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SOLDERED ELECTRICAL CONNECTIONS

NASA TECHNICAL STANDARD

CHAPTER 7 - PREPARATION FOR SOLDERING

7.1 Preparation of Soldering Tools

Users shall check tools daily for proper condition, operation, performance, and cleanliness.

7.2 Preparation of Conductors

1. **Insulation Removal**. Stripping tools, used to remove conductor insulation, shall be of the correct size and in correct adjustment and/or calibration.

2. **Damage to Insulation**. After insulation removal, the remaining conductor insulation shall not exhibit any damage such as nicks, cuts, or charring. Conductors with damaged insulation shall not be used. Scuffing from mechanical stripping or slight discoloration from thermal stripping is acceptable.

3. **Damage to Conductors**. After removal of the conductor insulation, the conductor shall not be nicked, cut, or scraped to the point that base metal is exposed. Part leads and other conductors that have been reduced in the cross-section area shall not be used. Smooth impression marks (base metal not exposed) resulting from tool holding forces shall not be cause for rejection.

4. **Wire Lay**. If disturbed, the lay of wire strands shall be restored as nearly as possible to the original lay. The conductor shall be cleaned following restoration to the original lay.

5. **Tinning of Conductors**. The portion of stranded or solid conductors or part leads that will eventually become a part of the finished solder connection shall be tinned with solder and cleaned prior to attachment. Immersion of conductors in a solder bath shall not exceed 5 seconds. Liquid flux may be used. The flux shall be applied so that it does not flow under the insulation except for traces carried by wicking. Precautions shall be taken when removing flux with a cleaning solvent to prevent excess solvent from flowing under the conductor insulation.

a. Hot tinning of solid conductors and part leads should not extend closer than 0.5mm (0.020 inch) to part bodies, end seals, or insulation unless the part configuration and mounting configuration dictate. If closer tinning is required, the part body, end seals, or insulation shall be inspected for damage after tinning and the results recorded (see also paragraph 4.1-3).

b. Solder pots or hand tinning with a soldering iron shall be used.

c. Gold plating on all surfaces that become part of finished solder connections shall be removed by two or more successive tinning operations (solder pot or iron), or by other processes demonstrated to have equivalent effectiveness.

d. Tinning solder pots shall be analyzed on an established schedule, based on usage, to ensure that they meet the requirements of Table 7-1, and that the total of gold plus copper does not exceed 0.3 percent. Records of the analyses shall be kept. The solder pot may be dumped on an established schedule, based on usage, in lieu of analysis. When the solder produces a dull, frosty, or granular appearance on the work, the pot shall be immediately removed from use.

Table 7-1. Solder Contaminant Levels
Maximum Allowable Percent by Weight of Contaminant

Contaminant	Percent Allowed
Copper (Cu)	0.25
Gold (Au)	0.20
Cadmium (Cd)	0.005
Zinc (Zn)	0.005
Aluminum (Al)	0.006
Antimony (Sb)	0.5
Iron (Fe)	0.02
Arsenic (As)	0.03
Bismuth (Bi)	0.25
Silver (Ag)	0.10
Nickel (Ni)	0.01

e. Solder pots used for tinning operations should be maintained at required temperatures and monitored, as a minimum, before and after each tinning operation or 8-hour period of operation.

6. **Conductor Tinning Product Control**. Conductor tinning personnel shall ensure that the tinned surfaces exhibit 100 percent coverage. Wire strands shall be distinguishable.

7.3 Preparation of Printed Wiring Boards, Terminals, and Solder Cups

1. Termination areas shall have been "tinned" with hot-coated tin-lead solder or hot reflowed electrodeposited tin-lead solder prior to mounting the parts. Final solder terminations shall not be made to any PWB or solder cup that has not had the gold removed from the termination area.

2. Terminals and solder cups shall be examined for damage and cleaned prior to the attachment of conductors. Terminals and solder cups shall not be modified to accommodate improper conductor sizes.

3. The PWB's shall be cleaned and demoisturized within 8 hours prior to their initial exposure to soldering temperatures. The PWB's may be stored for longer periods of time in a controlled moisture-free atmosphere. Demoisturizing may be accomplished by an oven bake at 93°C (200°F) ±5.5°C (±10°F) for a minimum of 4 hours for a printed wiring assembly (PWA) or 2 hours for a bare PWB, or by a vacuum bake at a lower temperature. The time in and out of the oven or chamber shall be recorded.

CHAPTER 8 - PARTS MOUNTING

8.1 General

Parts, terminals, and conductors shall be mounted and supported as prescribed herein. Dimensions provided in this chapter are for acceptance and/or rejection criteria only. Unusual environmental applications require special design measures to provide necessary environmental survival capability. Such measures shall be detailed on the appropriate engineering documentation. Engineering documentation shall prescribe which alternative approach is selected, as well as staking compounds and conformal coating requirements. They shall also detail any special mounting arrangements or design requirements not fully covered herein.

1. **Stress Relief.** Stress relief shall be incorporated, wherever possible, into all leads and conductors terminating in solder connections to provide freedom of movement of part leads or conductors between points of constraint. Leads shall not be temporarily constrained against spring-back force during solder solidification so that the joint is subject to residual stress. Examples of stress relief are shown in figures throughout this chapter.

2. **Part Positioning**. Parts shall be positioned in compliance with the engineering documentation and mounted in accordance with the requirements specified herein.

a. Parts shall be mounted so that terminations of other parts are not obscured. When this is not possible, interim assembly inspection shall occur to verify that the obscured solder joints meet the requirements herein.

b. Parts having conductive cases mounted over printed conductors or which are in close proximity with other conductive materials shall be separated by insulation of suitable thickness. Insulation shall be accomplished so that part identification markings remain visible and legible.

3. **Visibility of Markings**. Where possible, parts shall be mounted in such a manner that markings pertaining to value, part type, etc., are visible. For parts marked in such a way that some of the marking will be hidden regardless of the orientation of the part, the following shall be the order of precedence for which markings shall be visible:

a. Polarity.

b. Traceability code (if applicable).

c. Piece part value and type.

4. **Glass Encased Parts.** Glass encased parts such as diodes, thermistors, or resistors shall be covered with transparent resilient sleeving or other approved material when epoxy material is used for staking, conformal coating, or encapsulating or where damage from other sources is likely. The epoxy material shall not be applied directly to glass.

<u>CAUTION</u>: WHEN USING HEAT SHRINKABLE SLEEVING, EXTREME CARE SHOULD BE TAKEN TO PREVENT PART DAMAGE DUE TO EXCESSIVE HEAT OR SHRINKAGE OF THE SLEEVING.

5. **Hookup Wire**. Hookup wire, solid or stranded, shall be supported by a means other than the solder connections or conformal coating if wire length exceeds 2.54cm (1 inch). Attachment to a surface by staking with resin is considered adequate support.

6. **Lead Bending and Cutting**.

a. During bending or cutting, part leads shall be supported on the body side to minimize axial stress and avoid damage to seals or internal bonds. The distance from the bend to the end seal shall be approximately equal at each end of the part. The minimum distance from the part body or seal to the start of the bend in a part lead shall be 2 lead diameters for round leads and 0.5mm (0.020 inch) for ribbon leads. The stress relief bend radius shall not be less than the lead diameter or ribbon thickness. The direction of the bend should not cause the identification markings on the mounted part to be obscured. Where the lead is welded (as on a tantalum capacitor) the minimum distance is measured from the weld.

b. Part leads shall be formed so that they may be installed into the holes in the PWB without excessive deformation that can stress the part body or end seals.

c. All leads should be tinned and formed before mounting the part.

<u>CAUTION</u>: WHERE POSSIBLE, PART LEADS THAT ARE SUBJECT TO STRESS CORROSION CRACKING (E.G. KOVAR LEADS), SHALL BE PREFORMED AND TRIMMED PRIOR TO TINNING.

d. Whether formed manually or by machine, part leads shall not be mounted if they show evidence of nicks or deformations. Smooth impression marks (base metal not exposed) resulting from tool holding forces shall not be cause for rejection.

e. Tempered leads (sometimes referred to as pins) shall not be bent nor formed for mounting purposes since body seals and connections internal to the part may be damaged. Tempered leads or leads with a diameter of 1.27mm (0.05 inch) or more shall not be cut with diagonal cutters or other tools that impart shock to connections internal to the part.

7. **Coated Parts**. Parts shall be mounted so that the insulating coating meniscus applied by the manufacturer on the leads does not enter the mounting hole or soldered connection.

8. **Splices**. Broken or damaged conductors, part leads, or printed wiring conductors shall not be spliced.

9. **Location**. Part bodies shall not be in contact with soldered terminations.

8.2 Mounting of Terminals

1. **General**. Use of terminals shall generally be restricted to situations where parts are expected to be removed and replaced, or where there are other compelling design requirements for their use.

a. Terminals shall not be used as the interface connections in non-plated through holes (PTH's). Swaging of terminals shall be performed in a way that does not damage the PWB.

b. After swaging or flaring, the rolled area or flange shall be free of circumferential splits or cracks, but may have a maximum of three radial splits or cracks provided that the splits or cracks are separated by at least 90° and do not extend beyond the coiled or flared area of the terminal (Figure 8-1).

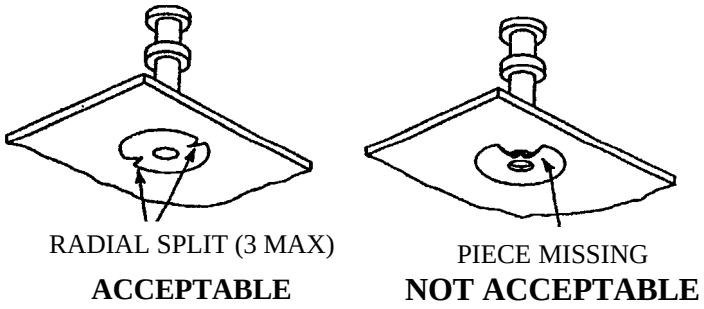


Figure 8-1. Terminal Damage

2. Swage type terminals in non-PTH's, designed to have the terminal shoulder soldered to the printed wiring conductor, shall be secured to the PWB by a roll swage (Figure 8-2).

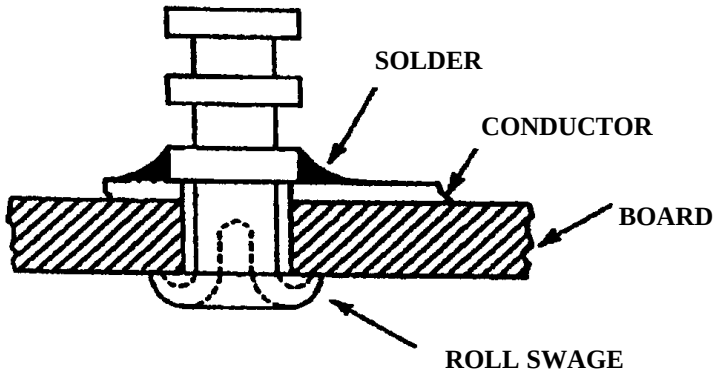


Figure 8-2. Roll Flange Terminal

3. PWB designs calling for soldering of the swaged end of the terminal to the printed wiring conductor on a single-sided PWB shall have the terminal secured with a V-funnel swage (refer to Figure 8-3).

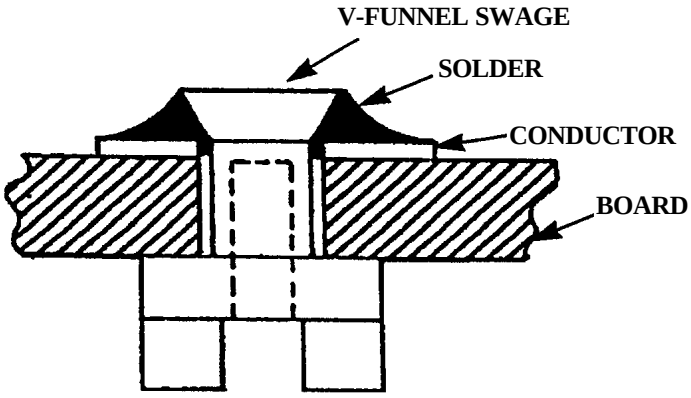


Figure 8-3. V-Funnel Type Swage

4. Swage type terminals that are mounted in a PTH shall be secured to the PWB by a V-funnel swage (Figure 8-3) or an elliptical funnel (Figure 8-4) swage. The elliptical funnel swage is the preferred method for attachment. Terminals shall be swaged such that they can be rotated under finger force.

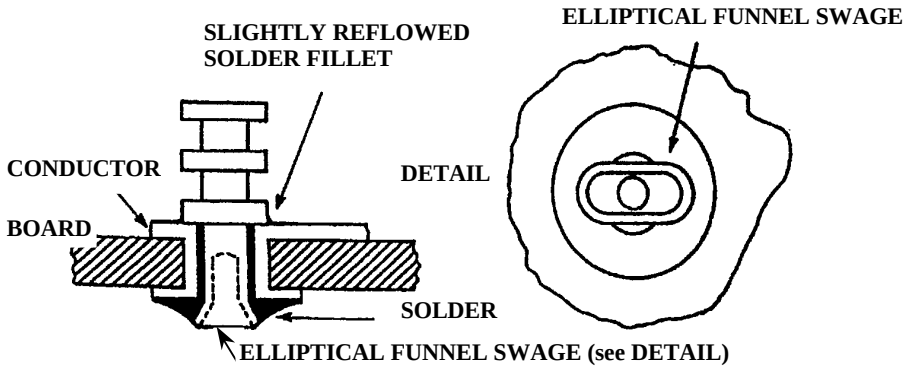


Figure 8-4. Elliptical Funnel Type Swage

8.3 Mounting of Parts to Terminals

1. **Parallel Mounting**. Parts shall be mounted parallel to, and in contact with, their mounting surface. Slight angularity is permissible.

2. **Lead Lengths**. The length of leads between parts and terminals should be approximately equal at both ends, except when special part shapes require staggering.

3. **Stress Relief.** Where parts are mounted between bifurcated terminals, without lead wrap, it is not mandatory that the part leads have stress relief bends. Where parts are mounted between other terminal types, it is mandatory to put a stress relief bend in at least one lead (Figure 8-5).

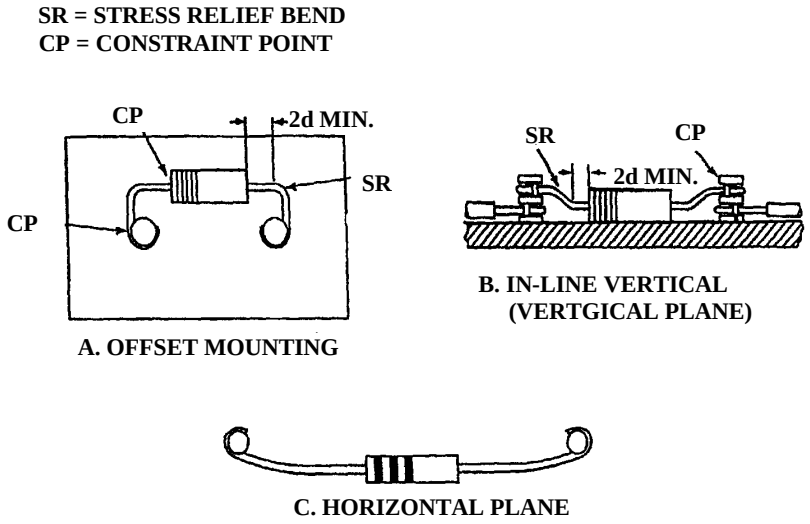


Figure 8-5. Stress Relief Examples

CAUTION: ***CARE SHALL BE EXERCISED TO ASSURE THAT SWAGED SOLDER CONNECTIONS ARE NOT MECHANICALLY STRESSED DURING PART MOUNTING OPERATIONS.***

4. **Wrapping and Routing**. Degrees of wrap and routing are specified in Chapter 9.

8.4 Mounting of Parts to PWB'S

1. **Parts Mounted To PWB's.** Solder terminations shall be visible for inspection after soldering. In the cases where visual inspection cannot be accomplished, a nondestructive method of inspection shall be performed (e.g., X-ray or fiberscope). The nondestructive method of inspection to be used shall be documented and approved by the procuring NASA Center prior to use. Recommended terminations and mounting techniques are shown throughout this chapter.

2. **Axial Lead Mounting**. Axial leaded parts shall be mounted as follows:

a. Horizontal Mount. Parts intended for horizontal mounting shall be parallel to, and in contact with, the mounting surface (see Figure 8-6), or as specified in the engineering documentation. Slight angularity is permissible. When parts will be bonded, slight spacing will be acceptable.

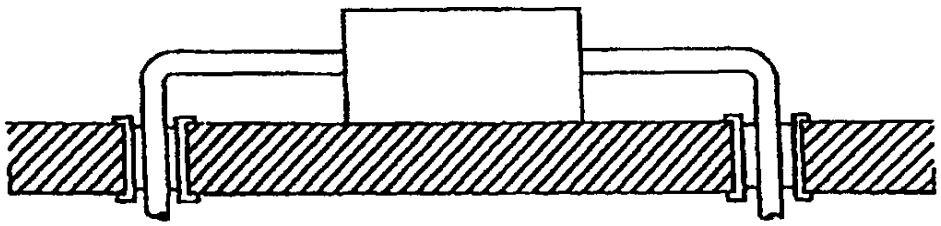


Figure 8-6. Horizontal Mount

b. Vertical Mount.

(1) **Plated-Through Hole**. The end of the part body must be mounted with at least 0.5mm (0.020 inch) to a maximum of 1.27mm (0.050 inches) clearance above the PWB surface or as specified on engineering documentation. The end of the part is defined to include any extensions such as coating meniscus, solder seal, or weld bead (see Figure 8-7A).

(2) **Non-Plated-Through Hole**. The end of the part body may be mounted flush with the PWB surface and shall be terminated with an off-the-pad-lap solder joint. The part shall be staked on the part side of the PWB. The opposite lead shall have two approximate right angle bends (see Figure 8-7B).

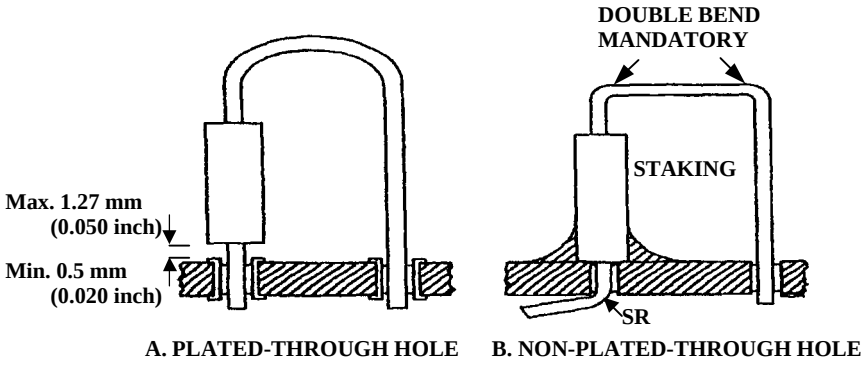


Figure 8-7. Vertical Mount

3. **Radial Lead Mounting**. Plated-through-hole: The part body shall be mounted with at least 0.5mm (0.020 inch) to a maximum of 1.27mm (0.050 inch) and shall allow inspection of the solder joint. The part body includes any extension such as coating meniscus, solder seal or weld bead (see Figure 8-8A).

Non-plated-through-hole: The part body may be mounted flush with the PWB surface and terminated with an off-the-pad lap solder joint (See Figure 8-8B).

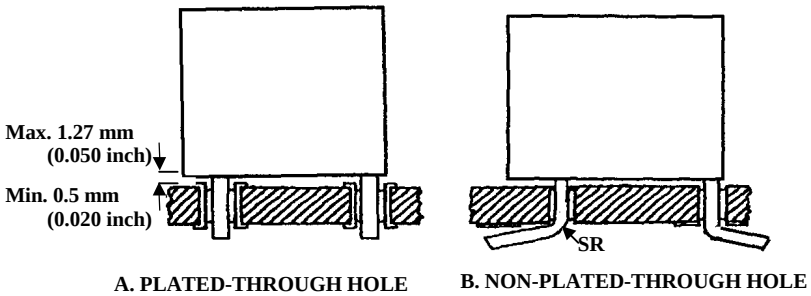


Figure 8-8. Radial Leaded Parts

4. **Hole Obstruction**. Parts shall not be mounted such that they obstruct solder flow or prevent cleaning of the topside termination areas of PTH's (Figure 8-9).

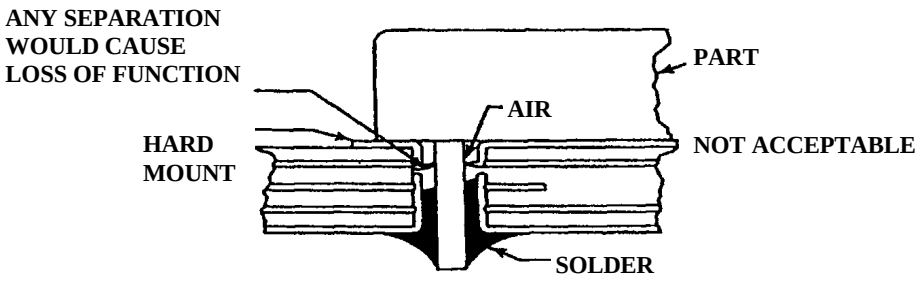


Figure 8-9. Hole Obstruction

5. **Parts with Leads Terminating on Opposite Sides**. Stress relief shall be provided in the part lead between the part body and solder terminations (Figure 8-10). The lead may be terminated by clinch, straight-through, or lap configuration.

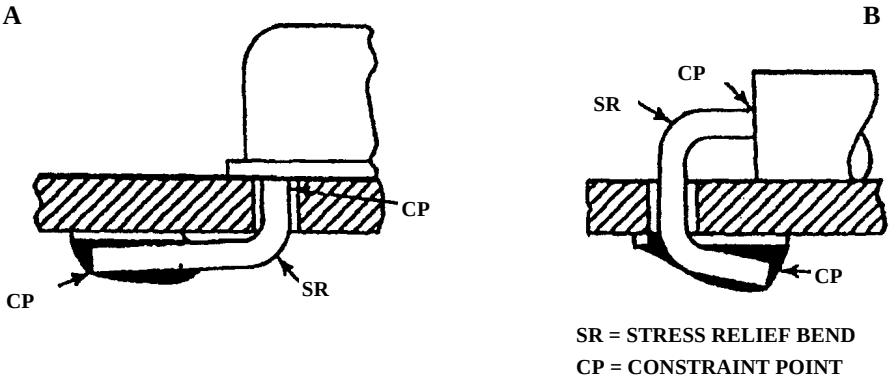


Figure 8-10. Stress Relief Part Termination

6. **Parts with Leads Terminating on the Same Side**. Stress relief shall be provided by forming the part leads at a bend angle to the PWB of not more than 95°nor less than 45° (Figure 8-11).



Figure 8-11. Bend Angle

7. **Conductors Terminating on Both Sides.** Stress relief shall always be provided in the part lead between the part body and solder termination. When a conductor is used to interconnect opposite sides of a PWB, stress relief or a PTH shall be provided (Figure 8-12).

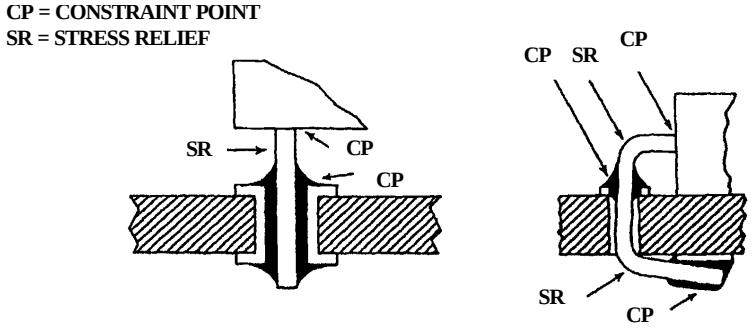


Figure 8-12. Conductors Terminating on Both Sides

8.5 Boards Lead Terminations, Printed Wiring

Part Lead Terminations. Part leads shall be of the lap, clinched, or straight-through configuration as defined by the engineering documentation and shall be terminated in accordance with paragraphs 8.4-1 through 8.4-3. No more than one item, whether conductor or part lead, shall be inserted in any one hole.

1. Lapped Terminations. Lapped terminations consist of both round and flat ribbon leads. It is preferred that leads be seated in contact with the termination area for the full length of the foot. Separation between the foot of the lead and the surface of the termination area shall not exceed 0.25mm (0.010 inches) (see Figure 8-13).

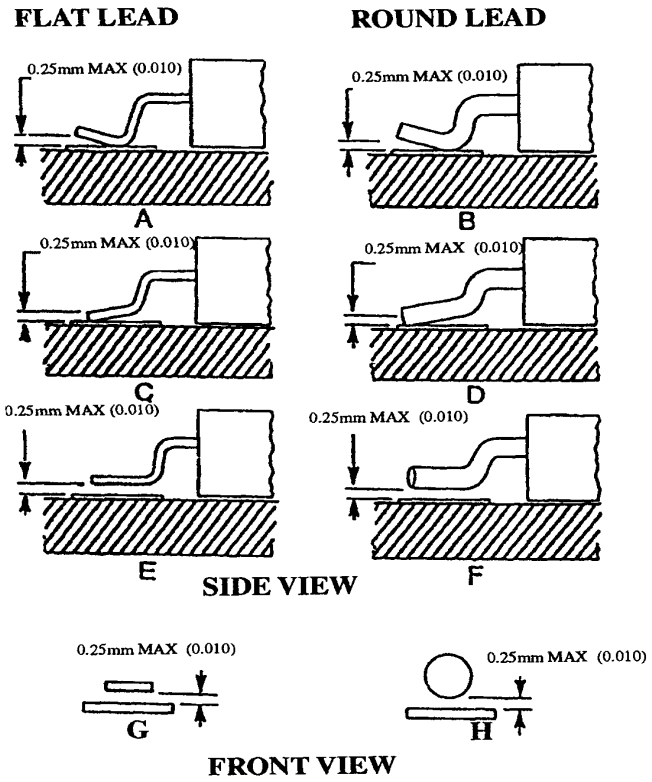
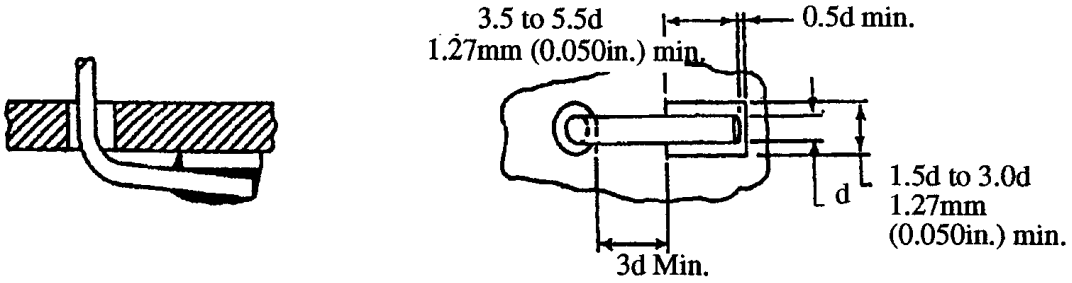
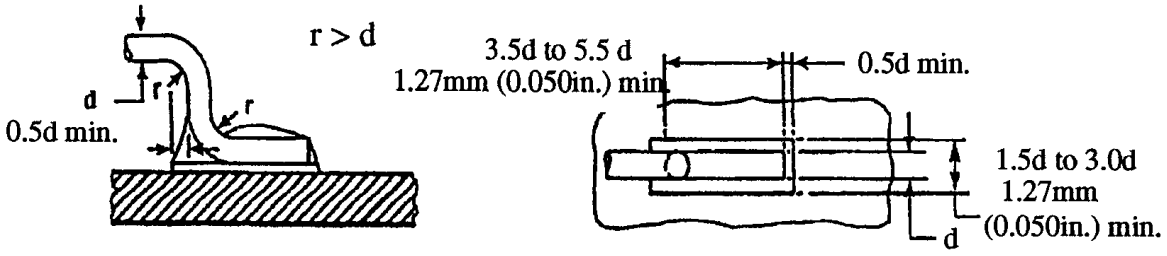


Figure 8-13. Lapped Lead Height above Board

a. Lapped Round Leads. The round lead shall overlap the solder pad a minimum of 3.5 times the lead diameter to a maximum of 5.5 times the lead diameter, but in no case shall the length be less than 1.27mm (0.050 inch). The cut-off end of the lead shall be no closer than ½ the lead diameter to the edge of the solder pad. Only that portion of the lead extending to the part body or to another soldered connection shall be beyond the solder pad (Figure 8-14A). For lapped terminations where the part body is on the same side of the PWB as the termination area, a heel fillet is mandatory (Figure 8-14B).



A. SINGLE SURFACE LAPPED TERMINATION

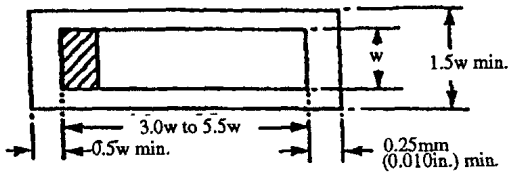


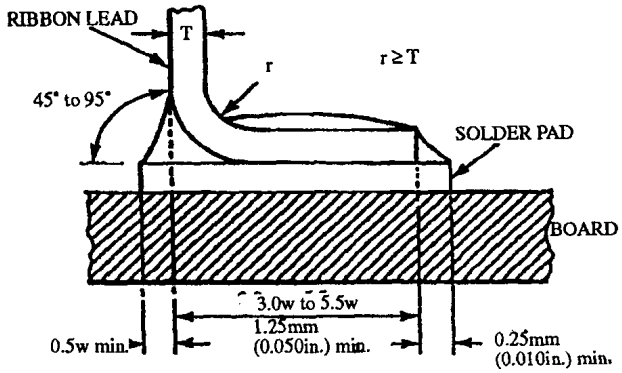
B. SINGLE SURFACE LAPPED TERMINATION

Figure 8-14. Lapped Round Termination

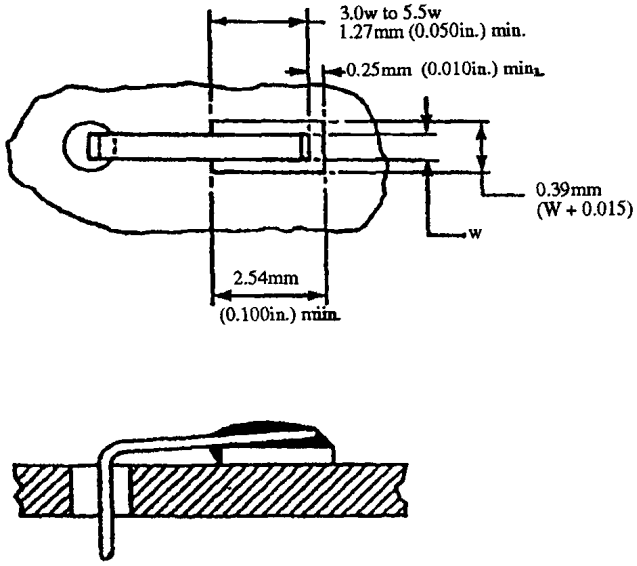
b. Lapped Ribbon Leads. The ribbon lead shall overlap the solder pad a minimum of 3 lead widths to a maximum of 5.5 lead widths. Only that portion of the lead extending to the part body or to another soldered connection shall be beyond the pad. The cut-off end of the lead shall be a minimum of 0.25mm (0.010 inch) from the end of the pad. One edge of the lead may be flush with the edge of the solder pad. There shall be sufficient area around two of the three lead edges to accommodate solder filleting (see Figure 8-15). In instances where ribbon leads are less than

0.5mm (0.020 inch) in width, ribbon overlap shall be no less than 1.27mm (0.050 inch). For lapped terminations where the part body is on the same side of the PWB as the termination area, a heel fillet is mandatory (Figure 8-15).





RIBBON LEAD, SINGLE SURFACE LAPPED TERMINATION



RIBBON LEAD, THROUGH-HOLE LAPPED TERMINATION

Figure 8-15. Lapped Ribbon Leads

2. Clinched Lead Terminations. The length of the clinched portion of conductors and part leads shall be at least ½ the largest dimension of the solder pad or 0.78mm (0.031 inch), whichever is greater. Lead overhang shall not violate minimum electrical spacing requirements. The lead shall be bent in the direction of the longest dimension of the solder pad. If the pad dimensions are not sufficient, the lead shall be bent in the direction of the printed wire path (Figure 8-16). There shall be sufficient solder pad area extending beyond the sides of the lead to accommodate solder filleting. Fully clinched leads are defined as leads bent between 75°and 90° from a vertical line perpendicular to the PWB (Figure 8-17). Nonbendable leads shall not be clinched.

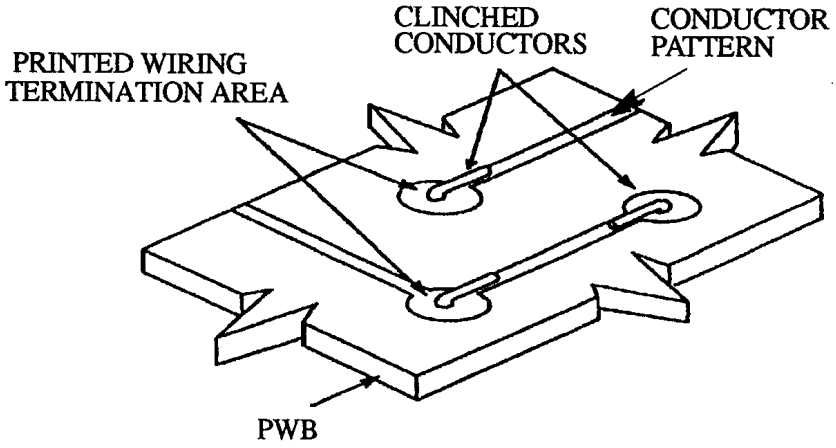


Figure 8-16. Clinched Termination

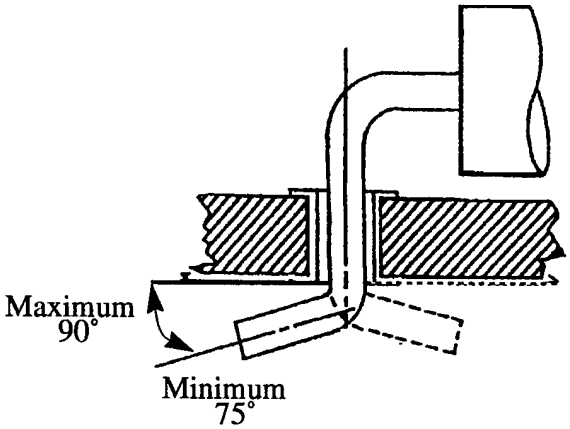


Figure 8-17. Lead Bend

3. Straight-Through Lead Terminations. Part leads terminated straight through the PWB shall extend a minimum of 0.5mm (0.020 inch) and a maximum of 2.29mm (0.090 inch) (Figure 8-18). The minimum lead length shall be determined prior to soldering (actual measurement is not required except for referee purposes). Straight-through leads may be bent up to 30° from a vertical plane to retain parts during the soldering operation (Figure 8-19). Nonbendable leads shall not be bent.

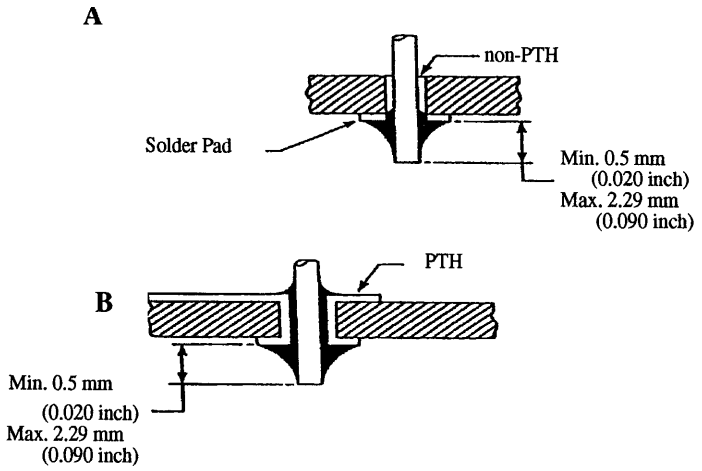


Figure 8-18. Straight-Through Termination

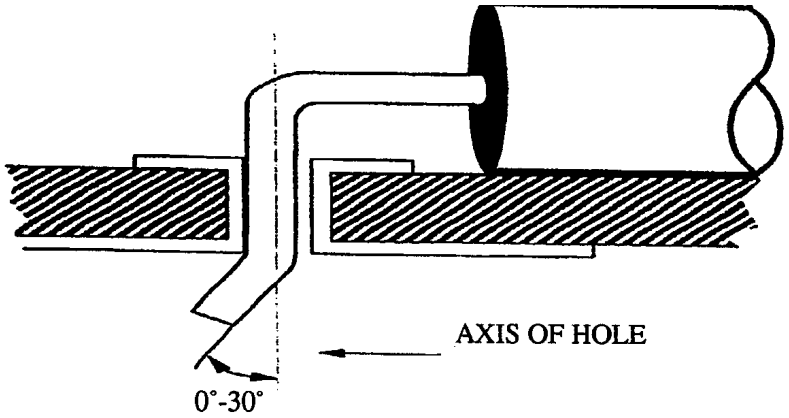


Figure 8-19. Straight-Through Lead Retention

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CHAPTER 9 - ATTACHMENT OF CONDUCTORS TO TERMINALS

9.1 General

1. **Minimum Insulation Clearance**. The insulation shall not be imbedded in the solder joint. The contour of the conductor shall not be obscured at the termination end of the insulation.

2. **Maximum Insulation Clearance**. The insulation clearance shall be less than two wire diameters, including insulation, but in no case shall permit shorting between adjacent conductors. Insulation clearance shall be referenced from the first point of contact of the conductor to the terminal.

3. **Multiple Parallel Entry**. For multiple parallel entry of conductors to a terminal, insulation clearances need not be equal.

4. **Variations**. When characteristic impedance or other circuit parameters are affected, as in high-voltage circuits or coaxial line terminations, the insulation clearance requirements may be modified. All variations shall be documented.

5. **Breakouts from Wire Bundles**. For multiple conductors routed from a common wire bundle to equally spaced soldered terminals, the length of the conductor ends, including bend allowance, shall be uniform to prevent stress concentration on any one conductor.

6. **Mechanical Support.** Wire bundles shall be supported so that the solder connections are not subjected to mechanical loads. The methods, means, and location of this support shall be specified on the design engineering documentation.

7. **Stress Relief.** Conductors shall be provided with sufficient slack to preclude tension on the solder termination or conductor.

8. **Wrap Orientation.** Conductors may be wrapped clockwise or counterclockwise on the terminal and shall continue the curvature of the dress. The conductor shall not interfere with the wrapping of other conductors on the terminal. The curvature of the dress shall not exceed 20° from a perpendicular line from the last point of contact between the conductor and terminal (Figure 9-1).

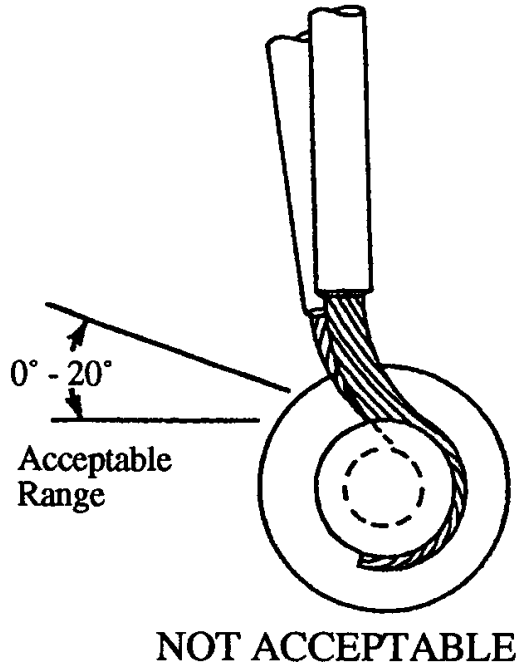


Figure 9-1. Wrap Orientation

9. **Terminal Fill**. Conductors and part leads shall be in full contact with the terminal. They shall not be wrapped onto each other or extend beyond the top of the terminal.

10. **Part Leads.** Part leads shall not be used as terminals unless the part is designed for the lead to function as a terminal.

11. **Mounting of Parts to Terminals.** The mounting of parts shall comply with the requirements of paragraph 8.3 and this chapter.

12. **Terminals**. Hot dipped, tin-lead coated or hot reflowed, electrodeposited tin-lead solder terminals shall be used. Terminals with uneven or excessive coatings on their mounting surfaces shall not be used as they may loosen in subsequent soldering operations. Terminals shall be of proper size to accommodate the conductors. Terminals and conductors shall not be modified except for high voltage applications.

13. **High-Voltage Lead Wrap.** High-voltage lead wraps shall be defined on the engineering documentation.

9.2 Turret and Straight Pin Terminals

1. **Side Route.** The side route shall be connected as follows:

a. Conductor sizes larger than American Wire Gage (AWG) 26 shall be wrapped a minimum of 1/2 (180°) to a maximum of 3/4 turn (270°) around the post (see Figure 9-2A).

b. Conductor sizes AWG 26 and smaller shall be wrapped a minimum of 1/2 turn (180°) but less than one full turn (360°) around the post (see Figure 9-2B).

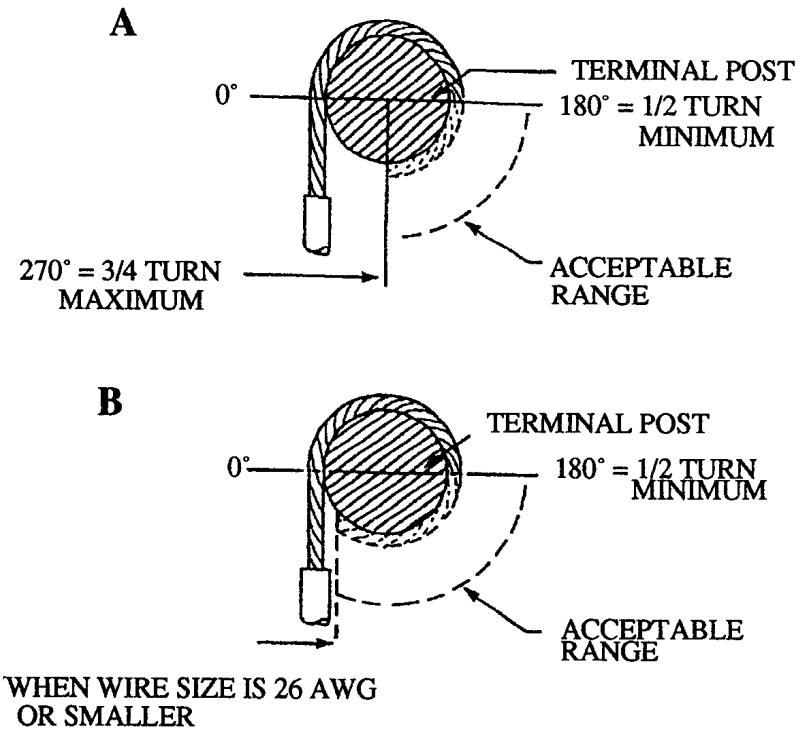


Figure 9-2. Conductor Wrap

c. For turret terminals, all conductors shall be confined to the guide slots (see Figure 9-3A).

d. Conductors shall be maintained in contact with the post for the full curvature of the wrap and the conductor ends shall not extend beyond the base of the terminal.

e. More than one conductor may be installed in a single slot of sufficient height, provided each conductor is wrapped on the terminal post and not on another conductor.

2. **Bottom Route.** The conductor shall enter the terminal from the bottom, be brought through the side slot at the top, and wrapped as required for side route (Figure 9-3B).

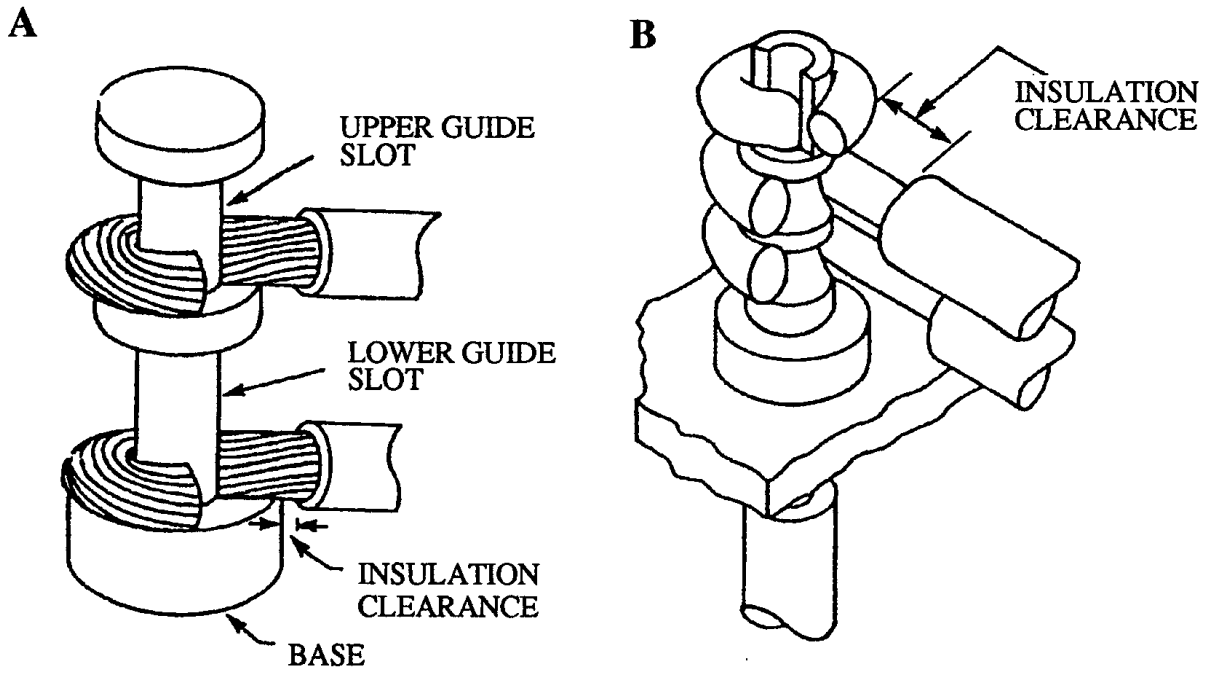


Figure 9-3. Turret Terminal

3. **Continuous Run Wrapping.** If three or more terminals in a row are to be connected, a solid bus wire jumper may be continued from terminal to terminal as shown in Figure 9-4. The wrap to the first and last terminal of the series shall conform to paragraph 9.2-1A or paragraph 9.2-1B depending on the conductor size.

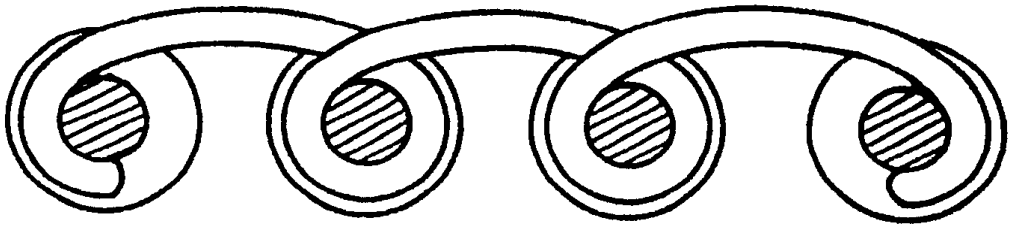


Figure 9-4. Continuous Run Wrapping--Turret Terminals

9.3 Bifurcated Terminals

1. **Bottom Route**. Bottom route shall be connected as shown in Figure 9-5. Conductors shall not extend beyond the diameter of the base of the terminal except where physical clearance is adequate for the intended environment or electrical characteristics. When more than one conductor is to be attached, it shall be inserted at the same time but shall be wrapped separately around alternate posts.

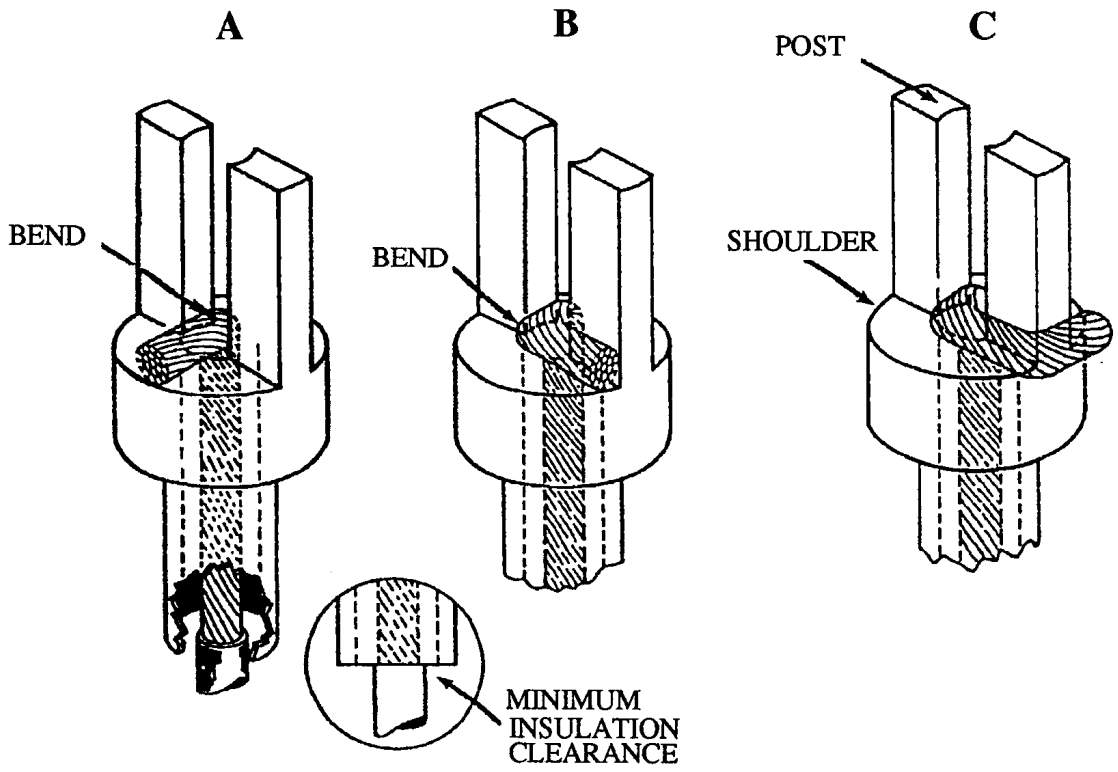


Figure 9-5. Bottom Route Connections to Bifurcated Terminals

2. **Side Route**. Side route shall be connected as follows (Figure 9-6):

a. The conductor shall enter the mounting slot perpendicular to the posts.

b. A conductor may lay straight through a terminal slot provided the conductor surface remains in contact with the terminal surface (Figure 9-6A). Where conductors are wrapped on a terminal post, they shall wrap a minimum of 90° and a maximum of 180° (1/4 to 1/2 turn); refer to Figure 9-7.

c. More than one conductor may be installed on a single post provided each conductor is wrapped on the terminal post and not on another conductor.

d. When more than one conductor is connected to a terminal, the direction of bend of each additional conductor shall alternate (Figures 9-6B and D).

e. Conductors shall not extend beyond the diameter of the base of the terminal except where physical clearance will not adversely affect environmental or electrical characteristics.

3. **Side and Bottom Route**. The bottom route shall be installed first as shown in Figure 9-5, then the side route as shown in Figure 9-6, methods B, C, or D.

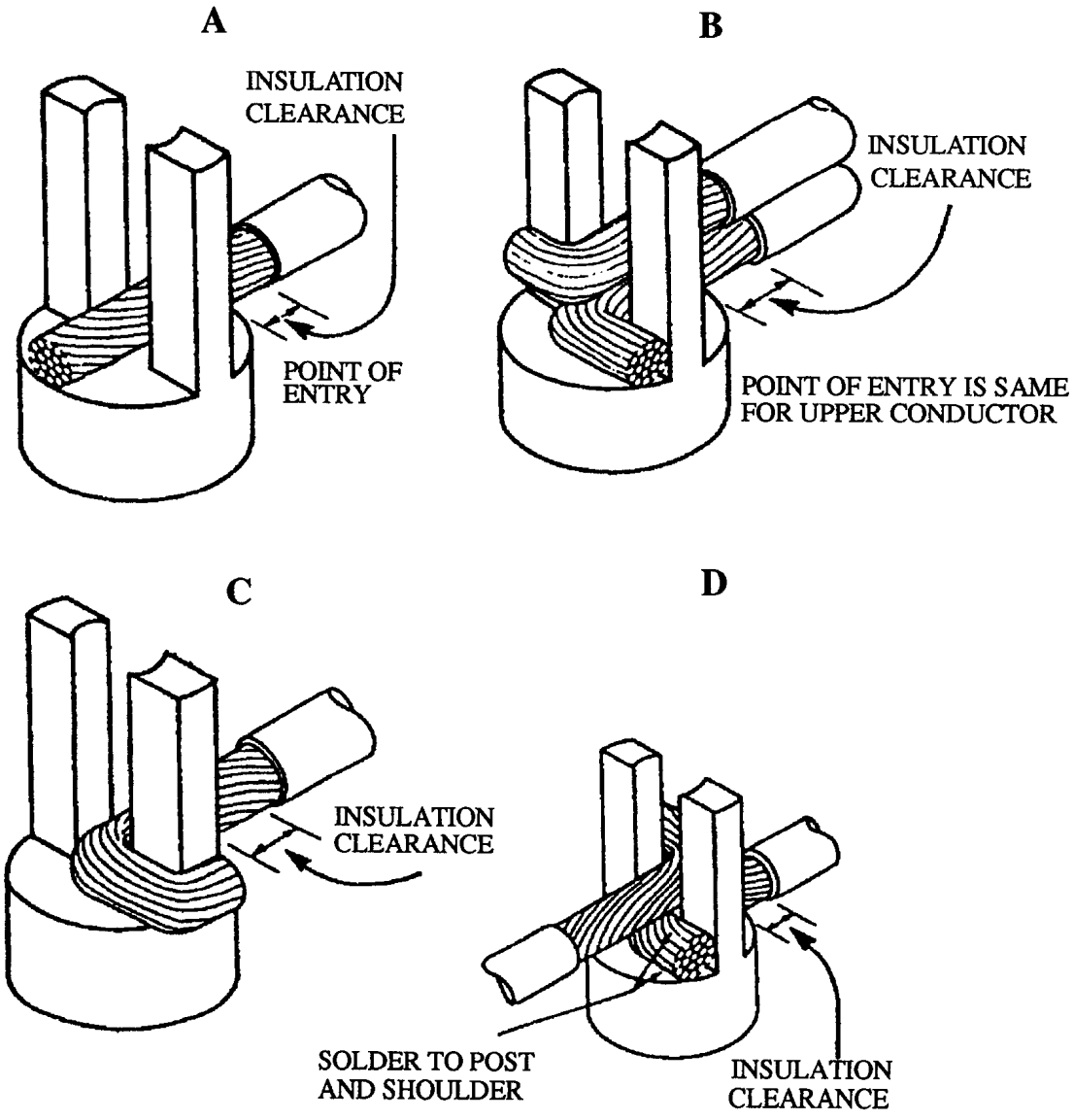


Figure 9-6. Side Route Connections to Bifurcated Terminals

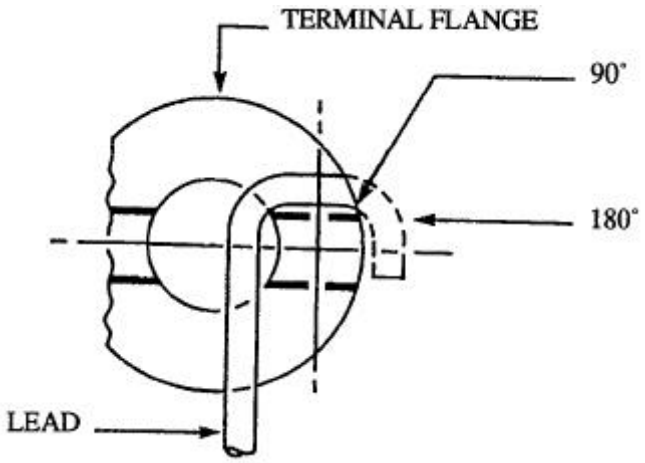


Figure 9-7. Lead Wrap

4. **Continuous Run Connections**. When a series of terminals are to be connected to each other, such interconnections shall be made with a solid wire in accordance with Figure 9-8 or 9-9. The wire shall be attached to the first and last terminal in accordance with paragraph 9.3-2.

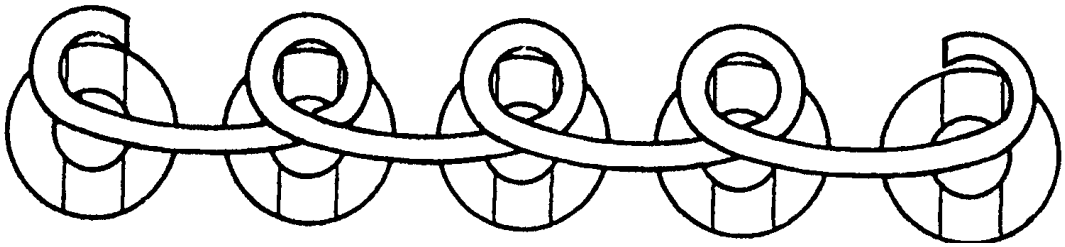


Figure 9-8. Continuous Run Wrapping--Bifurcated Terminals

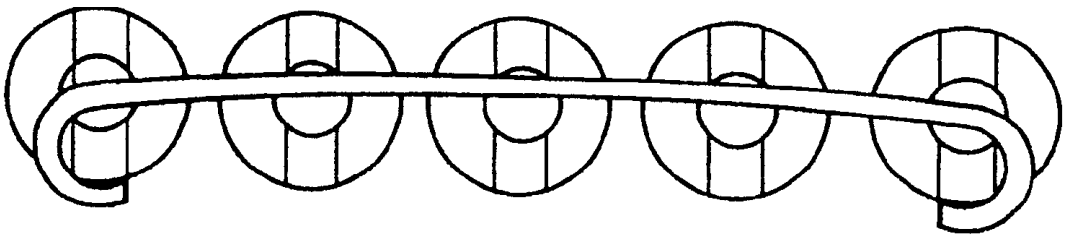


Figure 9-9. Continuous Run Wrapping--Bifurcated Terminals Alternate Procedure

9.4 Hook Terminals

Connections to hook terminals shall be as shown in Figure 9-10. The bend to attach conductors to hook terminals shall be a minimum of 1/2 turn (180°) to a maximum of 3/4 turn (270°). Protrusion of the conductor ends shall be controlled to avoid damage to the insulation sleeving. Conductors shall be wrapped directly to the terminal and not on other conductors. When more than one conductor is connected to the terminal, the direction of the bend of each additional conductor shall alternate (Figure 9-10).

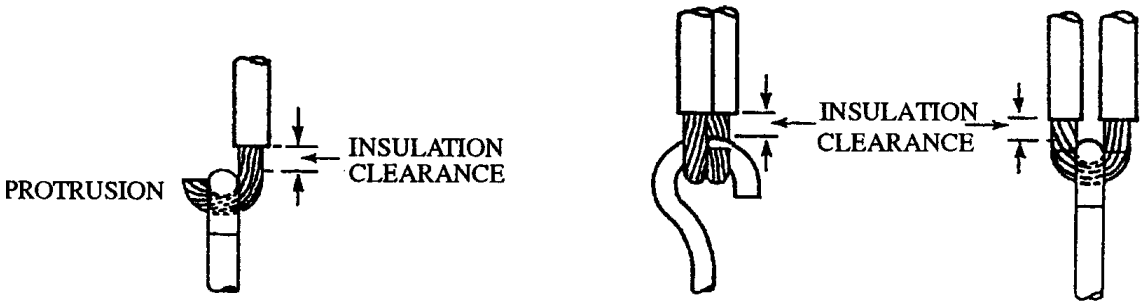


Figure 9-10. Connections to Hook Terminals

9.5 Pierced Terminals

Connections to pierced terminals shall be as shown in Figure 9-11. The bend to attach conductors to pierced terminals shall be a minimum of 1/4 turn (90°) to a maximum of 1/2 turn (180°). Protrusion of conductor ends shall be controlled to avoid damage to insulation sleeving.

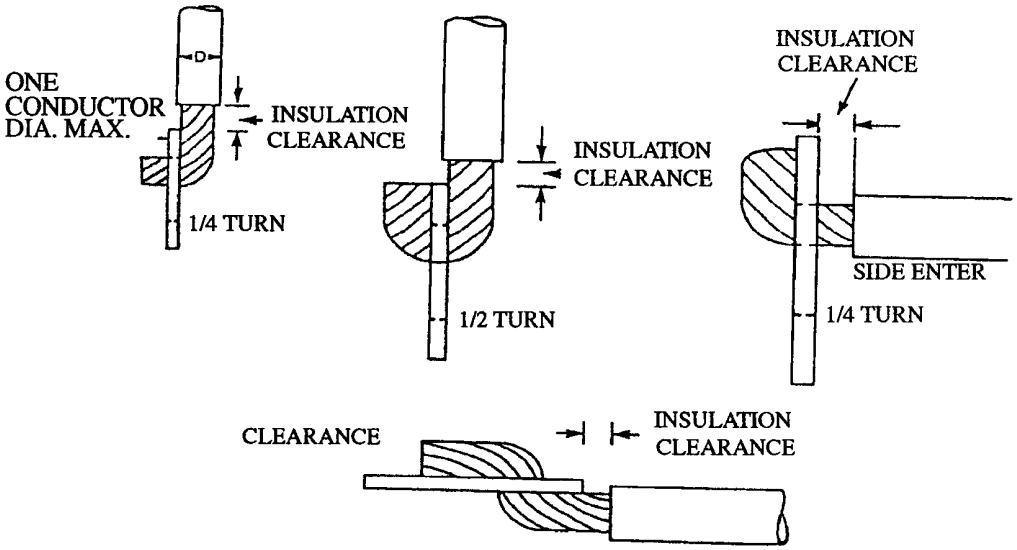


Figure 9-11. Connections to Pierced Terminals

9.6 Solder Cups (Connector Type)

Conductors shall enter the solder cup as shown in Figure 9-12. Conductors shall be bottomed in the cup and shall be in contact with the inner wall of the cup. The maximum number of conductors shall be limited to those that can be in contact with the full height of the inner wall of the cup.

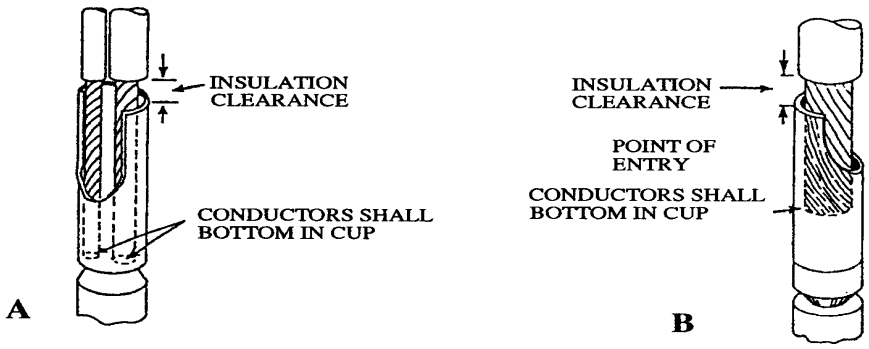


Figure 9-12. Connections to Solder Cups (Connector Type)

9.7 Solder Cups (Swaged Type)

Connections shall be as shown in Figure 9-13. Conductors entering from the top shall be in contact with the inner wall of the cup and shall bottom in the cup or on the bottom conductor.

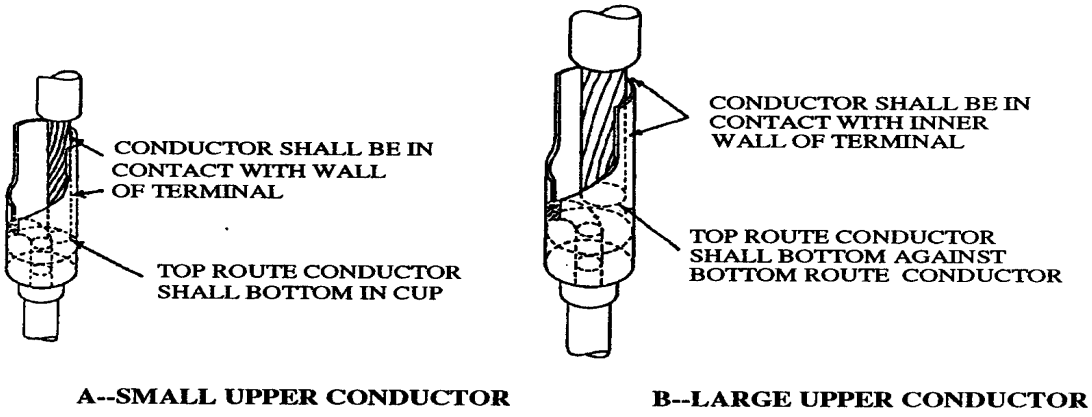


Figure 9-13. Connections to Swaged Type Solder Cup

9.8 Insulation Sleeving Application

All joints required to be covered by insulation sleeving shall be inspected prior to and after sleeving. Heat shrinkable insulation sleeving shall be used for electrical insulation, as appropriate. Where a part covered by insulating sleeving requires mechanical support, measures shall be taken to ensure that the part is not free to move within the sleeving. Material selection shall be specified on the engineering documentation. Sleeving shall not be pierced, split, charred, or otherwise damaged.

CAUTION: ***EXTREME CARE SHALL BE TAKEN TO PREVENT DAMAGE TO THE ASSEMBLY DUE TO EXCESSIVE HEAT WHILE SHRINKING THE SLEEVING.***