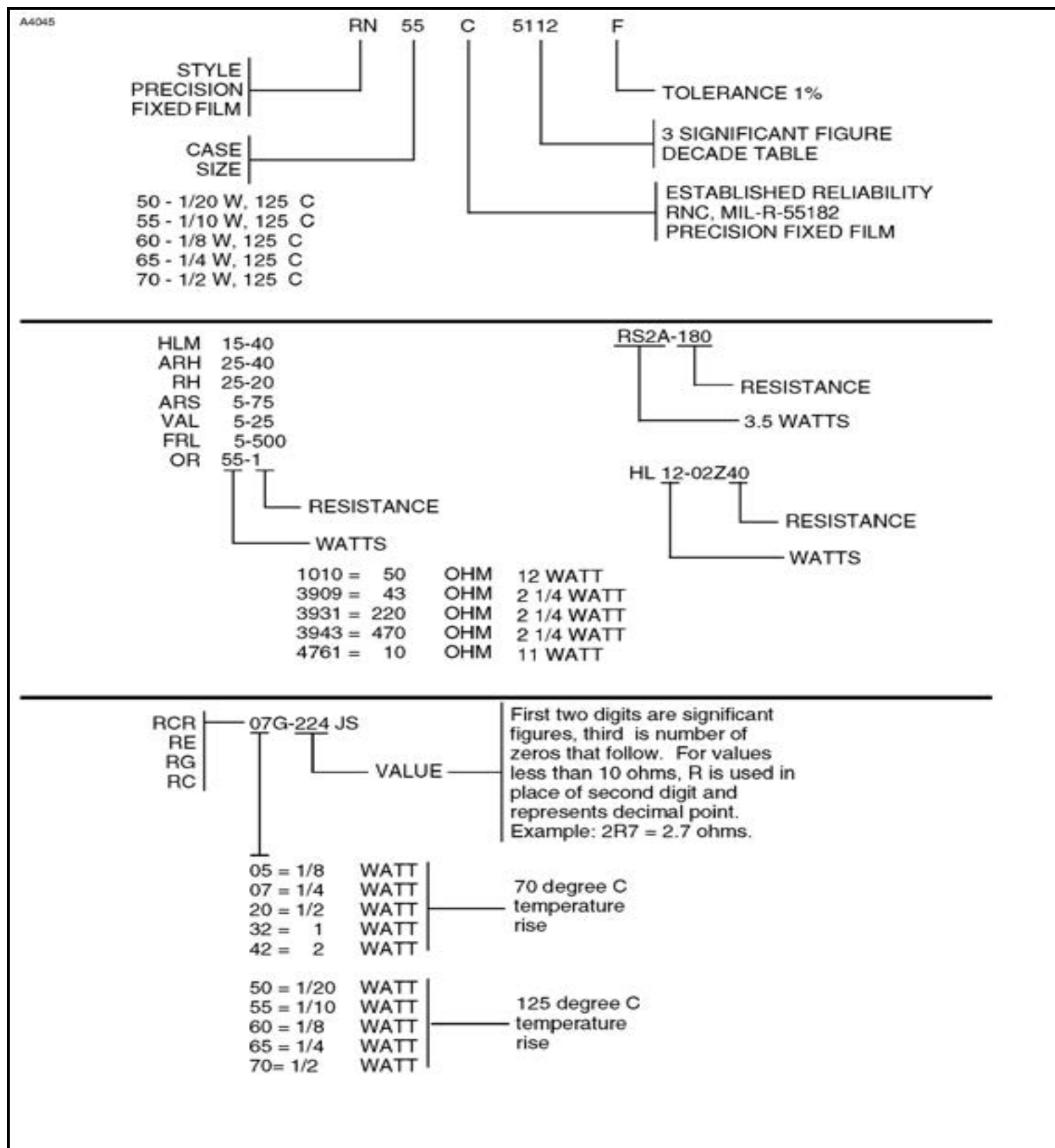


Resistor Color Code Application Table

COLOR	FIRST DIGIT A	SECOND DIGIT B	MULTIPLIER C	TOLERANCE D
BLACK	0	0	1	
BROWN	1	1	10	
RED	2	2	100	
ORANGE	3	3	1,000	
YELLOW	4	4	10,000	
GREEN	5	5	100,000	
BLUE	6	6	1,000,000	
VIOLET	7	7	10,000,000	
GRAY	8	8	100,000,000	
WHITE	9	9	1,000,000,000	
GOLD			0.1	+5, -5 Percent
SILVER			0.01	+10, -10 Percent
NO COLOR				+20, -20 Percent

6218T1375

Figure 201 : Sheet 2 : Resistor Part Numbers



TORQUE VALUES FOR THREADED FASTENER - MAINTENANCE PRACTICES

1. General

- A. These torque values are for electrical current carrying fasteners.
- B. Threads should be free of dust, metal filings and other material.
- C. Lubricants should not be added to any bolt.

2. Torque Values

- A. All threaded electrical current carrying fasteners for relay terminals, shunt terminals, fuse limiter mount block terminals, and bus bar attaching hardware should be torqued per [Table 201](#).

Table 201. Threaded Current Carrying Fasteners

FASTENER DIAMETER	TORQUE IN INCH-POUNDS
3/16	20-30
1/4	40-60
5/16	80-100
3/8	105-125
1/2	130-150

- B. All threaded fasteners at airframe ground terminals should be torqued per [Table 202](#).

Table 202. Threaded Ground Fasteners

FASTENER DIAMETER	TORQUE IN INCH-POUNDS
5/16	130-150
3/8	160-190

SEALING OF ELECTRICAL CONNECTORS - MAINTENANCE PRACTICES

1. General

- A. This section describes procedures for sealing electrical connectors where protection from moisture is required.

2. Tools and Equipment

- A. The materials (or equivalent) listed in [Table 201](#) are required.

Table 201. Tools and Equipment

NAME	NUMBER	MANUFACTURER	USE
Sealant	Silastic 738	Dow Corning 3901 S. Saginaw Road Midland, MI 48640	Potting connectors.
Cleaning solvent	Mozel Number 18	Mozel Chemical Prod. Co. 4003 Park Ave. St. Louis, MO 63110	Cleaning.
Cleaning solvent	Methyl n-propyl keytone	Commercially available	Cleaning.
Parting agent	MS-122 fluorocarbon	Miller-Stephenson Chemical Co., Inc. George Washington Highway P.O. Box 950 Danbury, CT 06810	For separation.
Parting agent	Resin- Release-N	General Mills, Inc. 9200 Wayzata Blvd. P.O. Box 1113 Minneapolis, MN 55440	For separation.
Etching supplies	Tetra-Etch	W.L. Gore and Associates 555 Paper Mill Road Newark, DE 19711	For etching.
Cheesecloth, Lint-free		Commercially available	For applying solvent.

3. Cleaning

- A. All surfaces to which sealant or primer is to be applied should be cleaned and dried immediately prior to sealant application. Remove all dust, lint, chips and shavings.
- B. Cleaning shall be accomplished by scrubbing the surfaces with a brush or cheesecloth moistened with solvent. It is essential that only clean cloths and clean solvent be used in the cleaning operations.

4. Etching

- A. All areas of insulation materials which contain fluorine, such as, Teflon or Kevlar, to which sealant is to adhere, should be cleaned per [paragraph 3](#), and then etched in accordance with the manufacturer's instructions and recleaned before sealing.

5. Sealant Application

- A. Before application of sealant, check all wires to make sure they are properly attached and in the correct position.
- B. After sealant is applied, joints should not be flexed until sealant is tack-free.
- (1) At 77°F, sealant will require 20 minutes to be tack-free.
 - (2) Seventy-two hours is required to cure sealant thickness of one-eighth inch or thicker.
- C. Carefully insert the nozzle into the center of the wires. Inject the sealant keeping the nozzle slightly below the surface of the sealant.
- (1) The injection shall be done slowly to allow the sealant to flow between the wires as it rises. Entrapped air may be released by vibration or lightly tapping the receptacle on a firm surface.

- (2) Do not damage connector contacts.
- D. When the nozzle cannot be inserted between the wires because of spacing, insert the nozzle to one side of the wires and as near to the center as possible without forcing.
- E. Application continues until the mold is filled.
 - (1) Backshells should be filled to a minimum height of 0.25 inch above the top of the longest contact or the highest shield termination.
 - (2) Complete filling of backshell is preferred.
- F. Entrapment of air within sealants must be avoided in all cases. Air bubbles act as reservoirs for moisture buildup which may lead to short circuits.