STANDARD OVERHAUL PRACTICES MANUAL

REPAIR OF PRINTED CIRCUIT ASSEMBLIES AND COMPONENT BOARD ASSEMBLIES

PART NUMBER NONE

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To: All holders of REPAIR OF PRINTED CIRCUIT ASSEMBLIES AND COMPONENT BOARD ASSEMBLIES 20-11-01.

Attached is the current revision to this STANDARD OVERHAUL PRACTICES MANUAL

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

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INTRODUCTION

1. General

A. The instructions in this manual tell how to do standard shop procedures during maintenance functions from simple checks and replacement to complete shop-type repair.

B. This manual is divided into separate sections:

(1) Title Page

(2) Transmittal Letter

(3) Highlights

(4) Effective Pages

(5) Contents

(6) Revision Record

(7) Record of Temporary Revisions

(8) Introduction

(9) Procedures

C. Refer to SOPM 20-00-00 for a definition of standard industry practices, vendor names and addresses, and an explanation of the True Position Dimensioning symbols used.

D. The data is general. It is not about all situations or specific installations. Use it as a guide to help you write minimum standards.

E. If the component overhaul instructions are different from the data in this subject, use the component overhaul instructions.

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REPAIR OF PRINTED CIRCUIT ASSEMBLIES AND COMPONENT BOARD ASSEMBLIES

1. INTRODUCTION

A. The data in this subject comes from Boeing Process Specifications as listed below. The airline has a copy of the Boeing Process Specification Manual.

B. The data is general. It is not about all situations or specific installations. Use this data to help you write minimum requirements.

C. For more details, refer to these Boeing Process Specifications.

(1) BAC5162-60 – Assembly of BACC65-series connectors

(2) BAC5128 – Requirements for Electrical/Electronic Assemblies, which replaces

(a) BAC5850 – Polyurethane Resin Conformal Coating

(b) BAC5853 – Installation of Electronic Parts on Printed Circuit Boards

D. This subject tells you how to repair printed circuits where components are mounted in holes through the board. For removal and replacement of surface mounted components, refer to SOPM 20-11-07. For removal and replacement of ball grid array components, refer to SOPM 20-11-10.

E. Refer to SOPM 20-00-00 for a list of all the vendor names and addresses.

2. DEFINITIONS

NOTE: BAC5035 is a glossary of many general electrical and electronic terms. Some of the terms used in this subject are given below.

A. Circuit Pads – areas along the metal circuit pattern which are shaped or drilled to permit connection to the leads of the components.

B. Component Board Assembly – a board that has components installed on it, but the electrical connections are not made by the etch procedure.

C. Conformal Coating – see Encapsulant

D. Dual in Line Flat Pack – an electronic component in a rectangular shape with two parallel rows of pins or leads that extend from opposite sides of the part and are then bent downwards.

E. Encapsulant (coating) – a layer of acrylic, polyurethane, or other material applied to a circuit to give protection from abrasion, moisture, and help hold components in position.

F. Etched Circuit Board – a board with the metal circuit pattern made by a chemical procedure.

G. Feed-Through or Interconnect – a wire or swaged hardware device through a circuit board to make electrical connection between the circuit on one side and the circuit on the other side.

H. Flat Pack – a configuration of electronic component with ribbon leads that extend from the edges.

I. Icicle – a sharp cone-shaped point in the solder of a connection.

J. Printed Circuit Assembly (PCA) – an etched circuit board with components installed.

K. Printed Circuit Board (PCB) – an etched circuit board without the components installed.

L. TO-Type Can – a configuration of electronic component which is a metal cylinder with wire leads that come out from the bottom (for commonly used low power transistors and integrated circuits).

3. GENERAL

CAUTION: MANY OF THESE COMPONENTS CAN BE DAMAGED BY ELECTROSTATIC DISCHARGE. IF YOU SEE YELLOW, STATIC-SENSITIVE, CAUTION LABELS, REFER TO SOPM 20-12-02 FOR INSTRUCTIONS.

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(CAUTION PRECEDES)

A. Be careful with all electronic components to prevent problems with lead stress, dents, scratches, twists, or cracks.

B. Do not use a lead pencil or other conductive material which can leave a conductive residue to trace circuitry, or to touch any part of the board or any electronic part.

C. Compressed air, as in forced air dryers, must have a maximum of 3 ppm by weight of hydrocarbons at the work.

D. Install all components to let you see part numbers and serialized labels. If the data comes off or cannot be seen after installation, you can mark or identify it again as necessary.

E. Always hold boards by their edges, but not by the electric contact edge.

F. To help prevent damage to the units, use cushioning material on the work bench surface, such as a 1/8 inch or thicker rubber mat. BAC5485 gives recommended items.

G. Examine the electronic unit if it fell 6 inches or more onto a hard surface. Do tests as necessary.

H. If damage occurs during overhaul, repair it the same as an original defect.

I. Be careful not to damage adjacent components. If necessary, remove adjacent components that prevent removal of a bad component.

J. Remove as one unit the bad components mounted on heat sinks when the heat sink is attached to the board, unless the heat sink is riveted to the board. Then the component can be removed from the heat sink without removal of the heat sink from the board.

K. Printed circuit boards are serviceable if there is only a small change in color because of heat. A board is not serviceable if it is charred, blistered, if the laminations break apart, or if the epoxy coating is burned or melted because of too much heat.

L. When you install bare conductors, keep a 0.10 inch minimum air gap from other bare metal conductors or parts.

M. Do not put tension or compression on leads in the finished assembly. Components with rigid leads mounted by threaded fasteners must have the fasteners fully tightened before soldering. Do not loosen or tighten mounting screws and nuts after soldering.

N. Do not try to move, pull or push a component or lead as a check of the mechanical strength of a solder joint. This will cause poor or broken solder connections and could tear the copper from the board.

O. If the overhaul instructions tell you to bond parts to the circuit board, but the adhesive is not specified, bond them with Type 69 or Type 52 per SOPM 20-50-12 (Figure 1).

P. Do not bend a board to remove the warp. You could break the board or pull the components loose. The warp will be removed when the board is mounted.

   (1) When measured by this procedure, the warp or twist of the circuit board must not be more than 1.5 percent.

      (a) Put the loose board by itself on a flat, horizontal surface with the convex surface up.

      (b) Measure the height of the convex upper surface. Subtract the thickness of the board. Divide by the length of the longest side and convert to a percent.

   (2) Measurement is not necessary if you can see that the circuit board does not have too much warp.

Q. Do not put printed boards in a stack. Put them side by side on their edges.

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R. Clean contamination from the leads with gauze or swab and isopropyl alcohol.

S. Tin leads as necessary, as given in BAC5128.

T. Install all parts to prevent small spaces that could catch flux residues. Solder by hand the parts and wires that could catch flux.

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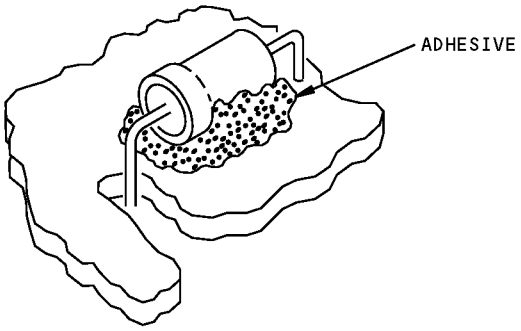

Part Bonding
Figure 1

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4. FAULT ISOLATION AND REPAIR QUALITY CHECKS

A. Visually examine all electronic equipment before all tests and after all repairs. This inspection is to make sure you find obvious defects first, to make sure the repairs did not cause more damage, and to look for defects that could cause more damage if power is applied. Use 4X to 10X magnification if necessary. The board must not have these defects:

(1) Drops of solder

(2) Sharp points (icicles) on the solder surfaces

(3) Terminals, leads, or pad base metal areas without conformal coating

(4) Damage other than small concave empty spaces (indentations)

(5) Rough holes

(6) Probe holes not repaired with conformal coating

(7) Overheated electronic components

(8) Loose or missing mechanical hardware

(9) Defective operation of mechanical controls

(10) Frayed, burnt, pinched or broken wires

(11) Loose components or circuit cards

(12) Defects in mechanical, crimped or soldered connections

(13) Missing, damaged, recessed or bent connector contacts

(14) Defects in insulation around contacts

(15) Defects in the case

(16) All defects (such as nicks, scratches, dents) in the conductor surface must not decrease the cross section area of the conductor more than 20 percent along no more than 0.80 inch of the conductor

B. Touch instrument probes to the solder joints or the component leads only.

C. Use instrument probes with small, sharp points to go through the encapsulant. Hold the probe perpendicular to the encapsulant surface to make the hole as small as possible.

D. If you attach probe clips to component leads, be careful not to damage the leads.

E. After the repair, do functional tests as necessary to be sure that the problem is gone.

F. Clean and apply conformal coating to the probe holes and the repaired areas.

G. Be sure to replace markings which were removed.

5. REMOVAL OF CONFORMAL COATING (ENCAPSULANT)

CAUTION: WHEN YOU CLEAN CIRCUIT BOARDS OR REMOVE THE CONFORMAL COATING, FIRST TRY THE PROCEDURES FOR REMOVAL OF ACRYLIC COATING IN A SMALL TEST AREA BECAUSE ISOPROPYL ALCOHOL REMOVES ACRYLIC COATING.

A. Apply a small amount of isopropyl alcohol to a small test area. If the conformal coating becomes soft and removable, continue with this procedure to remove the conformal coating at the damaged area. If the coating stays hard, use the procedures for removal of polyurethane coatings or parylene as necessary. If the conformal coating is soft before you apply the alcohol, it could be a silicone coating that you can easily peel off. Then use the procedure for removal of silicone coatings.

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CAUTION: BE CAREFUL NOT TO CUT OR CAUSE DAMAGE TO THE ADJACENT COMPONENTS OR THE FIRST FIBERGLASS LAYER OF THE BOARD.

B. Break the bond between the encapsulant on the board and the component, with long nose pliers or a sharp cutting tool (scalpel). Push and pull in a direction perpendicular to the longitudinal axis of component.

NOTE: To help you remove the encapsulant coating, you can heat the board to 210°F. maximum for no more than 20 minutes.

(1) As an alternative, apply a soldering iron with a component-removal tip. Be careful not to apply too much heat to adjacent electronic components during removal operations.

(2) Use wire braid to soak up the melted encapsulant. Add a small amount of solder flux to help soak up the melted encapsulant.

CAUTION: BE VERY CAREFUL WHEN YOU REMOVE CONNECTORS WHICH HAVE CONFORMAL COATING. THE CIRCUIT BOARD CAN BE DAMAGED.

C. Remove encapsulant from connector pin solder joints on the circuit side of the board and also on the screws which attach the connector. Refer to Paragraph 10. on how to remove connectors.

D. Mechanically remove encapsulant from the terminals and back 0.25 inch on all leads and jumper wires attached.

E. Remove a sufficient amount of encapsulant around heat sinks and attaching hardware to make the bond weak for removal.

F. Remove conformal coatings only in a clean work area. Cut and scrape carefully.

G. To remove polyurethane and epoxy coatings:

(1) Soften the coating with heat. Heat the assembly to 210°F maximum for no more than 20 minutes.

(2) Remove the polyurethane from the part with a vacuum-solder removal device. Remove parts per Paragraph 9. Do not burn or damage the adjacent encapsulant area.

(3) Apply acetone or methyl ethyl ketone to a local area of the encapsulant for faster removal of the Humiseal 1A33 polyurethane coating. The assembly temperature can be at the usual air temperature or increased to 210°F maximum. Apply solvent with a rigid brush or a cotton swab with a strong movement to remove the encapsulant.

H. To locally remove acrylic coatings, use isopropyl alcohol or toluene and a clean cotton swab or pipe cleaner.

I. To remove all acrylic coatings from the unit:

(1) Put the part fully into isopropyl alcohol or toluene for 10 minutes maximum. Do not use toluene on parts without a hermetic seal.

(2) Or, as an alternative, put the part into 1,1,1 trichloroethane (vapor degreaser) gas for one minute maximum. Then spray each side one minute maximum with 1,1,1 trichloroethane.

(3) Apply acetone or methyl ethyl ketone to a local area of the encapsulant for faster removal of the Humiseal 1A33 polyurethane coating. The assembly temperature can be at the usual air temperature or increased to 210°F maximum. Apply solvent with a rigid brush or a cotton swab with a strong movement to remove the encapsulant.

J. To remove Uralene 5750 coating:

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(1) Apply Uralene 5750 thinner to the local area of the encapsulant for faster removal of the Uralene 5750 coating. Apply the solvent with a rigid brush or a cotton swab with a strong movement to remove the encapsulant.

(2) Also, you can apply toluene or methyl ethyl ketone to a local area to remove Uralene 5750 coating. Apply the solvent with a rigid brush or a cotton swab with a strong movement to remove the encapsulant.

K. To remove Parylene C conformal coating:

(1) Make a hole in the coating.

(2) Remove the coating with tweezers. A small strip (lip) of less than 5 mils of lifted coating is permitted.

L. To remove silicone coatings such a Sylgard or Dow-Corning RTV 3140:

(1) These coatings are removable by hand, but old coatings could be hardened or without edges to pull on. Then you can use a scalpel or equivalent to carefully cut into the coating.

(2) Remove other coatings, such as polyurethane or acrylic conformal coatings, if necessary.

(3) Replace components as necessary.

(4) Fully clean the surfaces with isopropyl alcohol. Let the surfaces air dry.

6. REMOVAL OF CONDUCTORS AND EDGE CONTACTS

A. Internal Conductors

(1) At locations other than at plated-through holes:

(a) Use a location on the conductor which has sufficient clearance from adjacent conductors.

(b) Use the clearance hole procedures of Paragraph 6.C. to drill a hole through at this location to cut the conductor.

(c) Use a drill, a drill with an end mill cutter or bottom drill (180 degree point), an engraving burr or a ball mill. The drill, end mill, engraving burr or ball mill must not touch the circuit traces below the hole.

(d) The hole must isolate the conductor ends by 0.010 inch minimum. More holes can be drilled to isolate the conductor ends.

(e) Examine the sides and bottom of the hole with a 10X to 30X magnification lens for copper particle contamination. (See Figure 2).

(f) Flush with isopropyl alcohol to remove copper particles. A rough wall is permitted. Gouges, pits or tearouts are not permitted.

(g) For a conductor that is not above other conductors, drill a hole completely through the printed wiring board. Examine the hole, as above.

(h) Fill the hole with epoxy resin BMS 5-72, Type 1, or Type 52 adhesive, or with Scotchcast 251. No bubbles are permitted in the filled hole.

(2) At plated-through hole locations:

(a) Drill out a plated-through hole as specified in Paragraph 6.C.

(b) Drill the hole no larger than necessary to remove the through-plating.

(c) Fill the hole with epoxy as specified above.

(d) If a surface conductor is to be connected, drill a new hole for the lead.

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(e) If the overhaul instructions do not specify the hole size, drill the hole diameter to 0.010-0.015 inch larger than the specified component or lead diameter to be installed in the hole.

B. Surface Conductors

(1) Carefully cut through the conductor with a sharp knife or scalpel. Do not damage adjacent conductors or circuit board base laminates below the first layer of glass fiber.

(2) Remove the piece of the conductor from the circuit board.

(3) Remove a minimum length of 0.01 inch of conductor where the circuit is to be stopped.

(4) Remove all particles of the conductor.

(5) Apply a layer of Type 52 adhesive to the first layer of glass fiber.

C. Clearance Holes Through Thermal, Ground and Power Planes

(1) Drilled holes must meet these requirements:

(a) When not specifically dimensioned, keep hole locations away from conductors on other layers whenever possible.

(b) Hold the assembly tightly to not let it move or bend during drilling operations.

(c) Use only solid carbide drills. Drill no more than 200 holes with each drill.

(d) Examine each drill for damage before you use it again.

(e) Primary cutting edges must be sharp and free of chips and nicks. Nicks up to 0.002 inch are acceptable on margin cutting edges.

(f) Drill the hole to be larger than the given lead size by 0.040 inch minimum unless a specific size is given.

(2) Clean the drilled holes to the requirements of step (4) below.

(a) For assemblies which have static sensitive parts installed, use a hand-held reamer or twist drill 0.001-0.005 inch larger than the drill used.

(b) For all other assemblies, clean the holes with a dry abrasive:

NOTE: Do not apply the dry abrasive to the complete assembly.

1) Use 27 micron aluminum oxide abrasive in an air or gas jet at 60-80 psi.

2) Hold the abrasive cleaning nozzle perpendicular to the surface of the board and at a distance to produce a spray pattern larger than the diameter of the hole.

3) Clean the holes from each side of the board. Clean each hole for no more than 4 seconds.

4) Blow loose particles from the holes with air.

(3) Flush abrasive from the assembly and the clean hole with isopropyl alcohol and let it dry in the air.

(4) Examine all of the hole wall at 10X to 30X magnification and light from the rear and at the surface.

(a) Copper annular rings must be completely visible. The hole must be uniform. Copper annular rings must be bright with continuous, sharp, distinct edges. Abrasion on the surface of the board is acceptable if it is not more than 0.030 inch from the edge of the hole and does not damage pads or circuitry. Exposed copper extending no more than 0.030 inch from the edge of the hole is acceptable.

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(b) There must be no loose or rubbed-in copper particles or burrs.

(c) There must be no loose epoxy particles or epoxy smear.

(d) There must be no visually detectable inner layer nail heading.

(e) There must be no torn out epoxy or fiberglass material from the hole wall, or gouging of copper layers where the bottom of the hole cannot be seen at a viewing angle of 45 degrees or less. (See Figure 3).

(5) Fill the hole with Scotchcast 251, BMS 5-72, Type 1 or Type 52 adhesive. There must be no bubbles or bare locations larger than 0.010 inch or which make an overlap between conductors.

(6) Visually examine all of each hole.

D. Removal of edge contacts which are not used.

(1) Do not remove more than 3 edge contacts from each side of a printed circuit board. Such contacts must not connect to any circuits and are to be removed because they are unwanted, damaged, are not plated correctly and for other faults. Do not damage the fiberglass.

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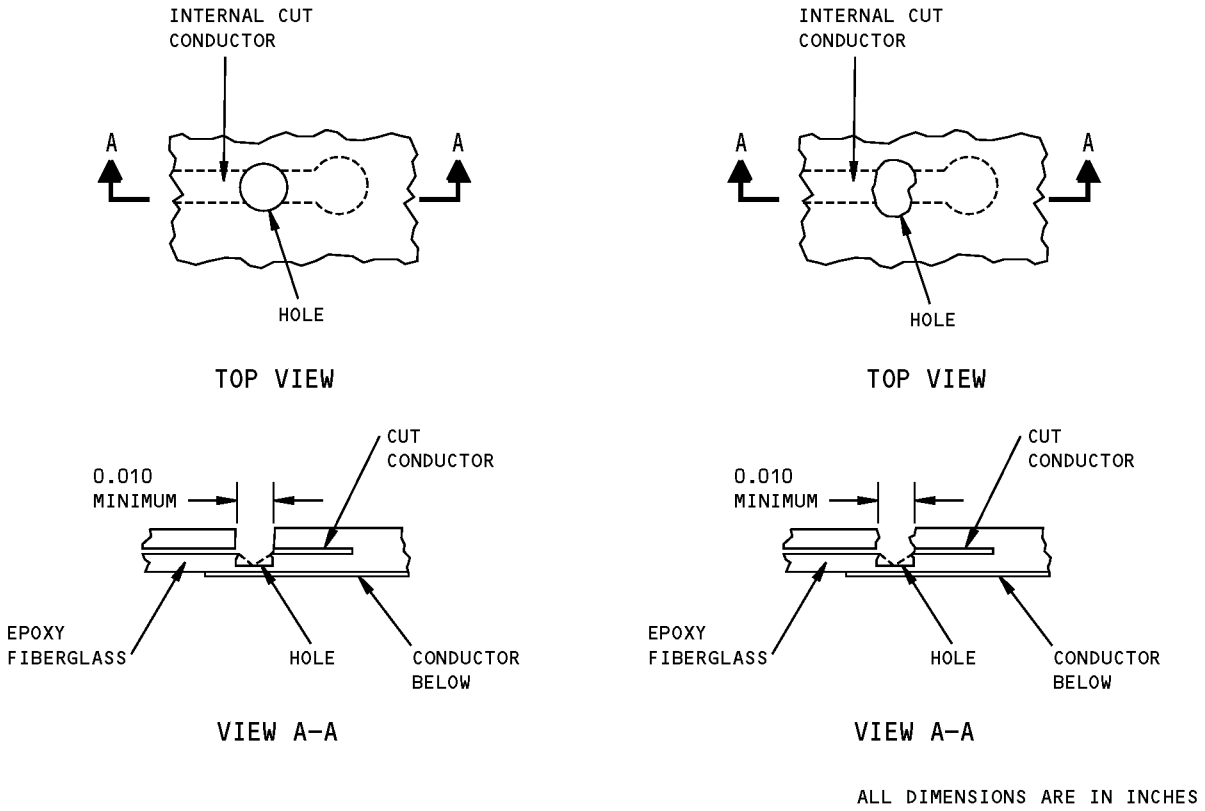

PREFERRED REMOVAL OF CONDUCTOR ON INTERNAL LAYER

ACCEPTABLE REMOVAL OF CONDUCTOR ON INTERNAL LAYER

Removal of Internal Conductor
Figure 2

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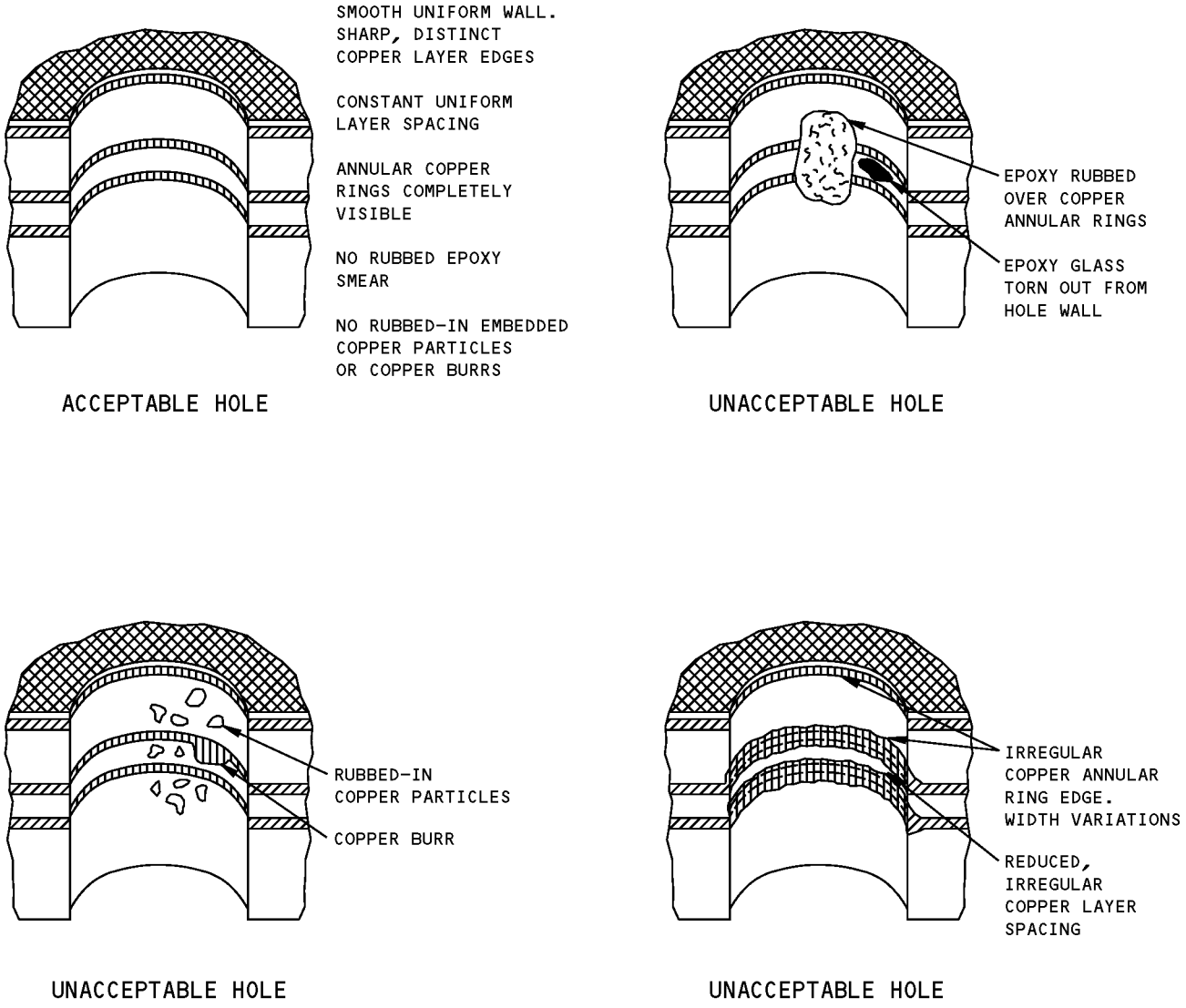

Clearance Holes
Figure 3

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7. REPAIR OF CONDUCTOR FOILS

A. Use these procedures to repair lifted or damaged surface conductors. Because the bond between the conductor foil and the board is not strong, the conductor can be made unserviceable because of nicks, breaks, separation from the board, or damage to terminal pads and areas.

B. Nicks and Scratches

(1) Clean the surface with isopropyl alcohol. Remove conformal coating.

(2) Fill the nick or scratch with melted solder by hand-soldering.

(3) Make sure the repair did not decrease the distance to adjacent conductors.

(4) Apply conformal coating to the area.

C. Broken Surface Conductors

(1) Scratches

(a) Remove conformal coating from an area along the conductor foil a minimum of 0.5 inch in each direction from the defect.

(b) Clean the foil with an eraser.

(c) Rub melted solder into the defect with a dental explorer or equivalent tool until the area is smooth.

(d) Add a small amount of flux.

(e) Add a small amount of solder.

(f) Tin over the defect.

(g) Let the solder cool. Then clean the area with isopropyl alcohol and apply conformal coating.

(2) Cuts or Breaks

(a) Remove conformal coating from an area along the conductor foil a minimum of 0.5 inch in each direction from the defect.

(b) Clean the foil with an eraser.

(c) With a sharp blade held at a 45 degree angle from the vertical, cut out the damaged area a minimum of 0.06 inch from the defect, to put a 45 degree downwards slope from the good conductor surface to the cut ends.

(d) Lightly tin the two cut ends.

(e) Get a scrapped circuit board. Cut and trim from it, a replacement piece of foil of the same width and thickness as the damaged conductor.

NOTE: As an alternative, you can make and install a jumper wire, but this must not be smaller in cross-sectional area than that of the damaged foil or any wire attached to it.

(f) Cut the replacement foil piece to extend a minimum of two times the width of the damaged foil over each cut end of the damaged foil. Cut the ends of the replacement foil at a 45-degree angle.

(g) Scrape off the adhesive from the bottom surface of the replacement foil which will touch the surfaces of the damaged foil. Then tin these cleaned surfaces.

(h) Apply a thin layer of Type 52 adhesive to the circuit board surface between the two cut ends of the damaged foil.

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(i) Put the replacement piece of foil into position on the damaged foil.

(j) Lap solder, with liquid flux only, one end of the replacement foil to the mating foil on the circuit board. Do not add solder, because the tinned surfaces will contain a sufficient amount of solder to make a serviceable joint.

(k) Let this connection cool. Then lap solder by the same procedure at the other end of the replacement foil.

(l) Let the connection cool.

(m) With a clamp, a piece of teflon or plastic, and orange sticks, apply pressure to the repaired area.

(n) Cure the adhesive for 4 hours minimum at room temperature or 2 hours minimum at 140-160°F.

(o) After the adhesive is cured, remove unwanted adhesive with an eraser.

(p) Clean the repaired area with isopropyl alcohol. Apply conformal coating.

D. Lifted Surface Conductors

NOTE: Foils can come loose from the circuit board if too much heat was applied during soldering operations.

(1) Clean the area under and around the lifted foil to remove conformal coating, adhesive, and burned material.

(2) Carefully de-solder the lifted metal foil and make it smooth.

(3) Bond the lifted foil to the circuit board with Type 52 adhesive. Make sure this does not decrease the distance to adjacent conductors.

(4) Push the foil down into position.

(5) With a clamp, a piece of teflon or plastic, and orange sticks, apply pressure to the repaired area.

(6) Cure the adhesive for 4 hours minimum at room temperature or 2 hours minimum at 140-160°F.

(7) After the adhesive is cured, remove unwanted adhesive with an eraser.

(8) Clean the repaired area with isopropyl alcohol. Apply conformal coating.

(9) If there are mounting holes in the area, clean or drill the holes to original size.

E. Damaged or Missing Terminal Areas

(1) Remove the defective terminal area if it is there. Clean the area with isopropyl alcohol and let it dry.

(2) Get a scrapped circuit board. Cut and trim from it a replacement piece of foil of the same shape and thickness as the damaged or missing terminal area. Make the piece larger to permit a 0.125 inch minimum overlap with the remaining good foil pattern for a good solder lap joint.

(3) With an electric eraser, clean the mating foil surfaces to remove all contamination and oxides.

(4) Clean the area with isopropyl alcohol.

(5) Solder the replacement foil piece to the existing circuit. Be sure to align the terminal area with the mating hole in the circuit board.

(6) Bond the terminal area to the circuit board with Type 52 adhesive per SOPM 20-50-12.

(7) Install an eyelet in the hole.

(8) Clean the area with isopropyl alcohol.

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(9) Install mating electrical items and apply conformal coating as applicable.

F. Lifted or Missing Pads

(1) Clean under the lifted pad, and the adjacent area, with isopropyl alcohol. Dry with clean compressed air.

(2) Prepare some Type 52 adhesive.

(3) If the pad has a solder joint, fill the space under the pad and around the pad with the adhesive. If the pad has no solder joint, apply sufficient adhesive to fill only the bond line and push down on the pad to make it flat against the circuit board. Do not let adhesive get on the top surface of the pad.

(4) Cure the adhesive a minimum of 4 hours at room temperature or 2 hours minimum at 140-160°F.

(5) Solder as necessary.

(6) Apply Type 52 adhesive to the completed solder joint and the repaired pad. Make the adhesive smooth with the adjacent area.

(7) Make sure this layer of adhesive is smooth and continuous, with no voids or bubbles larger than 0.01 inch in diameter, and with no wrinkles, foldovers, kinks or other defects.

(8) Cure the adhesive per Paragraph 7.F.(4) above.

G. Defective Pads With a Preform

(1) Remove the mating part or feed through interconnect.

(2) Repair the lifted pad or circuit per Paragraph 7.D. or Paragraph 7.F. above.

(3) Make a drilled preform, or get one from a repair kit, which will make an overlap of 0.125-0.250 inch with the defect.

(4) Put the preform in position over the defect and hand solder to the mating circuit and leads as applicable. Make sure the solder connections are smooth, with no blow holes, icicles or cold solder joints.

(5) Apply conformal coating or a layer of Type 52 adhesive over the repaired area.

8. REPAIR OF INTERNAL CONDUCTORS

A. Use these procedures when you find problems with internal conductors on multilayer printed circuit boards. These procedures are for components mounted through the holes.

B. Shorted Conductors

(1) After you find the bad conductors, remove the components at each end of each conductor. Clean the areas with isopropyl alcohol.

(2) Drill out the through-hole pads for each end of the bad conductor. Be sure to give the assembly support to prevent movement or deflection while you drill.

(a) Make the initial hole a small amount larger than the pad size, but not sufficiently large to cut into adjacent pads.

(b) Make the final hole size 0.040 inch larger than the part lead size.

(3) Clean the drilled holes with isopropyl alcohol and let them air dry.

(4) Fill the hole with Type 52 adhesive or Scotchcast 251. Make sure there are no bubbles or voids larger than 0.010 inch.

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(5) After the adhesive or Scotchcast 251 is cured, drill a new hole at each of these locations. Make the holes a maximum of 0.040 inch larger than the part lead size. There must be a minimum of 0.010 inch thickness of adhesive in the wall of the hole.

(6) Install replacements for the components you removed in Paragraph 8.B.(1) above. Bond axial-leaded discrete parts (such as resistors or capacitors) in place with Type 69 adhesive. This is not necessary for parts with 3 or more leads, because their installation will be sufficiently strong after the other leads are soldered to the existing circuit board foils.

(7) Do not clip the leads that will be connected to conductors (jumper wires) in Paragraph 8.B.(8).

(8) Install conductors (jumper wires) on the non-component side of the circuit board, between the points that were connected by the bad internal conductor. Give the jumper wires the same routing as the old internal conductors they replace. Tack-bond them to the circuit board with Type 69 adhesive and solder their ends to the leads by hand.

(9) Clip unwanted lead lengths, as necessary, to be sure there will be no interference when the circuit board is installed.

(10) Clean the area with isopropyl alcohol. Apply conformal coating as necessary.

C. Open Conductors

(1) After you find the bad conductors, remove the conformal coating at each end of each conductor. Clean the areas with isopropyl alcohol.

(2) Install conductors (jumper wires) on the non-component side of the circuit board, between the points that were connected by the bad internal conductor. Give the jumper wires the same routing as the old internal conductors they replace. Tack-bond them to the circuit board with Type 69 adhesive and solder their ends to the leads by hand.

(3) Clean the area with isopropyl alcohol. Apply conformal coating as necessary.

9. REMOVAL OF COMPONENTS

CAUTION: BE CAREFUL NOT TO DAMAGE ADJACENT COMPONENTS.

CAUTION: DO NOT USE ANY ELECTRIC COMPONENT AGAIN AFTER REMOVAL FROM THE CIRCUIT BOARD ASSEMBLY. IT COULD BE DAMAGED BY THE HEAT OR THE FORCE USED TO REMOVE IT.

CAUTION: DO NOT REPAIR A PRINTED-CIRCUIT BOARD AREA SUCH AS A PLATED-THROUGH HOLE MORE THAN TWO TIMES. THE CIRCUIT COULD BE DAMAGED.

A. Remove the conformal coating (Ref Paragraph 5.) from the joint area. It is not necessary to remove parylene conformal coating.

B. For parts installed into plated-through holes, cut the leads of the parts to remove the parts.

C. To remove the leads from the plated-through holes:

(1) Procedure with two soldering irons.

(a) Use one iron on each side of the board.

(b) When the solder is melted, use one iron to push the lead and use the other to pull the lead out.

(c) Push and pull with care to remove the leads.

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(d) Do not touch the board with the soldering iron for more than 3 seconds or the board or components could be damaged.

(2) Or, as alternatives, use solder wick, a vacuum unsoldering device, or use one soldering iron and a pair of tweezers.

D. Use resin flux to help in part removal.

E. The large leads and the configuration of a DIP (dual inline package) can prevent removal of the leads. To remove solder from these parts, apply a soldering iron to the component side of the circuit board and apply the vacuum unsoldering tool to the other side of the board.

F. To remove the leads from holes which are not plated-through, use a vacuum unsoldering device, solder wick or a soldering iron and tweezers.

G. To remove parts that are bonded to the board, cut through the adhesive bond. Then carefully rock, pry, or twist to break the part loose from the board.

(1) Some procedures to help make the adhesive soft or weak:

(a) Heat the assembly in an oven to 210°F maximum for no more than 20 minutes.

(b) Point a jet of hot air at the bond line while you carefully rock or pry the component.

(c) Use a heated blade, such as one mounted on a soldering iron, to cut away the adhesive.

(2) After removing the leads, remove solder from the circuit pads or plated-through holes with a device which melts and removes solder by vacuum as shown in Figure 4. As an option, you can use a soldering iron and wicking. Apply the solder iron on the solder for 3 seconds maximum, then wait for at least 30 seconds before you apply the iron to the same joint.

(3) Remove the flux residues from encapsulated units with isopropyl alcohol or with a bristle brush followed by an alcohol rinse.

(4) Be sure to examine all replaced components and joints.

(5) Replace the conformal coating on the affected area per Paragraph 17.

H. Transistors mounted on transistor pads must be removed as one unit with a tool which closes around the component and cuts parallel to the board. Gently rock the closed tool until the transistor and the pad breaks free of the board.

NOTE: Thermal expansion of the transistor pads can strain solder joints. Do not install transistor pads unless specified by the instructions.

I. To remove parts with lap-soldered flat leads:

(1) Disconnect or cut the part leads from the attachment pads.

(2) On encapsulant coated units, remove the part with a tool that will cut the encapsulant fillet and pull up and cut from under the part body. Be careful not to damage the conductor or feed through below the part. Remove flux with a small bristle brush, cotton tipped applicator or wiper wet with isopropyl alcohol.

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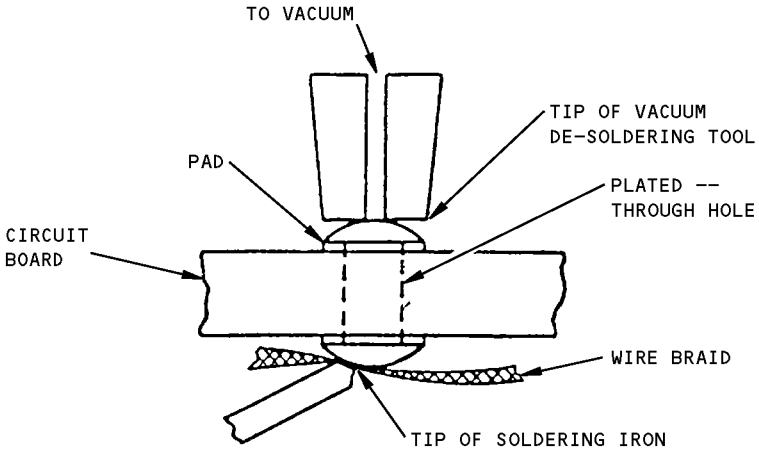

Solder Removal Details
Figure 4

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10. INSTALLATION OF NEW COMPONENTS

A. Preparation of the circuit board

(1) Manually ream the lead holes with a twist drill bit of the same size to remove solder which could prevent installation of the new component. Hold the drill with fingers or a pin vise. Do not enlarge the hole more than 10% of its original size.

WARNING: WHEN YOU USE ISOPROPYL ALCOHOL, DO NOT BREATHE THE VAPOR OR MISTS. USE ONLY WITH APPROVED VENTILATION, AVOID PROLONGED OR REPEATED SKIN CONTACT. KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.

(2) Carefully scrape the area with isopropyl alcohol and soldering iron or a sharp edged tool to let you install the new component. Make a smooth edge to the encapsulant around this area.

(3) Clean unwanted matter from the area with isopropyl alcohol. Do not use an abrasive. Remove solvent from cleaned areas with a clean cloth.

CAUTION: MANY OF THESE COMPONENTS ARE SUBJECT TO DAMAGE FROM ELECTROSTATIC DISCHARGE DURING HANDLING. IF YOU SEE YELLOW STATIC-SENSITIVE-CAUTION LABELS, REFER TO SOPM 20-12-02 FOR INSTRUCTIONS.

B. Preparation of the new components

(1) How to straighten component leads:

(a) Do not use component parts that have cracks in the dielectric at the lead-part junction.

CAUTION: DO NOT STRESS THE LEAD-TO-PART BODY JUNCTION OR GIVE SHOCK TO THE PART.

(b) Leads can be straightened if misalignment is within the limits shown in Figure 5. Do not use component parts which have lead misalignment greater than that shown in Figure 5. Leads can be aligned 0.03 inch to agree with the mounting members.

(c) Hand straighten leads only as follows:

1) Wear clean, dry, lint-free cotton or equivalent gloves.

2) Hold the lead between the point to be straightened and the part body with smooth, flat-jawed pliers.

(d) You can straighten rectangular flat pack leads which are not bent more than 30 degrees in a vertical plane at the seal and misaligned to more than one lead width in the horizontal plane. Reject the part if the leads are bent more than 30 degrees in a vertical plane at the part body junction.

(e) You can straighten dual-in-line package leads which are bent 30 degrees or less from normal.

(f) To prevent work hardening and the risk of broken leads, do not bend leads more than one time at the same location.

(2) How to Bend Component Leads (Figure 5, Figure 6, Figure 7)

(a) If the leads must be bent before assembly to the circuit board, use these requirements. (Solder seals, glass bead seals, and other protrusions are to be included in the part body.)

1) Bend rounded leads to a radius no smaller than one lead diameter. Bend flat-pack leads to a radius no smaller than one lead thickness. Measure the bend radius at the inside of the lead bend.

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2) For axial-leaded parts, make the bends agree with Figure 5. For flat packs, bend and cut the leads per Figure 6 and overhaul instructions.

3) For TO-type cans, CKO-5, -6 and CKRO-5, -6 capacitors, bend the leads when you put them into the circuit board holes, or into the lead-forming tool.

4) Before you bend the leads, make sure you hold the component body to keep the polarity identification visible after the part is installed.

5) While you bend the leads, hold or support the lead between the part body end of component and the point of bend, for those leads to be manually put into the holes.

6) After you bend the leads, make sure the part has none of the defects listed in Paragraph 10.B.(2)(a)8).

7) Clip or trim the leads with a tool which will not damage the seal, lead, part body or adjacent leads. The tool must cut smooth with the surface, with cutting edge faces toward the part body and perpendicular to the axis of the part lead. Hand trim leads before you solder them. Keep the tools and equipment in good condition to let the clipped end come off the lead in one operation.

8) Reject components with these defects:

a) One or more leads with nicks or cuts which expose base metal in the area between the component body junction and the point at which lead will be soldered.

b) Exposed base metal on leads larger than one-tenth the lead diameter, or a total exposed area more than 10 percent of the lead.

c) Lead bends with cracks in the base metal when viewed up to 10X magnification.

d) Damaged insulation, connector contacts, or cases.

e) Leaks in components that contain liquid dielectric.

9) Handle and store components after lead bending so they will not be damaged and the lead form will not be disturbed.

C. Installation of the parts

(1) How to mount components with accessible leads (such as resistors)

(a) Mount components with the leads down through the circuit board as shown in Figure 8, view A.

(b) The component must be parallel to, on the side opposite the circuitry, and down against the circuit board unless specified by the overhaul instructions or unless necessary for heat dissipation.

(c) Remove unwanted lead lengths to prevent stress to the lead-to-component body junction to send no mechanical shock to the part. Hold the component lead between component body junction and the cut. Do not swage.

(2) Mounting components with Inaccessible leads (such as transistors)

(a) Mount components that have leads extending from bottom of components as shown in Figure 8, views B, C, D and E, with one of these procedures to let you clean between the component and the circuit board after soldering.

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CAUTION: USE SEPARATE OR INTEGRAL STANDOFF PADS OR STRIPS ONLY WHEN REQUIRED BY THE OVERHAUL INSTRUCTIONS. TRANSISTOR PADS UNDER TO-TYPE CANS COULD DAMAGE SOLDER JOINTS BECAUSE OF THERMAL EXPANSION OF THE PAD.

(b) Mount transistors without pads with a clearance from the board as shown in Figure 7.

(c) Mount transistors with pads as shown in Figure 8, view B.

(d) Bond a piece of nylon strip (Polymer type 101, 0.031 inch thick), cut to a width to fit under the center of the component and between the leads as shown in Figure 8, view D, or bond a piece under each end of the component as shown in Figure 8, view E. Bond these pieces with a soluble maskant or Type R flux as a temporary adhesive. Do not let the nylon strips extend out from the edges of the component, or let them be nearer than shown to the component leads. Removable spacer strips (Dissopads) or permanent standoffs can be used.

(3) How to Clinch Component Leads (Figure 9)

(a) If the overhaul instructions tell you to clinch the leads, bend them in the direction of, parallel to, and against the circuit pattern, as shown. These leads must extend through the board a minimum of the pad radius and a maximum of the pad diameter. A spring back of 15 degrees maximum is permitted.

(b) Component leads can be formed or swaged before you clip them, to keep components tightly against the circuit board.

(4) How to Install Heat-Shrink Tubing (Figure 10)

(a) Install and shrink heat-shrink tubing on all parts with metal or conductive cases if the parts will be mounted over printed conductor wiring. These parts must not be mounted over solder connections.

(b) Install and shrink heat-shrinkable tubing on all parts with glass or ceramic cases if the parts are to be bonded to the circuit board.

(c) The tubing must completely cover the body of the part. It can extend onto the leads a maximum of 0.06 inch.

(d) Shrink the tubing on the part per SOPM 20-11-03 before you install the part on the circuit board.

(5) How to Mount Components to Terminal Posts or Lugs

(a) Give sufficient stress relief to unsupported components attached to terminals or lugs. To do this, put a gradual bend in one lead. If the component body is rigidly held in a component holder or if it is encapsulated, put the stress relief in the two leads (Figure 11).

(b) Wrap component leads around terminals 3/4 to 1-1/4 turns.

(c) Do not wrap component leads around slotted terminals. Make the lead parallel to the sides and the bottom of slot and extend the lead beyond terminal as shown (Figure 12).

(d) Put the component leads through the eye of terminal lugs and wrap the lead 3/4 to 1-1/4 turns around one side of the eye.

(e) As applicable, remove unwanted lead lengths per Paragraph 10.C.(1)(c) above.

(f) Refer to SOPM 20-12-01 to solder between the components and the terminal posts or lugs.

(g) If the leads are more than 1 inch long, refer to Paragraph 12. for instructions.

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(6) How to Install Parts With No Printed Circuit Pads

(a) For parts with lead ends on the side opposite to the component side of the board:

1) To make clearance holes in boards that have a ground or power plane, refer to Paragraph 6.C.

2) Drill holes for mounting parts.

a) If the overhaul instructions do not specify the hole locations, put the new holes in positions away from conductors on other layers, if possible.

b) Hold the assembly to help prevent movement or deflection while you drill the holes.

c) Drill new holes 0.035-0.060 inch larger than the diameter of the leads of the part.

d) Clean the new holes with a hand-held reamer or a twist drill 0.001-0.005 inch larger than the drill you used to make the holes.

e) Clean the holes with isopropyl alcohol. Let the holes air dry.

f) Fill the new holes with Type 52 adhesive or Scotchcast 251. Make sure there are no bubbles or voids larger than 0.010 inch, or which fill the space between conductors.

g) Drill the final hole through the adhesive, but make the hole size a maximum of 0.040 inch larger than the diameter of the leads of the part. There must be a minimum of 0.010 inch of adhesive between the hole wall and the original circuit board material.

3) Install the new part. Parts which are not mechanically fastened must be bonded with adhesive. Use Type 69 adhesive per SOPM 20-50-12.

4) Cut the lead to 0.03-0.06 inch length.

5) Add jumper wires to the component leads as shown in Figure 13.

6) Hand solder the connections.

7) Be careful not to attach component leads together.

8) When component leads are soldered directly to the conductor, there must be a minimum clearance of 0.05 inch from terminal area.

(b) For parts with lead ends on the component side of the boards:

1) Install part in its specified location. If it is not mechanically fastened, bond it to the board. Use Type 69 adhesive per SOPM 20-50-12.

2) Connect leads to existing part leads with 180 degrees minimum wrap as shown in Figure 14.

3) Hand solder the connections.

4) If the bare lead is too short to get to its attachment point or it must go nearer than 0.025 inch to another bare lead or other bare metal surface, prepare it as follows:

a) Cut the lead to 0.25-0.50 inch long.

b) Prepare the required length of magnet wire (AWG26 or AWG28 coated wire).

c) Wrap one of the prepared ends of the coated wire around the shortened part lead 3/4 to 1-1/4 turns. If the access is too tight, make a hook in the end of both the lead and the wire and connect them as shown in Figure 15.

d) Solder the connection. Solder the other end of coated wire to the attachment point.

5) Make sure you examine each joint.

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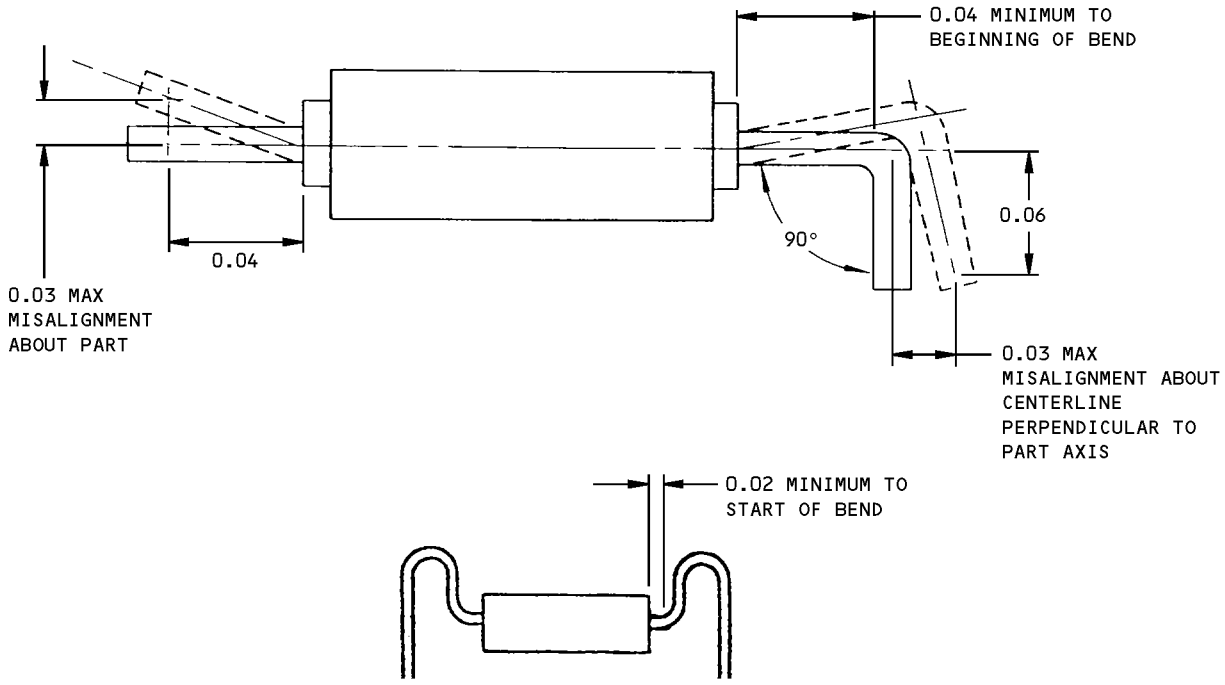

REVERSE LEAD BEND CONFIGURATION

ALL DIMENSIONS ARE IN INCHES

Axial-Leaded Component Lead Bend Limits
Figure 5

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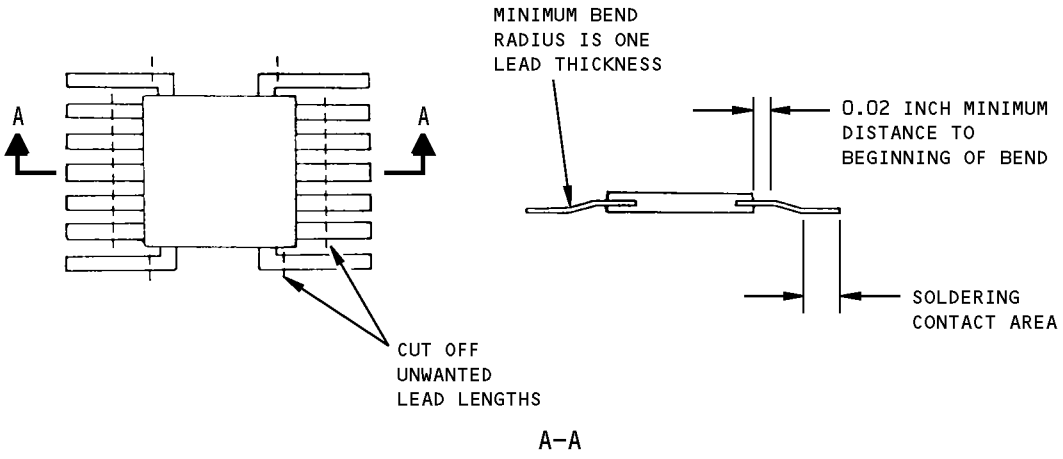

Flat Pack Lead Requirements
Figure 6

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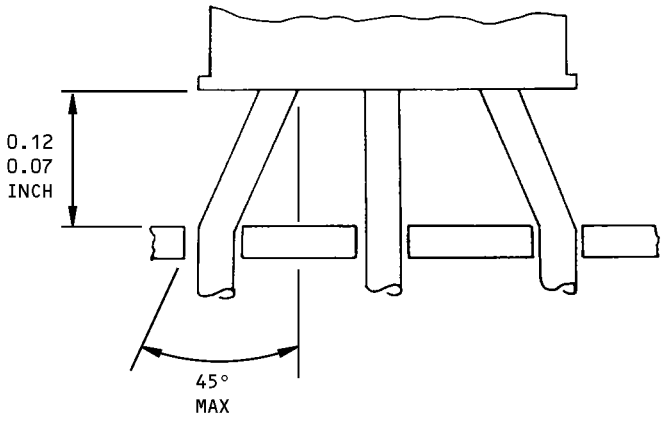

TO-Type Can Lead Bend Limits
Figure 7

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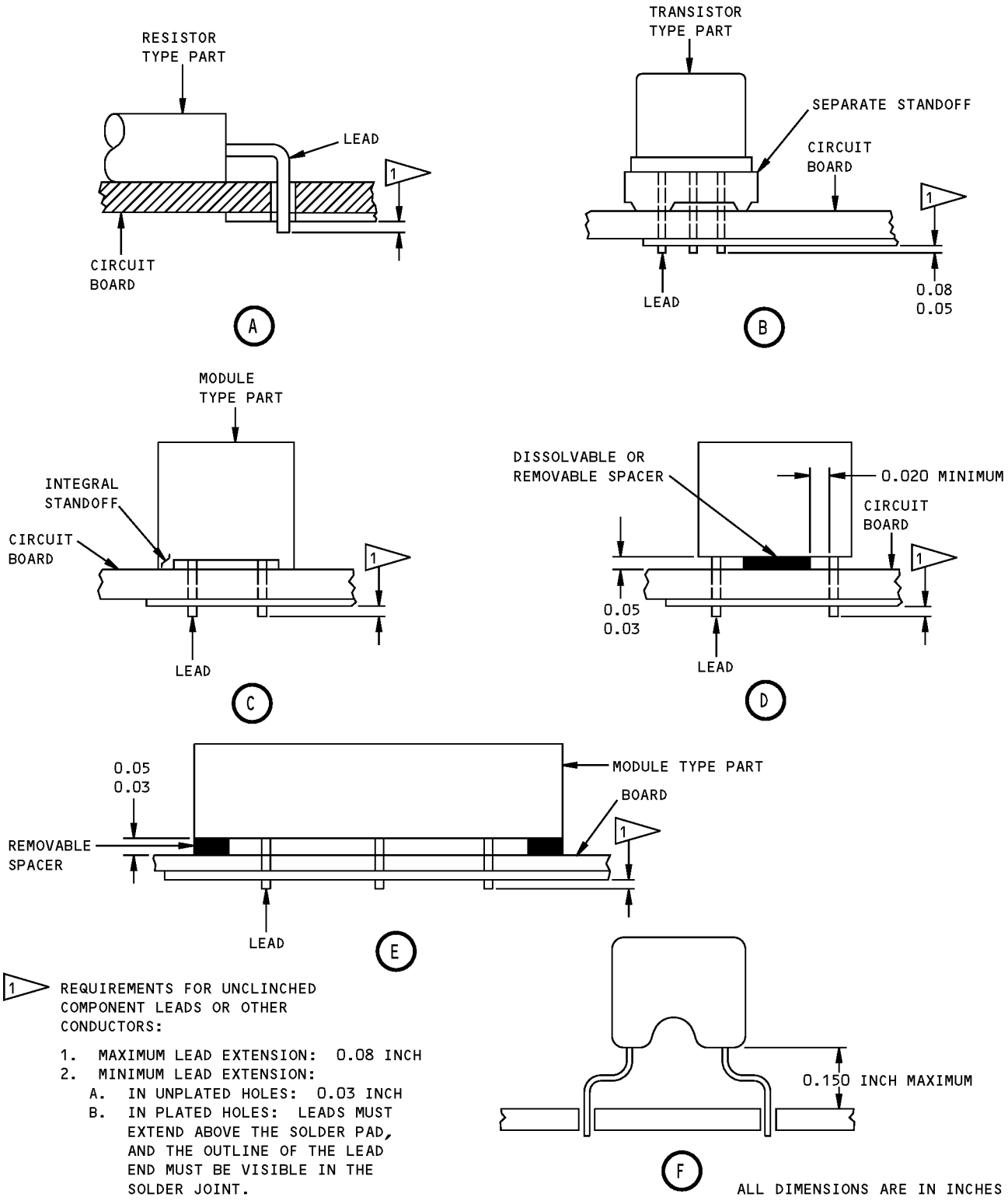

Mounting Components to Circuit Boards
Figure 8

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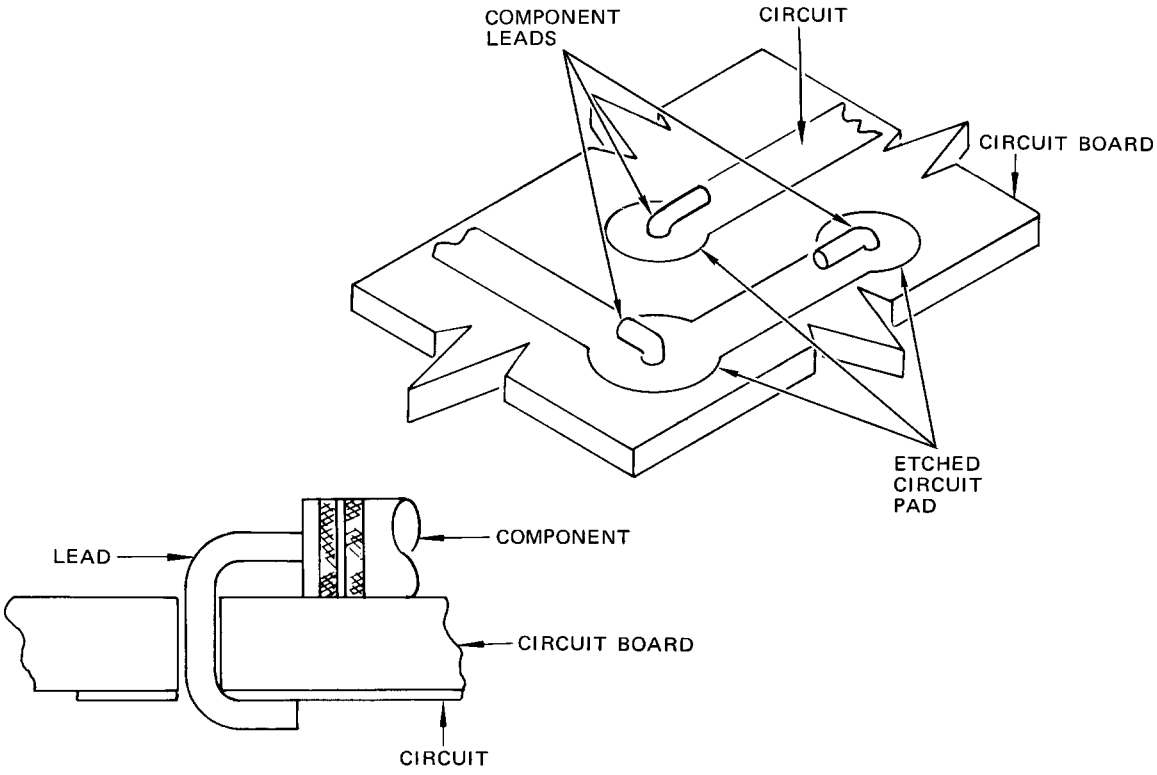

Clinched Leads
Figure 9

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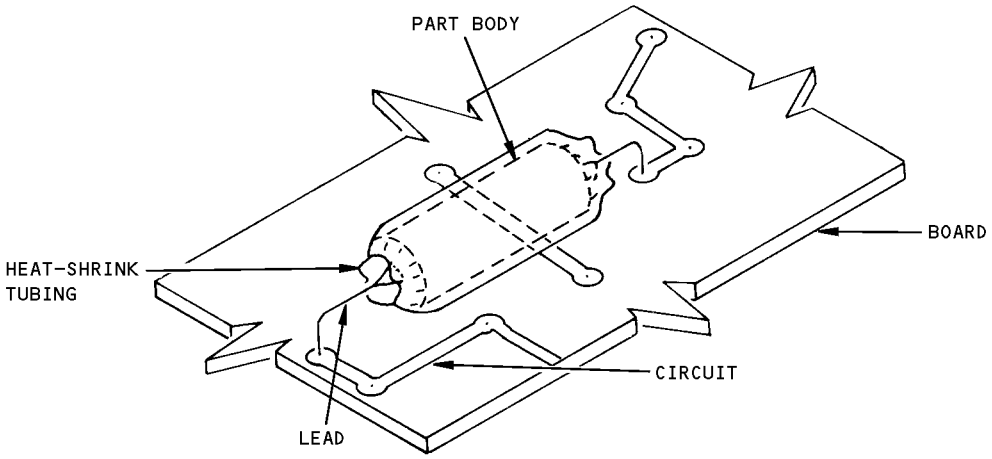

Heat-Shrink Tubing
Figure 10

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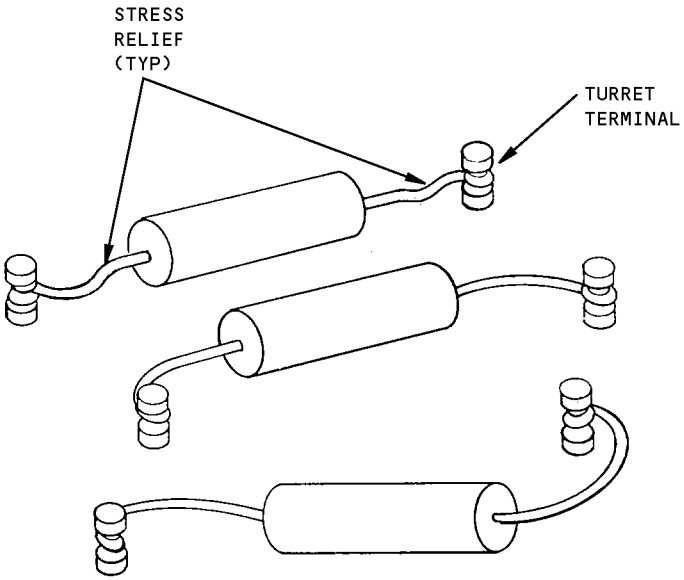

NOTE: PART LEADS SOLDERED TO PIN TERMINALS HAVE THE SAME REQUIREMENTS BUT PUT THE LEADS NO NEARER THAN 0.06 INCH FROM THE TOP OF THE PIN

Mounting Components to Terminal Posts
Figure 11

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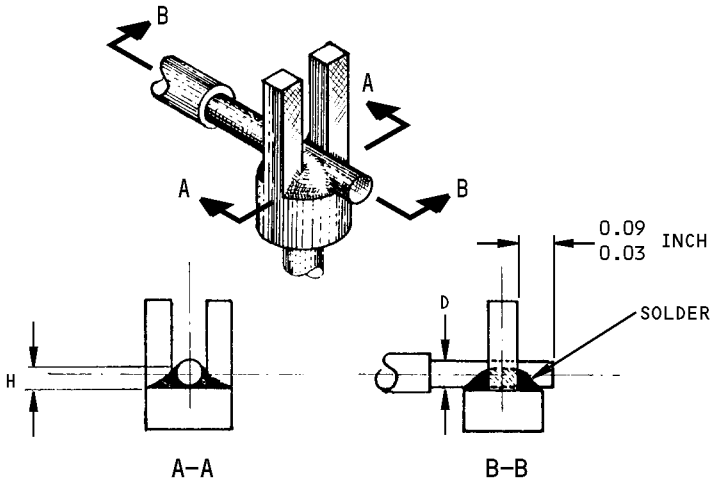

Soldering to Slotted Terminals
Figure 12

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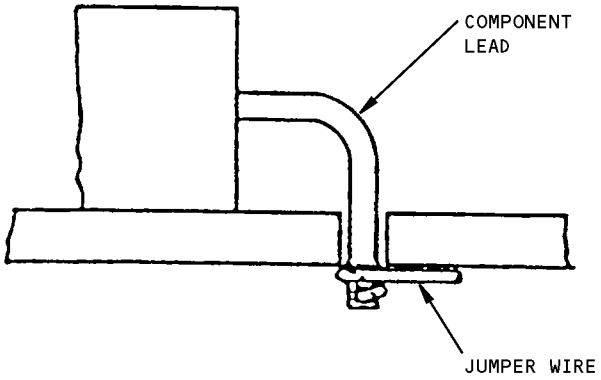

Position of Conductors
Figure 13

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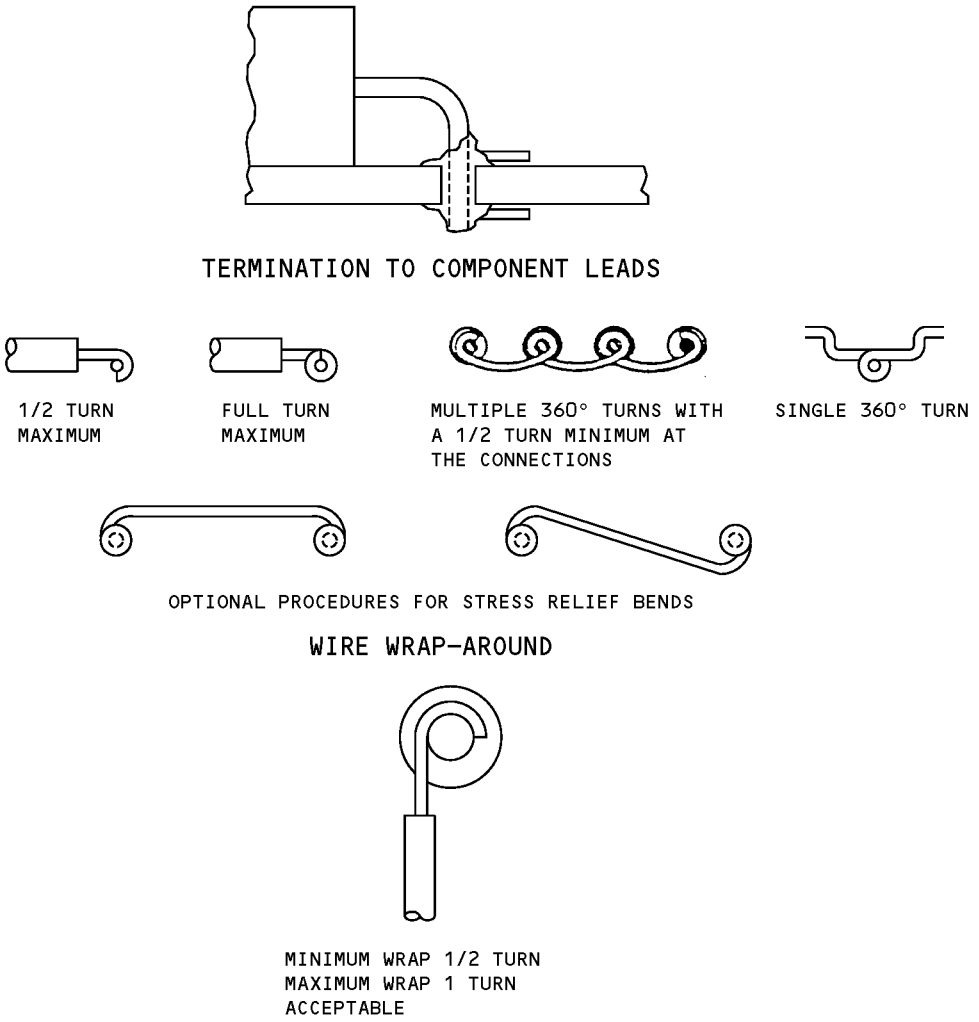

Component-Side Part Mounting
Figure 14

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11. REMOVAL AND REPLACEMENT OF CONNECTORS

A. Unpotted Connector

(1) Use the procedures for removal and installation of parts given in Paragraph 9., Paragraph 10.

(2) Clipping of connector pins is optional.

(3) Remove mounting screws and rivets. To remove rivets, drill or machine off the heads and punch out the body.

(4) Remove all metallic particles. Light scratches or burnishing are permitted. No delamination or machining damage to circuit board surfaces or mounting holes are permitted.

B. Potted Connector

CAUTION: BE VERY CAREFUL WHEN YOU REMOVE CONNECTORS WHICH HAVE CONFORMAL COATING. THE CIRCUIT BOARD CAN BE DAMAGED.

(1) Remove mounting screws.

(2) Machine off a large piece of the connector. Be careful not to damage the circuit board.

(3) Light scratches or burnishing are permitted. No delamination or machining damage to circuit board or components is permitted.

(4) Remove remaining conformal coating and potting material, remove solder, remove connector pins, clean assembly and install new connector per Paragraph 9., Paragraph 10.

C. Removal of BACC65K-series Connectors

CAUTION: BE VERY CAREFUL WHEN YOU REMOVE CONNECTORS WHICH HAVE CONFORMAL COATING. THE CIRCUIT BOARD CAN BE DAMAGED.

(1) Remove solder and encapsulant from the connector pin solder joint on the circuit side of the board per Paragraph 5.

(2) Remove connector mounting screws. Cut encapsulant if necessary.

(3) Cut and remove as much encapsulant as possible from around the connector.

(4) Carefully pry the connector from the board. Start the separation at one end of the connector and go along to the other end. Do not bend the board more than 0.25 inch over the span of the board.

D. Installation of BACC65K-series Connectors

CAUTION: REMOVE THE KEYING PINS BEFORE YOU MOUNT THE CONNECTOR TO THE CIRCUIT CARD. THE CONNECTOR IS NOT SERVICEABLE IF THE ADJACENT PINS ON THE CONNECTOR FACE ARE BENT OR DAMAGED.

(1) When you install new connectors, do not straighten connector pins which mate with plugs. Straighten pins that are soldered to printed circuit card only if misalignment is not more than the diameter of the pin. Use tools which will not damage the finish of the pins or contacts.

(a) Remove the unwanted keying pins of BACC65K-series connectors as specified by the overhaul instructions. Cut the pins off with tool ST2351B or ST2318C-9 or break the pins off with tool ST2351C. Then make sure the depth is 0.260 inch minimum to permit correct engagement of the mating connector (Figure 16).

(b) Remove contamination from the mating surface between the printed circuit assembly and the connector. Use isopropyl alcohol, cleaning solvent, or 1,1,1 trichloroethane with bristle brush within one hour after the solder is solid. Dry with compressed air or let the solvent evaporate.

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(c) Locate the assembly over the connector solder pins to make the hole position numbers in the assembly agree with the same pin numbers on the connector. Do not use force.

(d) Apply two drops of thread locking compound on the screw threads. Make the drop cover a minimum of two threads. Install the connector on the assembly with the screws.

(e) Tighten the screws equally to prevent too much load on one screw.

(f) Tighten the screws to 4-6 pound-inches.

CAUTION: DO NOT TIGHTEN OR REPLACE FASTENERS AFTER YOU SOLDER UNLESS YOU REFLOW THE SOLDER.

(g) Solder the connector to the board.

(h) If the assembly will not be coated with encapsulant within 24 hours:

1) If the assembly is not static sensitive, put it in a clean, dry polyethylene bag, seal the bag, and store it in an area where the relative humidity is no higher than 50 percent. If it is static sensitive, give it protection per SOPM 20-12-02.

2) As an alternative, you can clean the assembly again to prepare for the conformal coating.

(i) Apply the conformal coat to the repaired areas (Ref Paragraph 17.).

(j) Then apply the same coating to the slot between the connector and the board. Be sure to cover all of the conductors and leads.

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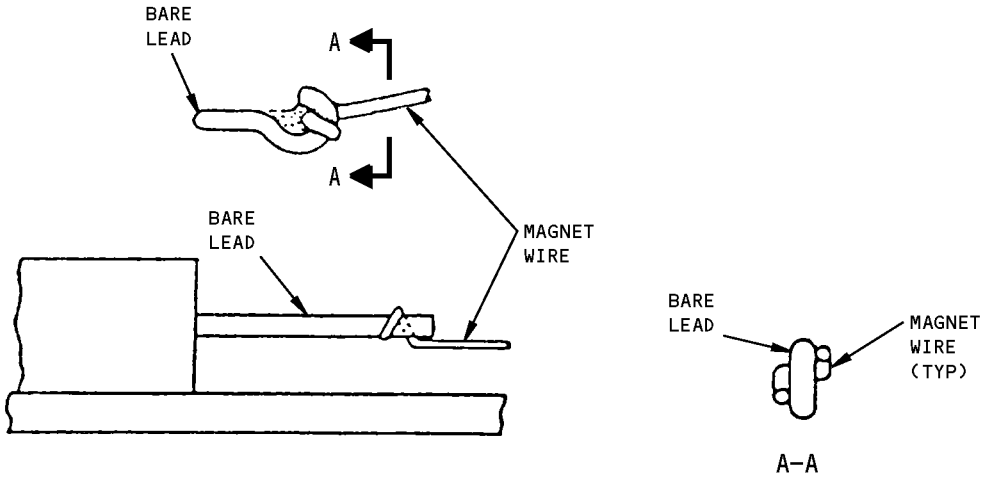

Connection of Wire to Lead
Figure 15

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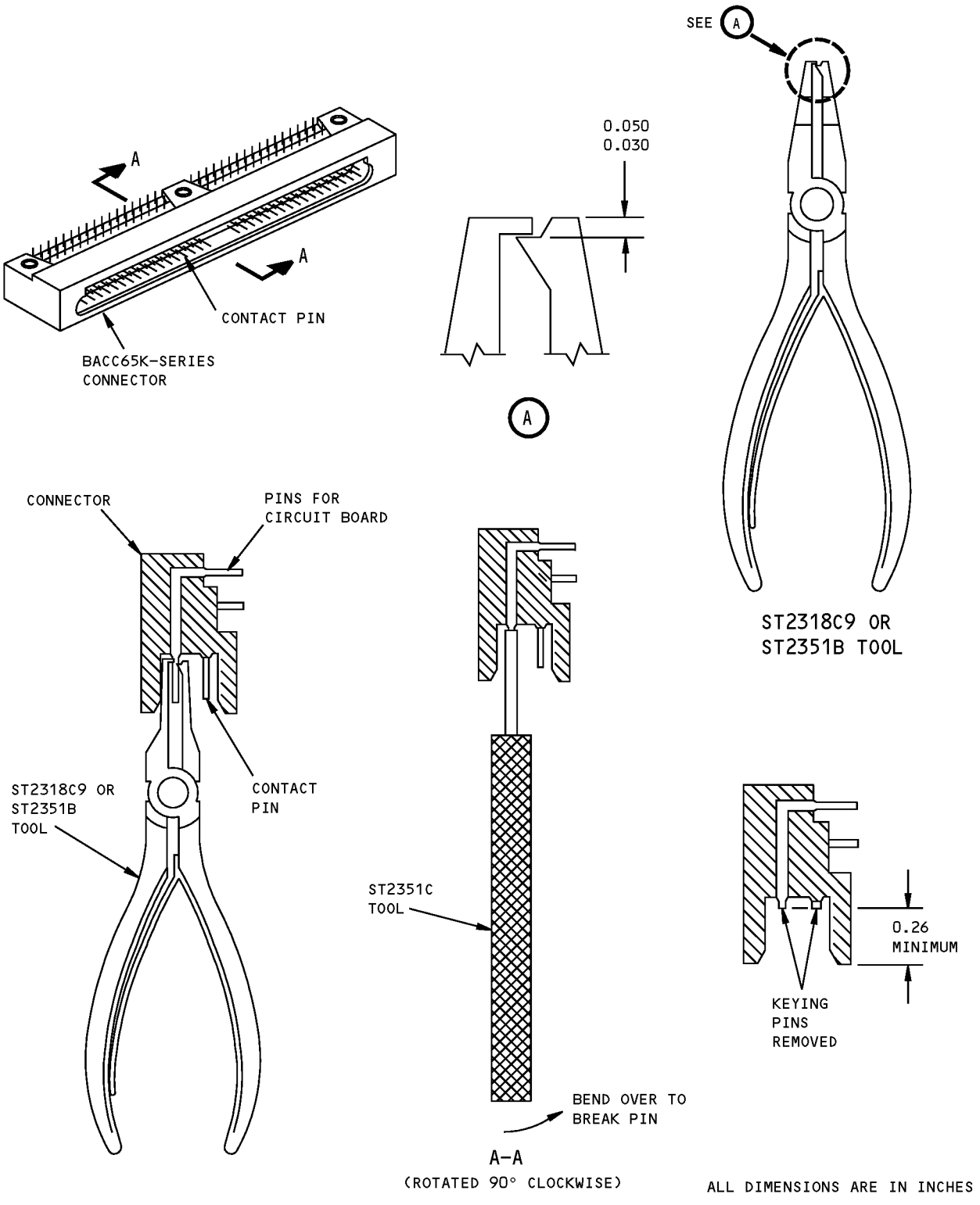

Removal of Contact Pins
Figure 16

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12. REMOVAL AND REPLACEMENT OF JUMPER WIRES

A. Removal of a Jumper Wire

(1) Cut the jumper wire at a location 0.05 inch or more from the termination point.

(2) Unsolder and remove the jumper wire terminations. Full removal of the jumper wire is optional.

(3) If the remaining part of the jumper wire will stay, make sure the cut ends of the jumper are a minimum of 0.02 inch from other conductors.

(4) Bond the cut ends of the jumper wire to the printed circuit board with Type 52 or BMS 5-72, Type 1 adhesive, or the conformal coating specified by the overhaul instructions.

B. Installing Solid Conductor Jumper Wires

(1) Do not use sleeving as insulation for jumper wires. Use AWG 26 or 28 polyurethane-nylon coated magnet wire, J-W-1177/9 (which has coatings such as Nylac, Nyleze, Nysol, Poly-Nylon, Soderon) unless otherwise specified by overhaul instructions. Wires of less than 0.5-inch length can be without insulation.

(2) To strip coated wires in areas to be soldered:

NOTE: Except as noted, these procedures can be used for J-W-1177/4, J-W-1177/9, and J-W-1170/10 magnet wire. These procedures can also be used for equivalent magnet wires per cancelled MIL-W-583.

(a) Solder Stripping

WARNING: DO NOT BREATHE THE FUMES. USE ONLY WITH APPROVED VENTILATION.

1) Apply rosin-base flux MIL-F-14256, Type RMA to end of wire to be stripped and put the end of the wire in a solder pot of solder QQ-S-571 Type SN60BS, SN60WS, SN63BS, or SN63WS, heated to 700-705°F.

WARNING: DO NOT BREATHE ISOPROPYL ALCOHOL VAPOR OR MISTS. USE ONLY WITH APPROVED VENTILATION. AVOID LONG OR REPEATED SKIN CONTRACT. KEEP AWAY FROM HEAT, SPARKS AND OPEN FLAME.

2) After the coating is removed, remove flux residues with isopropyl alcohol and a wiper.

(b) Chemical Stripping

1) Neutralize the surface of the insulation for at least two times the strip length. To do this, clean with isopropyl alcohol and rinse with water. Wipe dry with alcohol and rinse with water. Wipe dry with a wiper.

WARNING: KEEP THE STRIPPING SOLUTION AWAY FROM OTHER PORTIONS OF THE WIRE OR MAGNETIC DEVICES.

2) Put the end of the wire in chemical stripping solution only to the depth of the insulation to be removed. When it is not easy to put the wire into the solution, you can apply the solution to the insulation.

3) If this is the higher temperature class wire with a hard surface glaze, pull the length to be stripped through pieces of 320 to 400 grit abrasive cloth put between two sponges. Apply finger pressure and pull slowly. Run the wire through the adhesive twice.

4) Remove the soft insulation from the wire with a swab.

5) Wash the stripped surfaces and the adjacent insulation with clean water. Dry, then wipe with a wiper wet with solvent, isopropyl alcohol, or naphtha.

(c) Mechanical Stripping

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1) Adjust the tool to completely remove the insulation from the conductor. Do not adjust the tool smaller than necessary to completely remove the insulation.
2) Do not let the tool twist the conductor during insulation removal.
3) Do not make nicks or gouges on the conductor. But machining marks are acceptable on AWG 29 and larger wire.
4) Power sanders with 150 to 200 grit material can be used to strip rectangular magnet wire insulation.
5) Clean stripped portion and adjacent insulation cleaned with isopropyl alcohol or naphtha.

(d) Laser Stripping (not applicable to J-W-1177/4 or J-T-1177/10 wires)

1) Do not bend the wire to a radius smaller than half the wire diameter.
2) Clean the stripped surfaces and the adjacent insulation with isopropyl alcohol or naphtha.

(3) Use the procedures of SOPM 20-12-01 to apply a tinned surface of solder to the ends of the connection points of the jumpers.

(4) Put the wire ends through the holes in the terminals as shown in Figure 17.

(5) Connect Jumper Wires to Turret-Type Terminals as follows (Figure 18):

(a) Put the wires and component lead ends in sequence from base of terminal post toward top.

(b) Put the larger diameter wires around the base of the terminal post with the smaller diameter wires attached above.

(c) Bend the wires and component lead ends to make half a turn around the terminal post. Make sure they touch the post.

(d) Solder the connections. When more than one wire is connected to a terminal, solder all the wires at the same time.

(6) Solder wires to pin-type terminals with the same procedure as for turret terminals, except that tin and bend the stranded wires before you attach them to the terminals. Put the stranded wires no closer than 0.06 inch from the top of the pin.

(7) Where necessary, make connection between opposite sides of the board with swaged wires (Figure 19). On plated-through holes, swage the wire on the two sides of the board. On holes without plating, swage the wire on the part side of the board, so it will not fall through the holes. Then wire and clinch on the opposite side of the board. Clinch the wire in the direction of, parallel to, and to touch the circuit pattern. A 15 degree maximum spring back is permitted.

(8) If the configuration permits, unless the overhaul instructions are different, make the leads from terminals or lugs of electronic parts go out from the part terminal as shown before they go down to the surface of the board. If the connection is too close for this, make a loop in the wire, as shown (Figure 20). Do not let the wire touch itself at the loop, so the loop will stay flexible after encapsulant is applied.

(9) On boards which will use acrylic conformal coating or which have no coating, bond the jumper to the board. Use Type 69 adhesive per SOPM 20-50-12 to bond the jumpers at one-inch locations.

(10) Solder the jumper connections per SOPM 20-12-01.

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C. Installing Stranded Conductor Jumper Wires

(1) Use the procedures for solid jumper wires unless shown differently below.

(2) Make a Z or C bend or helical loop in the wire and bond it to the circuit board to prevent movement when the joint is soldered and so the solder joint cannot be stressed or bent (Figure 21). Bond the wire with an adhesive that will not contaminate the board, or be a problem during later procedures. We recommend Type 52 or Type 69 adhesives (Ref SOPM 20-50-12).

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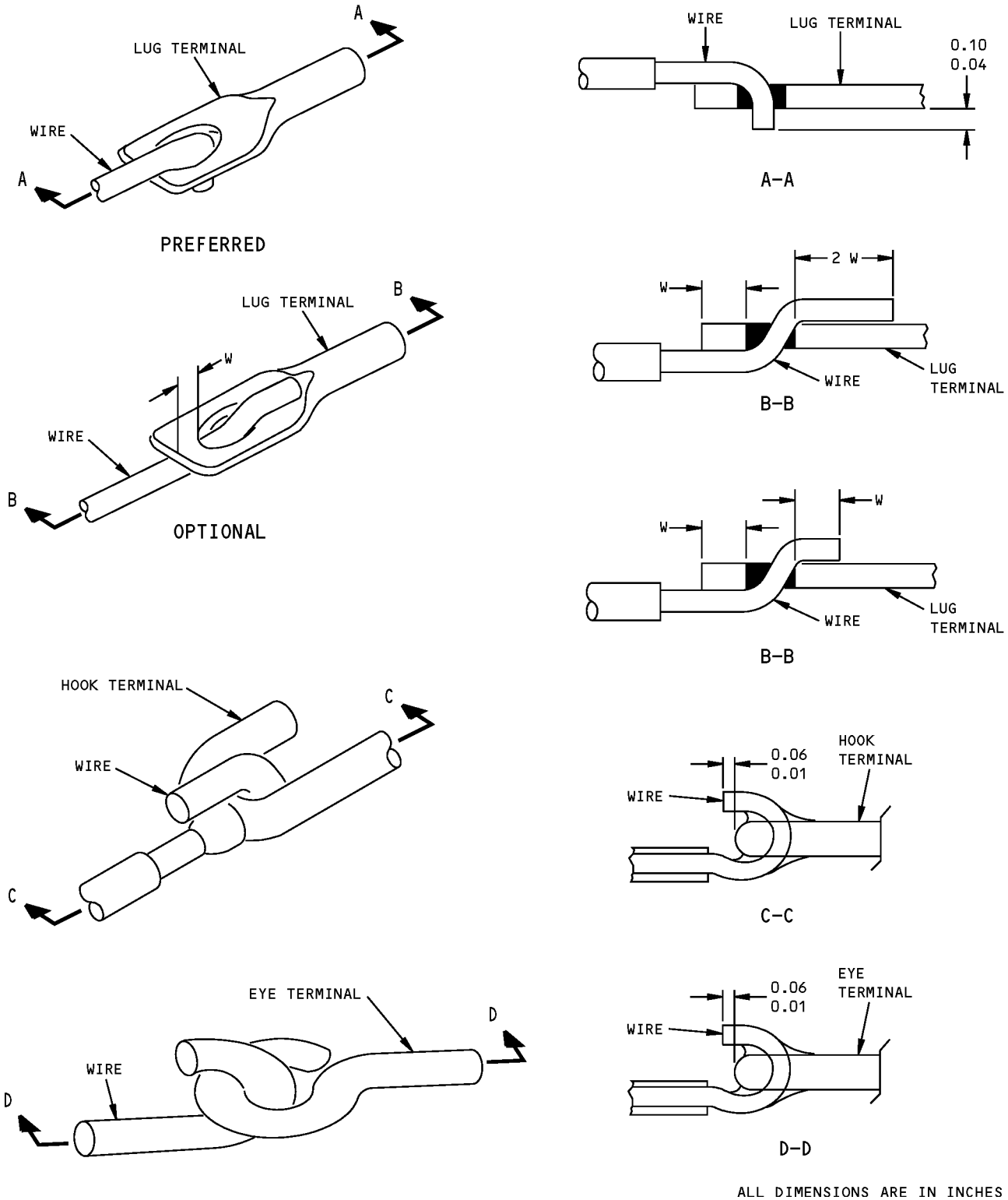

Jumper Wires to Terminals
Figure 17

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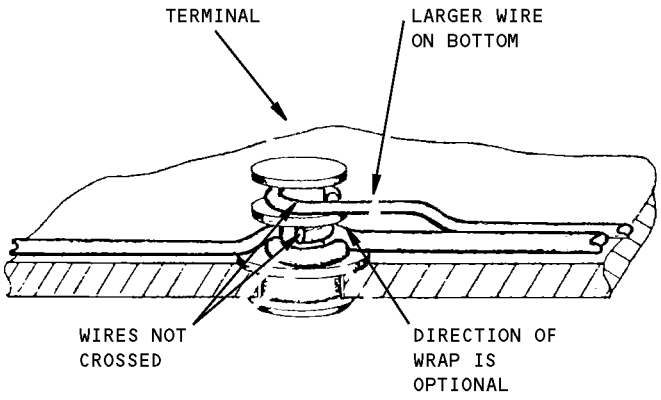

Jumper Wires to Turret Terminals
Figure 18

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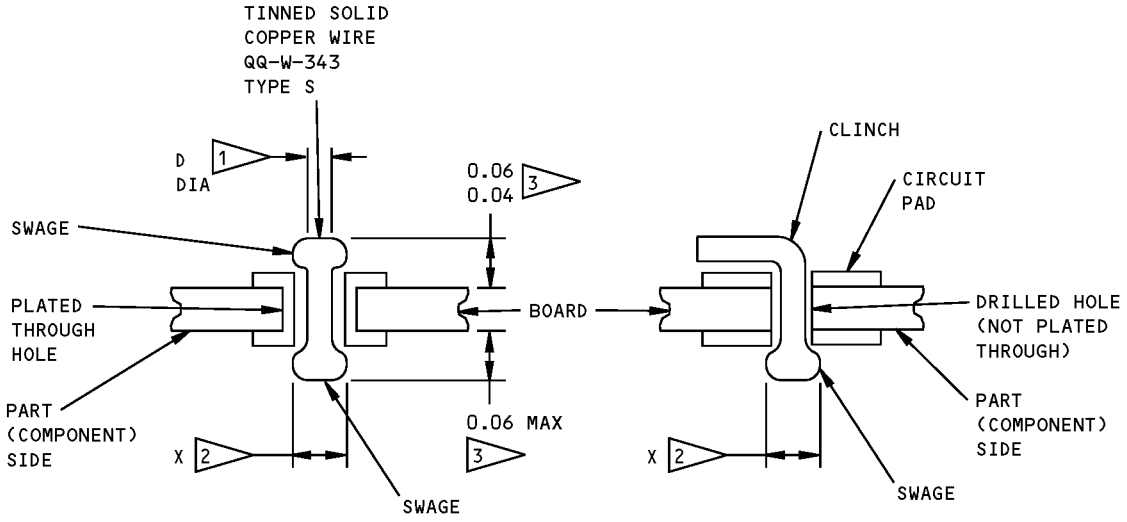

1 USE DIA 0.005-0.020 SMALLER THAN DIA OF THE PLATED-THROUGH HOLE

2 SUFFICIENTLY LARGE TO KEEP THE WIRE IN HOLE DURING SUBSEQUENT OPERATIONS

3 THESE VALUES ARE FOR PRINTED CIRCUIT BOARD (REF BAC 5869). FOR ETCHED CIRCUIT BOARDS (REF BAC 5853), USE 0.03-0.08 INCH.

ALL DIMENSIONS ARE IN INCHES

Feed-Through Interconnections
Figure 19

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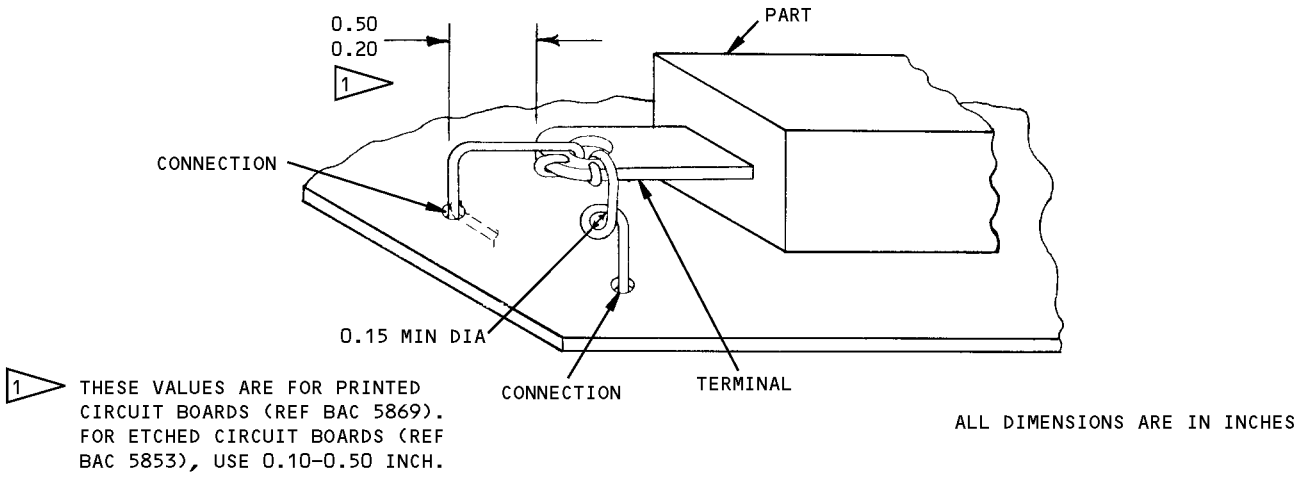

Routing of Solid Jumper Wires
Figure 20

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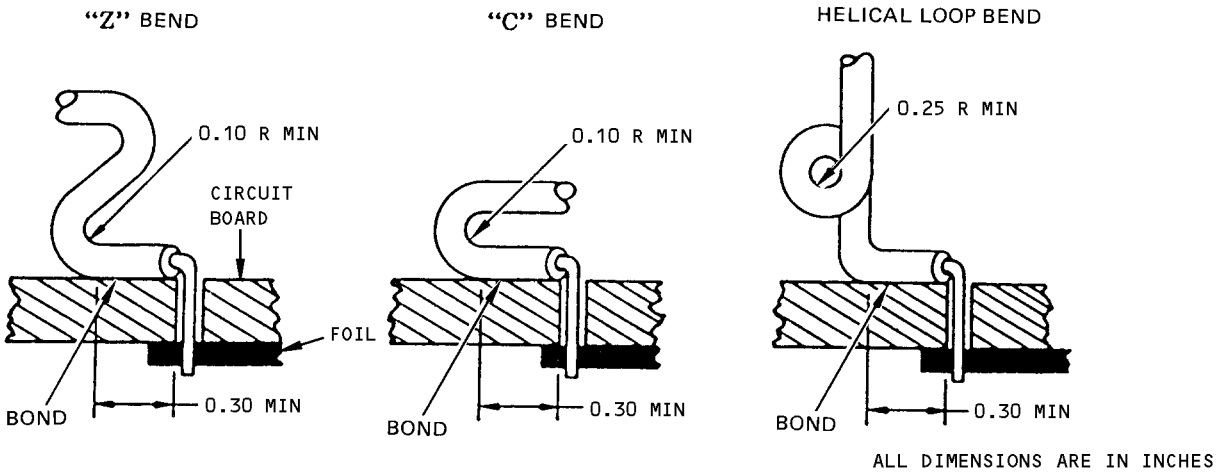

Routing of Stranded Jumper Wires
Figure 21

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13. REMOVAL AND REPLACEMENT OF LEADS AND WIRES FROM TERMINALS

A. Cut the lead or wire from the terminal.

B. Remove conformal coating from the terminal solder joint per Paragraph 5.

C. Remove unwanted solder and wire or lead pieces from the terminal with a soldering iron and wick.

D. Clean the terminal with isopropyl alcohol.

E. Install the new wires or leads and hand solder them.

F. Examine the joint carefully before you apply encapsulant or other coating.

14. REMOVAL AND REPLACEMENT OF TERMINALS

A. Remove the conformal coating as necessary. Refer to Paragraph 5.

B. Remove leads or wires per Paragraph 13.

C. To remove the terminals, drill or clip them from the hole. Try not to enlarge the hole more than 10 percent.

D. If the hole is enlarged more than 10 percent, fill the hole with Type 52 epoxy adhesive per SOPM 20-50-12. Drill a new hole to the correct hole size.

E. Install the new terminal.

F. Connect all part leads and jumper wires and hand solder the connections.

G. Encapsulate the area per Paragraph 17.

15. PLATED THROUGH HOLE PROCEDURES

A. Removal of Unwanted Solder

NOTE: Limit the removal of solder to 3 times per hole.

(1) Fill the holes with solder.

(2) Let the board cool a minimum of 30 seconds.

(3) Remove excess solder with a vacuum device or with a soldering iron and wick.

B. Removal of Adhesive from Plated-Through Holes and Pads

NOTE: This procedure is applicable to adhesives Type 52 and BMS 5-72 only.

(1) Melt the solder with a soldering iron.

(2) Wait until the solder is cool. Remove the adhesive manually.

(3) Clean the area with isopropyl alcohol.

(4) Examine for complete removal at a magnification of 4X.

C. Removal of Nodules From Plated-Through Holes

(1) Drill through the holes with an ST1255 drill. The diameter of the drill must be 0.0005-0.0010 inch smaller than that of the drill used to make the hole.

(2) Examine for complete removal at a magnification of 7X to 15X.

D. Removal of a Plated-Through Hole

(1) Drill the hole out to completely remove the plating.

(2) Fill the hole with epoxy (Ref Paragraph 6.).

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16. REPAIR OF PRINTED CIRCUIT BOARD BASE MATERIAL

CAUTION: WHEN YOU CLEAN CIRCUIT BOARDS OR REMOVE THE CONFORMAL COATING, FIRST TRY THE PROCEDURES FOR REMOVAL OF ACRYLIC COATING IN A SMALL TEST AREA BECAUSE ISOPROPYL ALCOHOL REMOVES ACRYLIC COATING.

A. Use these procedures to repair damage to the base material of the circuit board. Typical defects that can be repaired include cracks, nicks, holes, breaks, burns and delaminations.

B. Holes and Voids

(1) Put a small amount of Type 52 adhesive in the hole or void. Use an amount sufficient to fill the hole flush with, or a small distance above, the original board surface.

(2) Cure the adhesive 4 hours minimum at room temperature, or 2 hours minimum at 140-160°F.

(3) With a small piece of 400-grit wet-or-dry sandpaper on the end of your finger, sand the repaired area smooth with the adjacent surfaces. Use light pressure and a cross-hatch pattern.

(4) Polish the repaired area with a soft rotary brush and light constant pressure.

(5) Clean the area with isopropyl alcohol. Let this air dry.

(6) Replace removed conductors and components as necessary.

(7) Apply conformal coating as necessary.

C. Cracks

(1) Remove conformal coating, components, and foil pattern from the area around the crack.

(2) Drill a small hole at each end of the crack to stop the crack.

(3) Open the crack on each side of the circuit board with a V-shaped cut to a depth equal to one-half the thickness of the base material.

(4) Clean the broken surfaces and the adjacent area with isopropyl alcohol.

(5) Fill the crack and the drilled holes with Type 52 adhesive. Be careful not to let air bubbles or voids stay in the adhesive. Use an amount of adhesive sufficient to fill the area a small distance above the original board surface.

(6) Put a smooth piece of teflon or plastic over the repaired area. Put orange sticks on each side of the repair area and hold lightly with clamps.

(7) Cure the adhesive 4 hours minimum at room temperature or 2 hours minimum at 140-160°F.

(8) Remove the clamps, orange sticks, and the teflon or plastic.

(9) Remove unwanted adhesive.

(10) Clean the area with isopropyl alcohol.

(11) Install replacement foil patterns, holes, eyelets and components.

(12) Apply conformal coating as necessary.

D. Surface Defects

(1) Remove components and conductors as necessary to permit access to the defects.

(2) File away the damaged area with a rotary file. Remove all burnt material. If necessary, remove material to make a hole with a V-shaped taper from front to back. To make the repair stronger, you can do this also on the back side to permit a two-sided repair.

(3) Clean the repair area with isopropyl alcohol to remove loose material.

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(4) Fill the area with Type 52 adhesive to a small distance above the original board surface. Make sure there are no air bubbles or voids.

(5) Cover the repair area with a smooth piece of teflon or plastic. Make sure the piece does not move.

(6) If applicable, fill the area on the back of the circuit board per Paragraph 16.D.(4).

(7) Put the repaired circuit board in a screw press or equivalent device to apply pressure.

(8) Cure the adhesive for 4 hours minimum at room temperature or 2 hours minimum at 140-160°F.

(9) Remove the pressure, clamps, teflon or plastic.

(10) Remove unwanted adhesive. Clean the area with isopropyl alcohol.

(11) Install replacement conductors and components.

(12) Apply conformal coating as necessary.

E. Damage That Goes Through The Board

(1) Remove components and conductors as necessary to permit access to the damaged area.

(2) Remove all damaged or discolored board material with an abrasive.

(3) Bevel and undercut the edge of the area to help hold in the repair material.

(4) Clean all unwanted matter and loose particles from the area.

(5) Attach a smooth teflon or plastic surface against one side of the repaired area.

(6) From the side opposite the attached surface, fill the repaired area with Type 52 adhesive to a small distance above the original board surface. Make sure there are no air bubbles or voids.

(7) Cover the repaired area with a smooth piece of teflon or plastic, then install clamps to hold the piece down. Make sure the piece does not move after it touches the adhesive.

(8) Cure the adhesive 4 hours minimum at room temperature or 2 hours minimum at 140-160°F.

(9) Remove the clamps and the pieces of teflon or plastic.

(10) Remove unwanted adhesive. Clean the area with isopropyl alcohol.

(11) Install replacement conductors and components.

(12) Apply conformal coating as necessary.

F. Edge Delamination

(1) Completely fill with Type 52 adhesive the area where the circuit board edges have separations.

(2) Use clamps to hold the damaged area tightly between two flat surfaces.

(3) Cure the adhesive 4 hours minimum at room temperature or 2 hours minimum at 140-160°F.

(4) Remove the clamps.

(5) If necessary, make the repaired area smooth with 400-grit wet-or-dry sandpaper.

(6) Clean the area with isopropyl alcohol.

17. REPLACEMENT OF CONFORMAL COATING (ENCAPSULANT)

NOTE: We recommend that you use acrylic or polyurethane or silicone conformal coatings, not epoxy, to make easier the replacement of components on the board.

A. For a complete PCA or for a large area coating, refer to the detailed paragraphs for Cleaning and for Conformal Coating preparations. For small areas, as when only two or three components are to be replaced, use these procedures:

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(1) Apply a small amount of isopropyl alcohol to a small test area. If the conformal coating becomes soft and removable, continue with this procedure to remove the conformal coating at the damaged area. If the coating stays hard, use the procedures for removing polyurethane coatings or parylene as necessary. If the conformal coating is soft before you apply the alcohol, it could be a silicone coating that you can easily peel off. Then use the procedure for removal of silicone coatings.

(2) After a repair is complete, for all coatings but parylene, clean with a small brush or a cotton swab and isopropyl alcohol and then apply a coating to the repaired area. Use a brush to apply the coating to small areas. Cover all circuits for a minimum 0.03 inch overlap over the end of the repaired area unless an area is identified to be kept bare.

(3) To add a new coating to units with a parylene coating:

(a) Clean the area with isopropyl alcohol.

(b) Dry the assembly at 150-200°F for a minimum of 15 minutes.

(c) Apply a polyurethane conformal coating around the component. Make an overlap of the adjacent parylene coating of 0.03 inch minimum.

(d) Cure the coating per Paragraph 17.C.(5) below.

(4) To repair a Sylgard coating

(a) Remove the Sylgard coating from the defective area.

(b) Remove polyurethane or acrylic coating, as necessary, from the area of the components to be replaced.

(c) Replace the components as necessary.

(d) Clean the areas with isopropyl alcohol. Let them air dry.

(e) Do not apply acrylic coatings to areas where the base coating was removed.

(f) (Optional) Apply DC 1204 primer to the area. This primer is not necessary for the coating to bond to the surface. If you apply the primer, let it cure for one hour at room temperature before you apply conformal coating.

(g) Apply a continuous layer of RTV3140 coating. Be sure there are no bare surfaces (components, leads, etc.).

(h) Let the coating cure for a minimum of 48 hours at room temperature. The cure is complete after 7 days.

B. Acrylic Conformal Coating

CAUTION: THESE PROCEDURES WILL REMOVE ALL OF THE ACRYLIC COATING FROM THE ASSEMBLY.

(1) Clean the PCA

NOTE: You can use any of these 3 procedures to clean the PCA if all the circuit components have hermetic seals. If some components do not have a hermetic seal, use only the isopropyl alcohol wash procedure.

(a) Isopropyl Alcohol Wash

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1) Get three trays or other containers of a size to contain the assembly. Fill each one with isopropyl alcohol. Put them in a row. When the alcohol in the first container becomes dirty, discard that alcohol and put in it the alcohol from the second container. Put the alcohol from the third container into the second container and fill the third container with clean, new alcohol.
2) Rinse the assembly with tap water for 30 seconds minimum.
3) Put the assembly fully in the first container of isopropyl alcohol and brush with a bristle brush until all visible contaminants are removed.
4) Move the assembly to the second container and clean as before.
5) Move the assembly to the third container and clean as before.
6) Rinse with new isopropyl alcohol from the bottle.

   NOTE: A maximum total exposure time to alcohol of 15 minutes is recommended.
7) Let the part dry at room temperature.

(b) Freon TES fluorinated solvent in a vapor degreaser.

1) The rate of travel into and out of the degreaser must be a maximum of 12 feet/minute. Adjust the speed such that parts dry as they exit the vapor.
2) Place parts in racks to prevent part damage and to permit the vapor to circulate around all part surfaces and the condensate to drain off.
3) Do not move parts or assemblies down into the boiling sump.
4) Hold the parts or subassemblies in the vapor for a minimum of 60 seconds.
5) If necessary to remove heavy dirt or flux, flush with clean liquid solvent. Do not use solvent from the degreaser boiling sump. If the degreaser has a vapor phase only, the parts must be removed, cooled and put through again until they are clean.
6) Keep the nozzle and the parts at least 6 inches below the vapor level. Point the nozzle downward. Again hold parts or subassemblies in the vapor for a minimum of 60 seconds.

   NOTE: With automated vapor degreasing equipment, you can put the subassemblies into the condensate sump for a minimum of 6 seconds and a maximum of 120 seconds, after the equipment sprays the subassemblies.
7) Slowly remove the work from the degreaser. Let the liquid drain from the parts.
8) If you can see flux residue, do the cleaning cycle again after the subassemblies are cool to the touch.

(c) Butyl cellosolve wash (to be followed by isopropyl alcohol wash).

1) To make the butyl cellosolve solution, mix together 1-2 gallons Pluronic L-62F and 45-55 gallons butyl cellosolve. Then make up a 0.45 to 1.00 percent by volume solution of this in water.
2) Put the items through a modified nonrecirculating water rinse at 145-175°F for 3 minutes minimum for parts and printed-wiring boards, and 10 minutes minimum for printed-wiring assemblies.
3) Put the items through a recirculating bath of the butyl cellosolve cleaning solution for 5 minutes minimum.

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4) Put the items through a modified nonrecirculating water rinse at 145-175°F for 10 minutes minimum for parts, 15 minutes minimum for printed-wiring boards, and 20 minutes minimum for printed-wiring assemblies.

5) Wash the items in isopropyl alcohol per Paragraph 17.B.(1)(a) above.

(2) Apply Maskants

(a) Apply a mask to the connectors, test points, trim pots, adjustable capacitors, and areas of the assembly not to get the conformal coating. The adjustable portion of adjustable components can be outside of the conformal coating. Use tape masks (Scotch 218) or strippable maskants (TC-533), or both.

(b) If TC-533 strippable maskant is used, prepare and apply as follows:

1) Mix the maskant fully before you use it.

2) If necessary, dilute with water up to a maximum of 3 ounces per gallon of maskant.

3) Pour on, dip or use a brush to apply a layer sufficiently thick for easy removal (0.004 inch is adequate). Apply more than one layer if necessary. No thickness inspection is necessary.

4) Cure the coating for 2 hours minimum at room temperature (full tensile strength will occur in 12 hours), or 30-90 minutes at 140-160°F.

(3) Prepare Acrylic Coating

(a) General

1) Let the conformal coating material get to room temperature before you open the container.

2) Make sure the material is clean, transparent and has no coarse particles, lumps, or unwanted matter. Strain it if necessary.

3) Fully stir the material in the container, but do not mix in air bubbles.

4) Do not let the coating mixture get a surface film, or cured particles. If it does, discard it and mix up some new coating.

(b) Coatings to be applied by spray or brush

1) Before you use the material, thin it with xylene to a viscosity of 18-20 seconds when measured with a number 2 Zahn cup.

2) As you use the material, you can add more coating material (Humiseal 1B31) or xylene to the coating mixture, but the viscosity must be kept in the above range.

(c) Coatings as a dip

1) Before you use the material, thin it with xylene or toluene to get a viscosity of 40-60 seconds when meassured with a number 2 Zahn cup.

2) As you use the material, you can add more coating material or solvent to the coating mixture, but the viscosity must be kept in the above range.

(4) Apply Acrylic Coating

(a) General

1) Break bubbles that occur during application with a clean swab wet with tolune or isopropyl alcohol.

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2) As quickly as possible after application, remove coating from areas not to get the coating. Use toluene or isopropyl alcohol on a clean swab, cotton-tip applicator or wiper.

(b) Spray Coating – Set up, adjust, and operate the equipment by the usual equipment operating procedure.

(c) Dip coating

1) Put the assembly fully into the dip coating mixture then remove it. Control the rate in to prevent air pockets. Control the rate out to control the coating thickness.

2) Drain the coated assembly in a vertical position. You can use forced air, or other procedrures to adjust the material on the assembly to smooth out local buildups or remove bridges.

3) Keep covers on the containers of coating to prevent evaporation of solvent from the coating mixture.

(d) Brush Coating – Use a brush to apply the coating in small areas or if a spray or dip coating is not easily applied.

(5) Thickness Control

(a) If large areas are coated, the thickness must be measured. Apply the coating to test panels and measure the coating thickness.

(b) For spray coating and brush coatings, use one set of panels for each side of the assemblies.

(c) Measure and make a note of the thickness of the test panels before coating them and after the coating is fully cured.

(d) If the coating did not get to the minimum thickness necessary, you can apply more layers of coating, but you must let the first layers fully cure.

(6) Cure of Coating

(a) Let the coated assembly dry for a minimum of 10 minutes at room temperature.

(b) Then give the unit one of these cure cycles.

1) 24 hours minimum at room temperature.

2) 2 hours minimum at 140-160°F.

3) 30 minutes minimum at 160-180°F.

(7) Removal of Masks

(a) Cool the cured conformal coated assembly to room temperature before you remove the masks.

(b) To remove the masking tape from static sensitive assemblies, pull the tape slowly in an ionized air stream to prevent static build-up.

(c) Maskant residues can be removed with methyl ethyl ketone.

(8) Coating Touch-Up

(a) Do not try to touch up the coating until the cure is completed.

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(b) Remove bubbles or unwanted matter with a clean cotton swab wet with toluene, or isopropyl alcohol. Clean cavities with methyl ethyl ketone or isopropyl alcohol. Let them dry in air. Be careful when you use these solvents to keep them away from other coating surfaces.

(c) Apply more of the coating material as necessary with a brush or equivalent.

(d) Cure the coating again.

(9) Requirements

(a) The assembly must be completely coated unless specified. The end of the leads can be outside the conformal coating unless specified. Do not probe the coating to see if the layer is continuous. Sharp corners, part leads, tight areas between components, or other such irregular configurations are acceptable if the areas look wet. Use ultraviolet light to help.

(b) To find the dry film (final) thickness of the coating, measure the average thickness on the surface of the test panels. Measure and average to the nearest 0.0005 inch. Cured coating thickness must be 0.0005-0.0020 inch. Local edge buildup to 0.0030 inch is acceptable.

(c) Thickness limits are not applicable to sharp corners, part leads, tight areas between components, or equivalent configurations.

(d) On or between printed conductors, some bubbles no larger than 0.025 inch in diameter are acceptable, if they are not between printed conductors 0.025 inch or less apart. No bare areas are permitted.

(e) On component seams and lead seals, some bubbles no larger than 0.025 inch in diameter are acceptable. Component seal leaks (frothy bubbles) are not unacceptable.

(f) On areas without circuitry or electronic parts, and on or near nuts, bolts, and screws, bubbles no larger than 0.20 inch in diameter or groups of bubbles no larger than 0.10 square inch are acceptable if the area affected is not more than one percent of the assembly surface area.

(g) The coating layer must be smooth and continuous over the areas specified to get the coating.

C. Polyurethane Conformal Coating

(1) Clean the PCA

(a) Use the procedures of Paragraph 17.B.(1).

(b) Do not use water on printed-circuit-board assembles that have unsealed components.

(c) Dry the assemblies for 75 minutes minimum in an air-circulating oven at 145-155°F. Cool to room temperature before you apply the conformal coating.

(d) If the dried assemblies cannot be coated within 24 hours, put them in an area where the relative humidity is not higher than 60 percent. If assemblies must wait more than 6 months, clean them again.

(2) Apply maskants per Paragraph 17.B.(2).

(3) Prepare Polyurethane Coating

(a) General

1) Let the conformal coating materials get to room temperature before you open the container.

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2) Make sure the material is clean, transparent and has no coarse particles, lumps, or unwanted matter. Strain it if necessary. Remove unwanted bubbles by vacuum degassing.

(b) Dip Coatings and Flow Coatings

1) Thin encapsulant PC 18M as necessary with cellosolve acetate to get a viscosity of 25-32 seconds, as measured with a No. 2 Zahn cup. Keep the thinned encapsulant in a closed container when not in actual use.

2) As you use the material, you can add more encapsulant and solvent within 8 hours after you first thinned it. But the viscosity must be kept in the specified range. Discard encapsulant if it get a surface film.

(c) Spray Coatings

1) Thin each part of Humiseal 1A33 with 0.9-1.1 part by volume of xylene to get a viscosity of 25-30 seconds as measured by a No. 1 Zahn cup. Keep the thinned encapsulant in a closed container when not in actual use.

2) As you use the material, you can add more encapsulant and solvent within 8 hours after you first thinned it. But the viscosity must be kept in the specified range. Discard the encapsulant if it gets a surface film or cured particles.

(4) Apply Polyurethane Coating

(a) General

1) Break bubbles that occur during application with a clean swab wet with cellosolve acetate.

2) As quickly as possible after application, remove coating from areas not to get the coating. Use acetone or methyl ethyl ketone on a clean swab or wiper.

(b) Dip Coating

1) Carefully stir the coating material before you start to dip, and then at regular intervals. Keep the volume of the coating material as full as possible. Move the coating material from large size to smaller size containers, to decrease the deterioration because of mixed-in air and water. Tightly cover the tank or can at the end of the procedure.

2) Completely put the circuit-board assembly in the coating material, then pull it out vertically. Control the rate in, to avoid air pockets. Control the rate out at 3-5 inches per minute. Let the coated assemblies drain in the vertical position. Use forced air and move the units around to smooth out local buildups and remove bridges.

(c) Flow Coating

1) Fully stir the material before application, but do not mix air into it.

2) Flow the material over the assembly, with the flow in one direction as much as possible.

(d) Spray Coating

1) Set up, adjust, and operate the spray coating machine by the usual instructions.

2) Send the circuit board assemblies through the spray coating machine. Send them through again as necessary to get the specified thickness on each side.

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3) Include test panels with the production parts to monitor the coating thickness and make necessary machine adjustments. Be sure to include a test panel or coupon each time the automatic spray coating machine is adjusted when large surfaces are repaired.

(5) Coating Cure

(a) Dip Coatings, Flow Coating – Use one of these cure cycles:

1) Air dry for 12 hours minimum, then humidity cure at 145-155°F and 35-55 percent relative humidity for 4 hours minimum.

2) Cure at room temperature for 80 hours minimum. After 18 hours of cure, the assemblies can be moved to the clean room for tests and assembly procedures.

3) Air dry for 60 minutes minimum, oven cure at 140-160°F for 60 minutes minimum, then immediately humidity cure at 145-155°F and 35-55 percent relative humidity for 4 hours minimum.

(b) Spray Coatings – Cure the coating for ten days (240 hours) in ambient air or for a minimum of 15 hours in an air circulating oven at 140-160°F.

(6) Removal of Masks

(a) From Dip or Flow Coatings

1) Strip the mask after the conformal coating air dried at least 18 hours (8 hours for boards with plated edge contacts) or after one hour of oven cure. To remove the mask, make an edge loose and hand peel. If you use a tool to do this, be careful not to damage assemblies. Clean maskant from all uncoated surfaces with acetone or methyl ethyl ketone on a wiper.

(b) From Spray Coatings

1) The mask can be removed immediately after spray coating, or after the coating is cured. Use the same removal procedure as for dip and flow coatings.

(7) Coating Repair

(a) Dip or Flow Coating Surfaces

1) Break all unacceptable bubbles and cut out unwanted particles with a sharp or hot (450-650°F) tool.

2) Clean cavities with acetone, methyl ethyl ketone, or isopropyl alcohol. Then apply more polyurethane coating.

3) On coatings thinner than the minimum thickness or on uncoated areas, you can apply more coats of the same material. On local areas, the polyurethane coating can be applied with a brush.

4) Cure the added coats of polyurethane.

(b) Spray Coating Surfaces

1) Method 1

a) Break all unacceptable bubbles and cut out unwanted particles with a sharp or hot (450-650°F) tool.

b) Make sure you do not damage leads and parts. Remove loose flakes.

c) Clean cavities with acetone, methyl ethyl ketone, or isopropyl alcohol. Then apply more PC 18M or Humiseal 1A33.

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d) On coatings thinner than the minimum thickness, you can apply more coats of the same material. On local areas, PC 18M or Humiseal 1A33 coating can be applied with a brush.

e) Cure the added coats of PC 18M. Dry the brushed-on Humiseal 1A33 coating for 1 hour at room temperature or for 5 minutes at 140-160°F first.

2) Method 2

a) If necessary, remove Humiseal coating from the area as above.

b) Clean the area with acetone, methyl ethyl ketone isopropyl alcohol. Air dry.

c) Apply a brush coat of blended CE-1155 to the cleaned areas.

d) If more coats are necessary, let the material cure for 2 hours minimum at room temperature or 30 minutes minimum at 140-160°F between coats.

e) Cure for 3 hours minimum at 140-160°F or 1 hour minimum at 190-210°F. Do not seal coated assemblies from air or environmentally test them until the coating is cured.

(8) Requirements

(a) The assembly must be continuously coated, but the ends of the leads can be outside the conformal coating. Do not probe the coating to see if it is continuous. Sharp corners, part leads, or similar irregular configurations are acceptable if they look wet. Use ultraviolet light to help.

(b) Make sure the electronic part identification can be read through the conformal coating.

(c) To find the dry film (final) thickness of the coating measure the average thickness on the surface of the test panels. Measure and average to the nearest 0.0005 inch. Cured coating thickness must be 0.0005 to 0.0020 inch. Local edge buildup to 0.0030 inch is acceptable.

(d) Thickness limits are not applicable to sharp corners, part leads or equivalent configurations.

(e) On and between printed conductors, in dip and flow coatings, bubbles and voids no larger than 0.005 inch in diameter are acceptable. In spray coatings, bubbles no larger than 0.025 inch in diameter are acceptable, if they are not between printed conductors 0.025 inch or less apart. No voids are permitted.

(f) On component seams and lead seals, bubbles no larger than 0.025 inch in diameter are acceptable. Component seal leaks (frothy bubbles) are unacceptable.

(g) On areas without circuitry or electronic parts, or on or near nuts, bolts and screws, bubbles no larger than 0.2 inch in diameter or groups of bubbles no larger than 0.1 square inch are acceptable if the area affected is not more than one percent of the assembly surface area.

(h) The coating layer must be smooth and continuous over the areas specified to get the coating.

D. Silcone Conformal Coating

(1) Clean the PCA

(a) Use the procedures of Paragraph 17.B.(1).

(b) Do not use water on printed-circuit-board assemblies that have unsealed components.

(c) Dry the assemblies for 75 minutes minimum in an air-circulating oven at 145-155°F. Cool to room temperature before you apply the conformal coating.

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(d) If the dried assemblies cannot be coated within 24 hours, put them in an area where the relative humidity is not higher than 60 percent. If assemblies must wait more than 6 months, clean them again.

(2) Apply maskants per Paragraph 17.B.(2).

(3) Prepare Silicone Coating

(a) General

1) Let the conformal coating materials get to room temperature before you open the container.

2) Make sure the material is clean, transparent and has no coarse particles, lumps, or unwanted matter. Strain it if necessary. Remove unwanted bubbles by vacuum degassing.

(b) Use the coating as supplied by the vendor. Do not use a thinner.

(4) Apply Silicone Coating

(a) Clean the areas to be coated with a cotton tip applicator or BMS 15-5 wipers wet with isopropyl alcohol.

(b) Apply RTV3140 material to all areas specified by the overhaul instructions. As a minimum, apply the material to component leads and lead ends. Material can go onto adjacent areas such as component leads or bodies, solder pads or connections.

(c) Cure the RTV3140 material for a minimum of 48 hours at room temperature. After the material is tack free (approximately 1-2 hours), assemblies can be handled for examination and touchup.

(d) If necessary, touch up the layer with more RTV3140 material, but cleaning is not necessary.

(5) Removal of Masks

(a) Cool the cured conformal coated assembly to room temperature before you remove the masks.

(b) To remove the masking tape from static sensitive assemblies, pull the tape slowly in an ionized air stream to prevent static build-up.

(c) Maskant residues can be removed with isopropyl alcohol.

(6) Coating Touch-Up

(a) Do not try to touch up the coating until the cure is completed.

(b) Remove bubbles or unwanted matter with a clean cotton swab wet with isopropyl alcohol. Clean cavities with isopropyl alcohol. Let them dry in air. Be careful when you use these solvents to keep them away from other coating surfaces.

(c) Apply more of the coating material as necessary with a brush or equivalent.

(d) Cure the coating again.

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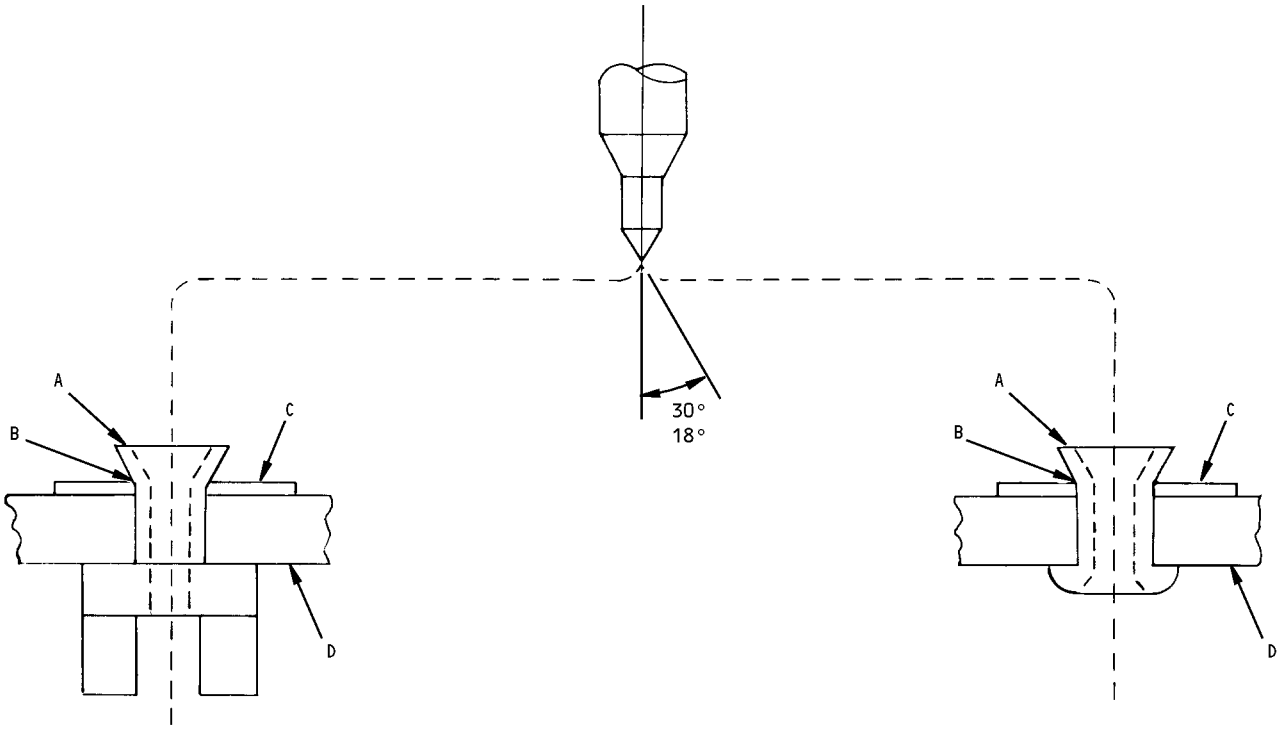
A – SOLDER RING (IF USED)
B – TERMINAL READY FOR SWAGING
C – TERMINAL MOUNTING SHOULDER (360 DEGREE CONTACT)
D – TERMINAL PAD



A – "V", OR FUNNEL TYPE SWAGE
B – POINT TO APPLY SOLDER IF SOLDER RING IS NOT USED
C – TERMINAL PAD
D – BOARD

Swaged Hardware Details
Figure 22

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18. ASSEMBLY OF SWAGED HARDWARE (EYELET, STANDOFF TERMINALS, ETC.)

A. The terminal or eyelet shank must be pressed through the board and the terminal aligned as shown in Figure 22.

B. A V-type funnel swage must be used on printed circuit boards where the swaged end ends in a circuit pad or pattern. It must be soldered after swaging. A roll-type swage can be used only where the swaged end comes down only on the circuit board base material. The swaged V-type flare must not be split and must not damage the circuit pattern. Cracks in the rolled type swage are permitted if they are no longer than 40% of the length of the radius of the swage.

C. Hardware which ends in a circuit pad or pattern to which it is to make electrical contact must be soldered after swaging.

D. The roll swage must be too tight to be moved by finger pressure. There must be no more than 0.050 inch of delamination of the base material beyond the flange and there must be a minimum of 0.030 inch of nondelaminated base material between the swaged hardware and other conductors. This includes delamination caused by installation or subsequent soldering operations.

(1) Scalloped or roller hardware must not have splits which extend to the midpoint between the crown of the roll and the tangent point of the barrel (Figure 23).

(2) The scallops must be made to let solder flow under them.

(3) If the overhaul instructions specify that the swaged terminals to be attached to circuitry must make an electrical connection, they must have a scalloped head. On single-sided cards, the scallop must be on the etched circuit side. These must be soldered.

(4) The scalloped or rolled flanges can have hairline cracks around their edges of roll.

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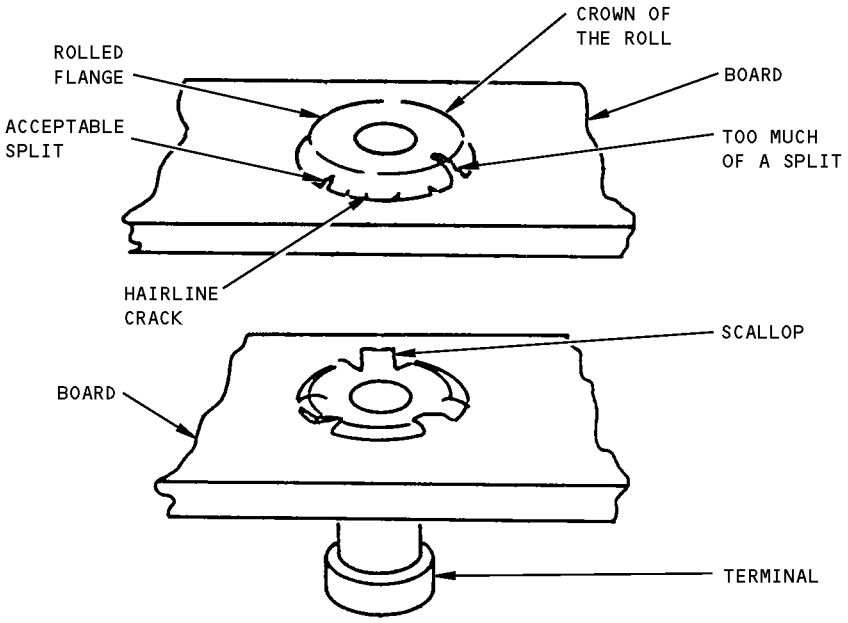

Assembly of Swaged Hardware
Figure 23

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19. STRIP BONDING

A. Sand the faying surfaces (Ref. Figure 24) with 240 grit or finer garnet or aluminum oxide abrasive. Remove grit and sanding debris with a blast of clean, dry, oil-free air.

WARNING: WHEN YOU USE ISOPROPYL ALCOHOL, DO NOT BREATHE THE VAPOR OR MISTS. USE ONLY WITH APPROVED VENTILATION, AVOID PROLONGED OR REPEATED SKIN CONTACT. KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.

B. Fully clean all faying surfaces with isopropyl alcohol.

C. Dry the strip and the circuit board in 140-160°F circulating air for 30-60 minutes.

D. Cool to room temperature and bond within 2 hours.

E. Mask across the etched contacts and pattern with Permacel P29 tape or Turco 522 Maskant.

F. Prepare BMS 5-72, Type 1 or Armstrong A31 adhesive by the manufacturers' instructions.

G. Apply the adhesive smoothly to one or both faying surfaces. Press the strip in position on the circuit board with up to 5 psi pressure (Figure 24).

WARNING: WHEN YOU USE SOLVENTS, DO NOT BREATHE THE VAPOR OR MISTS. USE ONLY WITH APPROVED VENTILATION. AVOID PROLONGED OR REPEATED SKIN CONTACT. KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.

H. Before the adhesive cures, remove masking and wipe off unwanted adhesive with a clean cloth wet with methyl ethyl ketone or isopropyl alcohol.

I. Cure BMS 5-72, Type 1 adhesive for 8 hrs at 75°F or 1 hr at 160°F.

J. Cure Armstrong A31 adhesive for 24 hrs at 75°F or 2 hrs at 160°F.

K. Apply conformal coat (encapsulant) to the repaired area per Paragraph 17.

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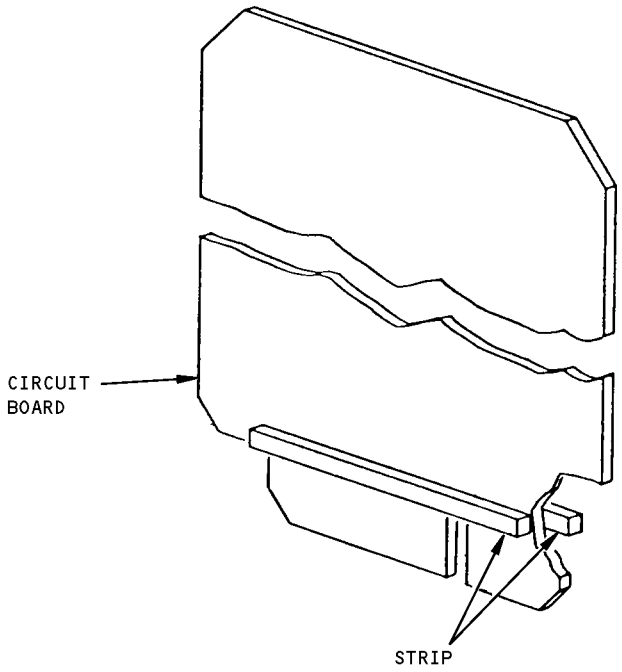

Strip Replacement
Figure 24

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20. REPAIR OF FLEXIBLE PRINTED WIRING

NOTE: Military Specification MIL-P-50884 does not permit the repair of flexible printed wiring used in military equipment.

A. Precautions

(1) Flexible printed wiring can be damaged if dropped, bent or folded. Lift the units by their larger components, not by the flexible circuit sections.

(2) Do not put stresses at inside edge corners that could cause cracks and progressive tears.

(3) During tests, apply instrument probes to component leads or solder joint fillets. Apply test clips to component leads. Do not put stress on leads or flexible circuit.

B. General

(1) Holes can be punched with a leather punch or equivalent, or drilled with a hand-held motor drill. Use a drill board below and plexiglass above when you drill. Holes must not have ragged edges that could grow into tears.

(2) To keep the wiring flexible, Humiseal 1A33 polyurethane can be used as an alternative to polyimide tape or Metre Grip in a fold area. Long lengths of wire can be sent over a fold area.

(3) Pin-to-pin connection by wire is an acceptable alternative to repair of a bad flex circuit conductor. The conductor can be cut, drilled or punched out and replaced with pin-to-pin wire.

(4) All corner areas must have a radius sufficiently large to decrease the risk of tears or cracks. Punch or drill at corner areas as necessary to get this radius.

(5) Use Humiseal 1A33 polyurethane to give protection to plated-through holes which do not have solder leads or polyimide covering.

(6) Remove solder with standard wick or vacuum procedures. Use heat for as short a time as possible to prevent delamination.

C. Removal and Replacement of Components or Wires

(1) To remove the polyurethane coating, use a stiff bristle brush or a cotton swab and acetone or methyl ethyl ketone.

(2) Use usual wick or vacuum solder procedures.

(3) Do not use too much heat, to reduce the risk of delamination.

(4) Do not use too much force during component removal, to reduce the risk of damage to the flexible circuit.

(5) Install the new component, solder it, and cut off the unwanted leads as required.

D. Repair of Circuitry (Figure 25)

(1) Use visual magnification as necessary.

(2) Uncover the circuit conductor for a minimum of one-eighth inch on both sides of the defect. Cut through the insulating cover of the conductor with the point of a scalpel or other sharp instrument. Push or scrape with a scalpel to remove the cover and get at the conductor. When you use the scalpel, be careful to keep to a minimum any damage to the base metal. Small scratches are permitted.

(3) Tin the exposed conductor with solder on both sides of the piece.

(4) Tin with solder a minimum of one quarter inch at ends of a length of AWG 26 or AWG 28 solid strand copper wire that will go across the defect.

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(5) Hold the wire segment in position over the break with the edge of a scalpel. Flux can be used. Solder the wire in place. Remove unwanted flux with a swab and isopropyl alcohol.

(6) Apply Metre Grip 303 or Humiseal 1A33 polyurethane coating over the repaired area for insulation and support.

E. Removal of Conductors (Figure 25)

(1) Find a point on the conductor that has sufficient clearance from adjacent conductors.

(2) Drill or punch a circular hole through the flexible circuit. Make this hole only of a size to break the conductor. If the circuit is two-sided, and the hole cuts a circuit on the far side, repair the conductor on the far side as if it were a damaged conductor.

(3) Cover the hole on each side with Scotch No. 92 tape. Put the tape over the cut area with a minimum of one quarter inch beyond the hole area.

(4) To remove a circuit at a pad location (for example, a electrical contact at a terminal post), you can punch or drill it out. Overcoat the hole with polyurethane. Be sure to include the walls. Tape is not necessary. If you must solder a wire to a terminal post that goes through such a hole, make sure that the solder fillet does not extend into the flexible circuit.

F. Addition of Conductors

(1) Get some coated copper wire, quadruple formvar wire, or copper wire per QQ-W-343 Type S or BMS 13-46.

(2) Remove insulation by the usual procedures.

(3) If the added wire is to end on a component lead, remove the solder fillet from the affected circuit side only.

(4) Bend the wire end around the component lead and solder it.

(5) If the wire is to end on a conductor pattern, remove the covering, tin the conductor pattern and wire, and solder in position as per Paragraph 20.D. above. Remove unwanted flux with a swab and isopropyl alcohol.

(6) Bond the wire with Metre Grip 303 or Humiseal 1A33 polyurethane as necessary to give protection to the wire insulation.

G. Repair of Cuts, Tears, Nicks, and Creases

(1) Cuts or tears which do not go through a conductor (Figure 25)

(a) Drill or punch a circular hole at the end of the defect. Make sure that the hole removes the end of the crack, or the defect will continue to grow. If this hole goes into a far side circuit, repair the far side circuit per Paragraph 20.D. above.

(b) Cover the hole on both sides with Scotch No. 92 tape. Center the tape over the hole area with a minimum of one quarter inch extension beyond the hole area.

(2) Cut or tear that goes through a conductor (Figure 25).

(a) Drill or punch a circular hole at the end of the defect. Make sure that the hole removes the end of the defect, or the defect will continue to grow.

(b) Repair broken circuits Paragraph 20.D. above. If no circuit is broken on one side, cover the hole there with Scotch No. 92 tape.

(3) Badly Creased Sections

(a) If the conductor is not damaged, apply Scotch No. 92 tape to the two sides of the creased area to add strength to the area.

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(b) If the conductor is damaged, repair per Paragraph 20.D. above. Give strength to the area of the crease withType 69 adhesive, or polyurethane coating, applied over the repaired side, and with Scotch No. 92 tape over the other side.

(4) Nicks

(a) Bend the area of the nick into an arc with sufficient radius to help it not become worse and change into a crack or tear.

(b) If necessary, apply Scotch No. 92 tape to give strength to the area.

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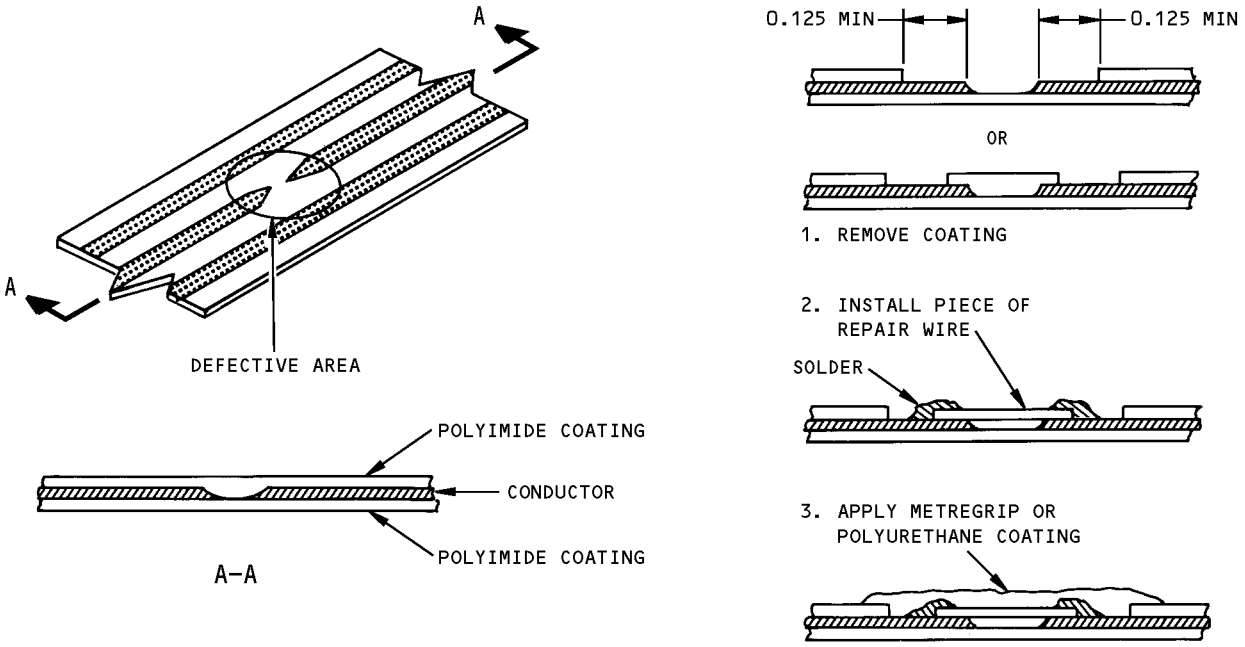
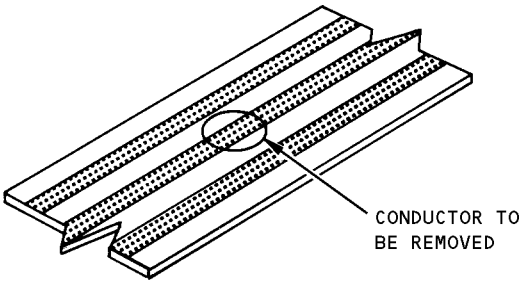
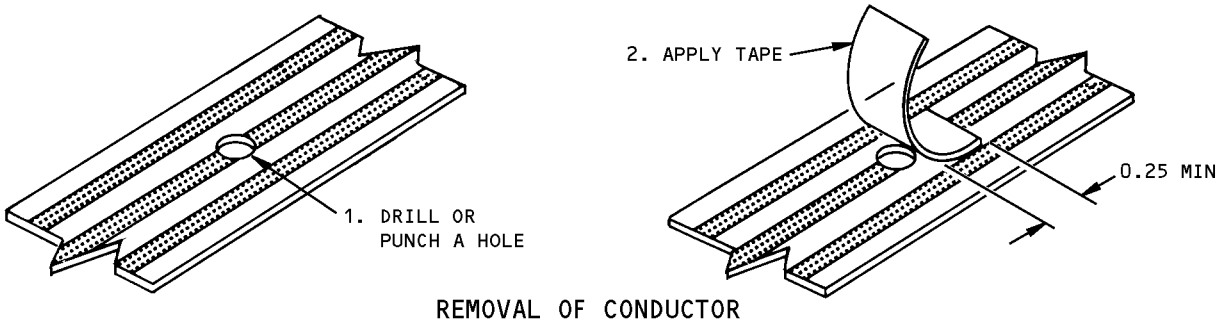


CORRECTION OF DEFECTIVE CIRCUITRY
NOT AT A CIRCUIT PAD

(A)





REMOVAL OF CONDUCTOR

(B)

ALL DIMENSIONS ARE IN INCHES

Repair of Flexible Printed Wiring
Figure 25 (Sheet 1 of 2)

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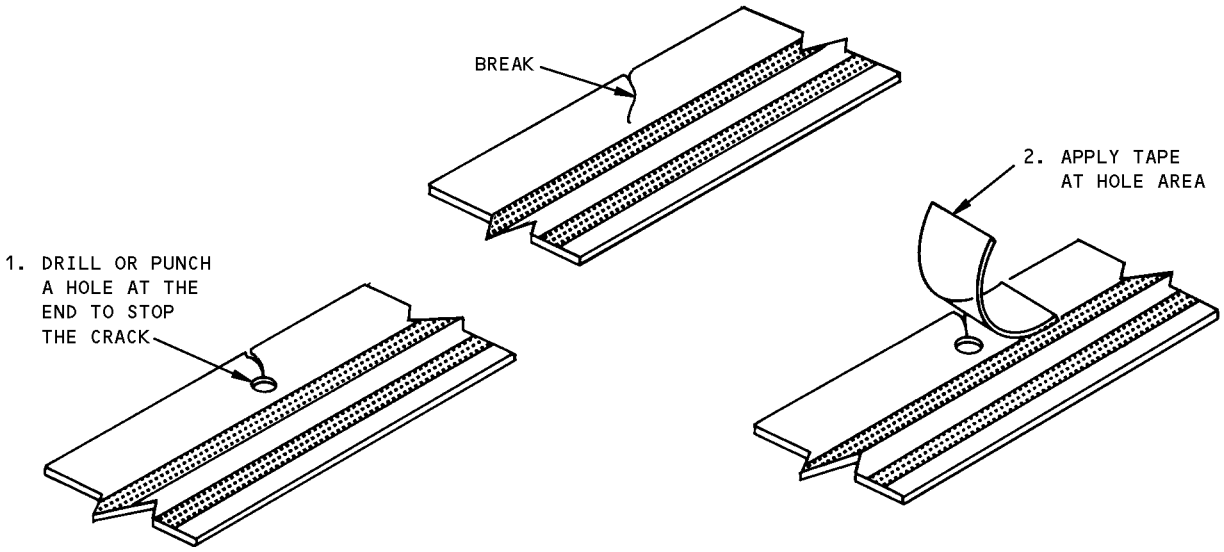
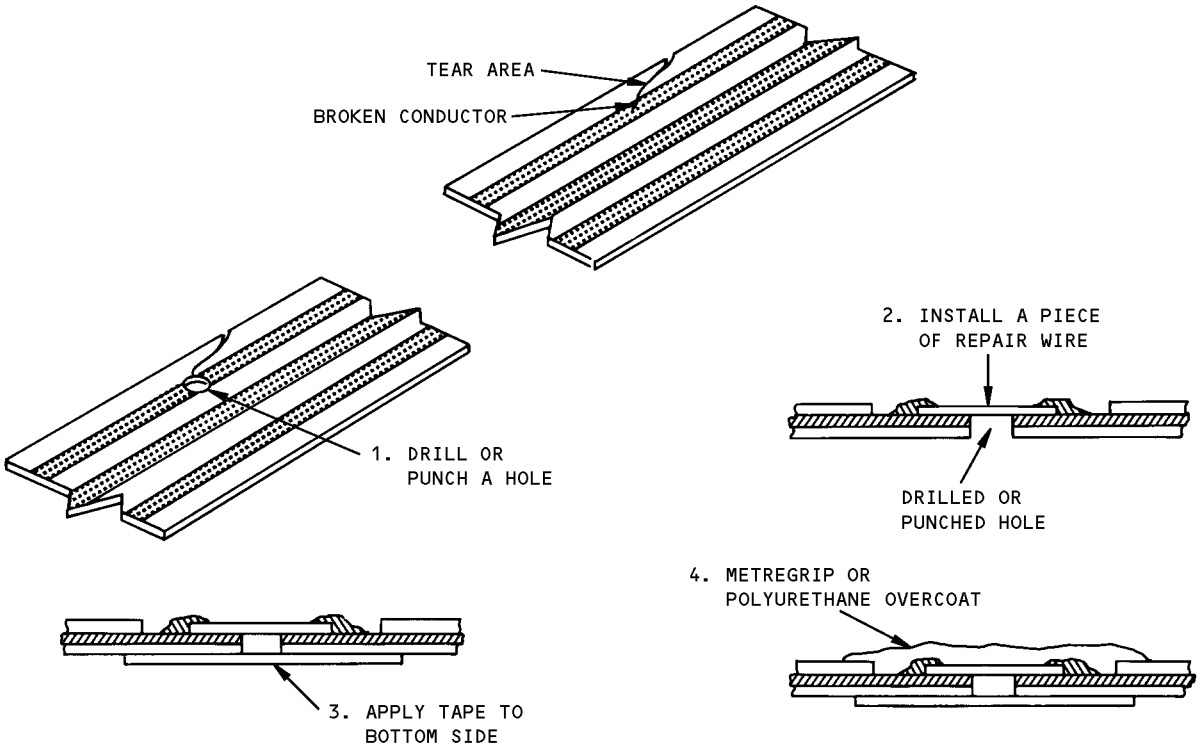


BREAK IN SUBSTRATE NOT THROUGH A CONDUCTOR

METHOD 3 -- REPAIR BROKEN (C)



BREAK IN SUBSTRATE AND THROUGH A CONDUCTOR

(D)

Repair of Flexible Printed Wiring
Figure 25 (Sheet 2 of 2)

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21. MATERIALS AND TOOLS

NOTE: Equivalent substitutes can be used.

A. Materials

(1) Abrasives

(a) Aluminum oxide, 27 grit

(b) Aluminum oxide or garnet, 240 grit or finer

(2) Adhesives

(a) Armstrong A31, V98911

(b) Type 52 (BMS 5-60)

(c) BMS 5-72, Type 1

(d) Type 69 (BMS 5-72, Type 4, which replaces Type 2) (Metre Grip 303, V18604)

(3) Cleaners and Solvents (SOPM 20-60-01)

(a) Acetone, technical – O-A-51

(b) Alcohol, Ethyl

(c) Aliphatic Naphtha – TT-N-95

(d) Butyl Cellosolve – TT-E-776

(e) Cellosolve Acetate – 2, Ethoxy Ethyl Acetate, 99%, Polyurethane Grade, V80524

(f) Isopropyl Alcohol – TT-I-735, Grade A Technical

(g) Methyl Ethyl Ketone (MEK) – TT-M-261

(h) Thinner for Uralane 5750 – 75% Toluene, 25% MEK (by volume)

(i) Toluene – TT-T-548

(j) 1,1,1-Trichloroethane – MIL-T-81533

(k) Xylene – ASTM D 846

(4) Coatings, Conformal (Encapsulants)

(a) Acrylic – Humiseal 1B31, MIL-I-46058 Type AR

(b) Polyurethane – Humiseal 1A33, V99109

(c) Polyurethane – Hysol PC 18M, V04347 (Supersedes BMS 8-109, Type 1)

(d) Polyurethane – MIL-I-46058, Type UR

(e) Silcone – RTV3140, V71984

(5) Epoxy – Scotchcast 251, V76381

(6) Epoxy Resin – Scotchcast No. 8, V76381

(7) Flux – MIL-F-14256, Type RMA

(8) Joint Compound, Thermal – Wakefield Type 152 (Type 120 optional), V92218

(9) Locking Compound, Glyptal – No. 1201 (Red Enamel), V34700

(10) Masking Materials

(a) Scotch No. 218, V76381

(b) Scotch No. 250, 1 inch width, V76381

(c) Spraylat SC-1071, V87354

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(d) Tech Form Laboratories TC-533, V52700

(e) TEC-660-2W, V25227 or V8E724

(f) Turco 522, V61102

(11) Nylon Strip – Polymer No. 101, 0.031 inch thick, V83616

(12) Phosphor-Bronze – QQ-B-750, Composition A Annealed, 0.010 inch thick

(13) Pipe cleaners – U.S. Tobacco Co., V4V681

(14) Solder – QQ-S-571 (SOPM 20-12-01)

(15) Spacer Strips, Removable – Dissopads, V32559

(16) Strippers

(a) ES1, V26348

(b) Strip Jel 990, V75554

(c) Strip-X, V72653

(17) Swabs, cotton (SOPM 20-60-04)

(18) Tape

(a) Flame resistant – Permacel P29, V99742

(b) Polyethylene – Polyken No. 822, V97327

(c) Polyimide – Scotch No. 92 Polyimide, V76381

(d) Protective – Scotch Y9017, V76381

(e) TFE Fluorocarbon – Permacel No. 422, V99742

(f) TFE Fluorocarbon – Scotch No. 65, V76381

(19) Tubing, Heat-Shrinkable, Clear

(a) Raychem RNF-100, V06090

(b) Scotchtite 3028, V76381

(c) Thermofit CRN Type 2, V06090

(d) MIL-I-23053/8

(20) Wipers – BMS 15-5, Class A or B (SOPM 20-60-04)

(21) Wire

(a) Bare, Copper, Tinned, Single Conductor, Soft Drawn or Annealed – QQ-W-343, Type S

(b) BMS 13-46

(c) Magnet Wire – J-W-1177/9, Class 130, Type SUN, V4F001 or V6B570

(22) Wire Braid – QQ-B-575

B. Tools and Equipment

(1) Soldering iron with built-in suction device – Enterprise Model 300, V18885

(2) Cutting tool – scalpel or knife

(3) Long-nose pliers

(4) Test jig for board assembly

(5) Lead cutting tool – Utica 262-5-1/2, V30106

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(6) Smooth flat jawed pliers

(7) Pin clip tool – ST2318C-9

(8) Brush, stiff bristle

(9) Drill board – tempered hardboard, approx. 1/8 inch thick, finished, Georgia Pacific, V00284

(10) Drills, carbide

(a) ST 1255

(b) Carbet Series 2000, Carbet Division, Chicago Circuit Drilling Co.

(c) Series 255, Metal Removal Division, Federal Mogul Corp., V98387

(d) Catalog No. 5738, Union Card Div., UTD Corp.

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