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RELIABILITY AND QUALITY ASSURANCE PUBLICATION

REQUIREMENTS
FOR
SOLDERED ELECTRICAL
CONNECTIONS



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Soldered Electrical Connections

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CHAPTER 5: PARTS MOUNTING

3A500 GENERAL REQUIREMENTS

1. Unless otherwise specified or approved by the procuring NASA Installation, parts shall be mounted parallel to, and in contact with the mounting surface.
2. **IRREGULARLY SHAPED PARTS.** When the shape of parts is such that only point contact can be made with the mounting surface, additional support shall be provided.
3. **HEAVY PARTS.** Parts which weigh more than 1/2 ounce (14 grams) shall be supported. Design requirements shall specify method of support or attachment.
4. **METAL CASE PARTS.** Metal cased parts mounted over printed conductors, or which can come in contact with each other or with other conductive material, shall be encased in transparent insulation. Such parts shall not be mounted over solder connections.
5. **GLASS ENCASED PARTS.** Glass encased parts (such as diodes) shall be enclosed in transparent resilient sleeving or coating material when epoxy material is used for support, conformal coating, or potting.

3A501 LEAD BENDING REQUIREMENTS

1. **GENERAL.** During bending or cutting, part leads shall be supported to minimize axial stress and avoid damage to seals or internal bonds. The inside radius of bend shall not be less than the lead diameter. The distance from the bend to the end seal shall be approximately equal at each end of the part. The minimum distance shall be two lead diameters. The direction of the bend shall not cause the marking 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. (See Figure 5-1).

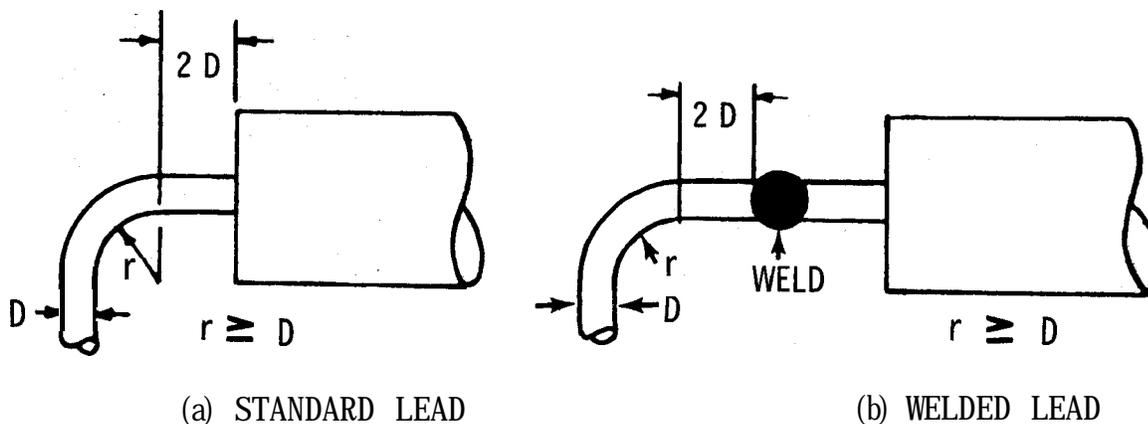


FIGURE 5-1 -- MINIMUM LEAD BEND

2. **NONBENDABLE LEADS.** Leads which cannot be bent shall be cut so that when mounted, the leads protrude through the board from $1/32"$ to $3/32"$. The contour of the end of the conductor shall be discernible after soldering. (See Figure 5-2.)

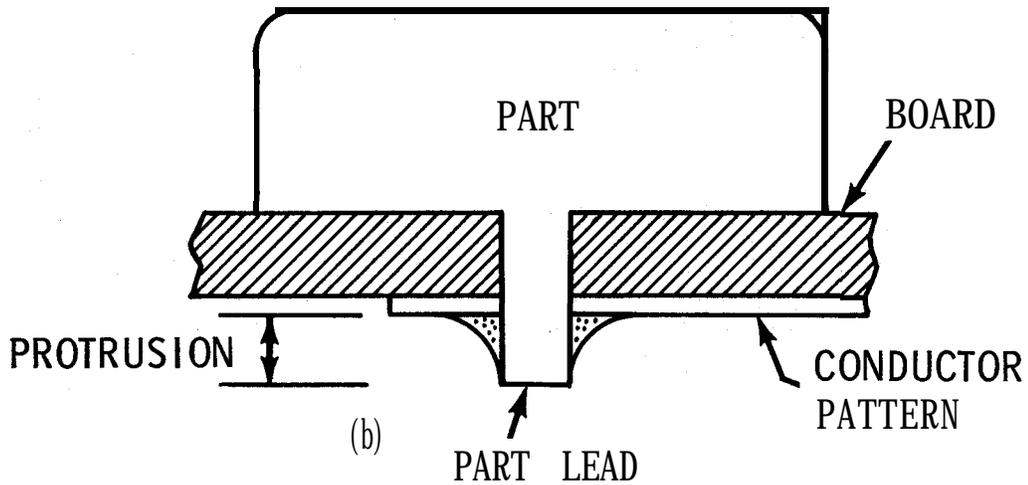


FIGURE 5-2--NONBENDABLE LEADS

3A502 LEAD CLINCHING, PRINTED WIRING BOARDS

1. **GENERAL.** The clinched lead shall not extend beyond the conductor pattern edge. The clinch shall not be forced to make the conductor lie flat at the bend radius. The innate springback of the part lead is acceptable. (See Figure 5-3.)

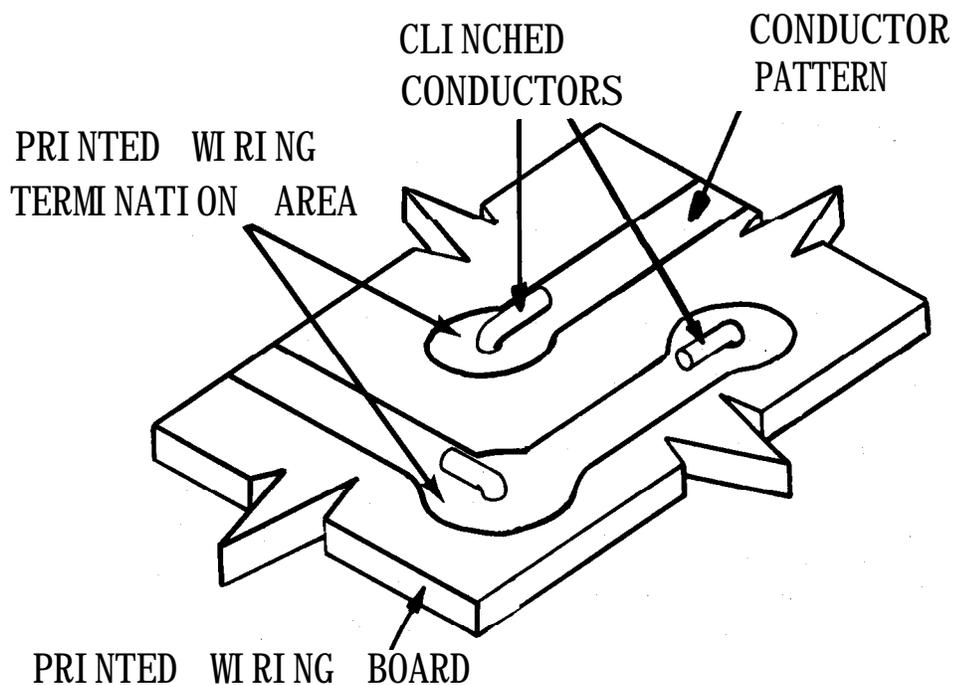


FIGURE 5-3--EXAMPLE OF CLINCH DIRECTION

2. ROUNDED TERMINATION AREAS. The leads shall extend through the board a minimum of the termination-area radius, and a maximum of two times the termination area radius, and shall be clinched in the direction of the conductor pattern.
3. IRREGULARLY SHAPED TERMINATION AREAS. For irregularly shaped termination areas, such as for shield and ground plane connections, the minimum clinch lead length shall be twice the diameter of the lead hole, and the maximum shall be four times the hole diameter.

3A503 MOUNTING OF PARTS TO TERMINALS

1. The length of leads between parts, and terminals shall be approximately equal at both ends, except when special part shapes, such as flanges on tophat diodes, requires staggering.
2. Each lead shall have provision for stress relief.
3. Degree of wrap, routing, and connection to terminals are specified in Chapters 6 and 7.

3A504 CORDWOOD MODULES

1. Parts in cordwood modules shall be mounted with the part axis perpendicular to the two parallel printed wiring boards.
2. Tubular parts shall be uniformly spaced between the printed wiring boards.
3. Coated parts shall be mounted so that coating on leads does not enter the mounting hole.
4. Termination of part leads shall be as specified herein, except when they are extended to serve as straight pin terminals (see paragraph 3A608), or as connections to the board on which the module is mounted.
5. Leads of heat sensitive parts shall not be used as straight pin terminals.
6. The selection and application of potting compound and the use of clinched or unclinched lead terminations shall be as approved by the procuring NASA Installation.

3A505 MOUNTING OF FLAT PACK CIRCUITS

1. The requirements of paragraph 3A502 shall not apply to the mounting of integrated circuit packages of the configuration known as "flat packs." Mounting may be on the wiring side of the boards, by lap solder joints to termination areas. Any bending of leads shall be done on suitable fixtures to prevent damage to seals.
2. Internal connections shall be suited to the intended use and environment and are not subject to the requirements of this publication.

CHAPTER 6: ATTACHMENT OF CONDUCTORS TO TERMINALS

3A600 GENERAL

1. **Conductors shall be attached to terminals as illustrated in this section, which shows the requirements for routing to terminals, terminal fill, insulation clearance, and the extent of conductor wrap or bend.**
2. **For terminals not described or illustrated herein, similar procedures to accomplish the same intent shall be documented and submitted by the supplier for review by the procuring NASA Installation.**

3A601 WIRE TERMINATION

1. **BREAKOUTS FROM CABLES. For multiple wires routed from a common cable trunk to equally spaced terminals, the length of the wire ends, including vibration bend allowance shall be uniform to prevent stress concentration on any one wire.**
2. **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.**
3. **MAXIMUM INSULATION CLEARANCE. The maximum insulation clearance shall be less than two wire diameters including insulation but in no case shall permit shorting between adjacent conductors.**
4. **MULTIPLE PARALLEL ENTRY. For multiple parallel entry of wires to a terminal, insulation clearances need not be equal.**
5. **VARIATIONS. When characteristic impedance or circuit parameters are affected, such as in high voltage circuits or coaxial line terminations, the insulation clearance requirements may be modified. All variations shall be documented in the process procedures.**

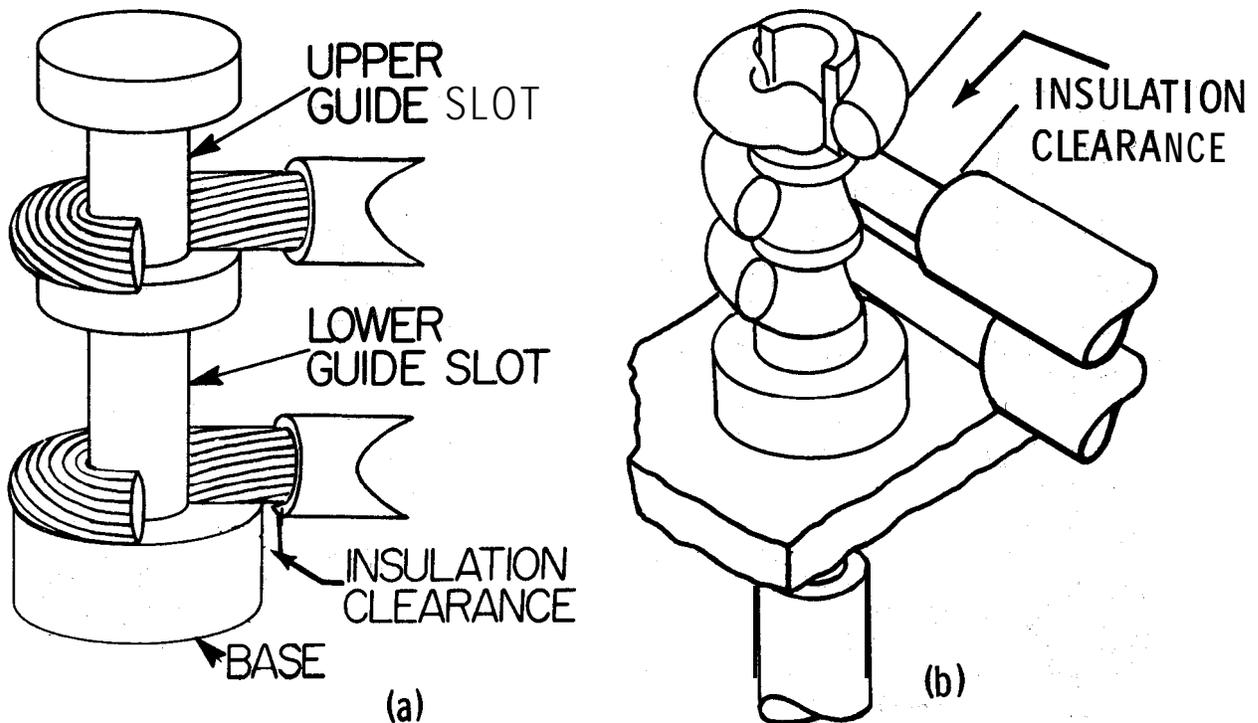


FIGURE 6-1--SIDE AND BOTTOM ROUTE CONNECTION TO TURRET TERMINALS

3A602 TURRET AND STRAIGHT PIN TERMINALS

1. **SIDE ROUTE.** The side route shall be connected as follows (see Figure 6-1 (a)):
 - a. Conductor sizes AWG 26 and smaller shall be wrapped a minimum of 1/2 turn to a maximum of one full turn around the post.
 - b. Conductor sizes larger than AWG 26 shall be wrapped a minimum of 1/2 to a maximum of 3/4 turn around the post.
 - c. For turret terminals, all conductors shall be confined to the guide slots.
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, see Figure 6-1 (b).

3A603 BIFURCATED TERMINALS

1. **GENERAL.** Top, side, or bottom routes, or combinations as illustrated in this chapter are permissible. Terminal side route connections shall not extend beyond the top of terminal.

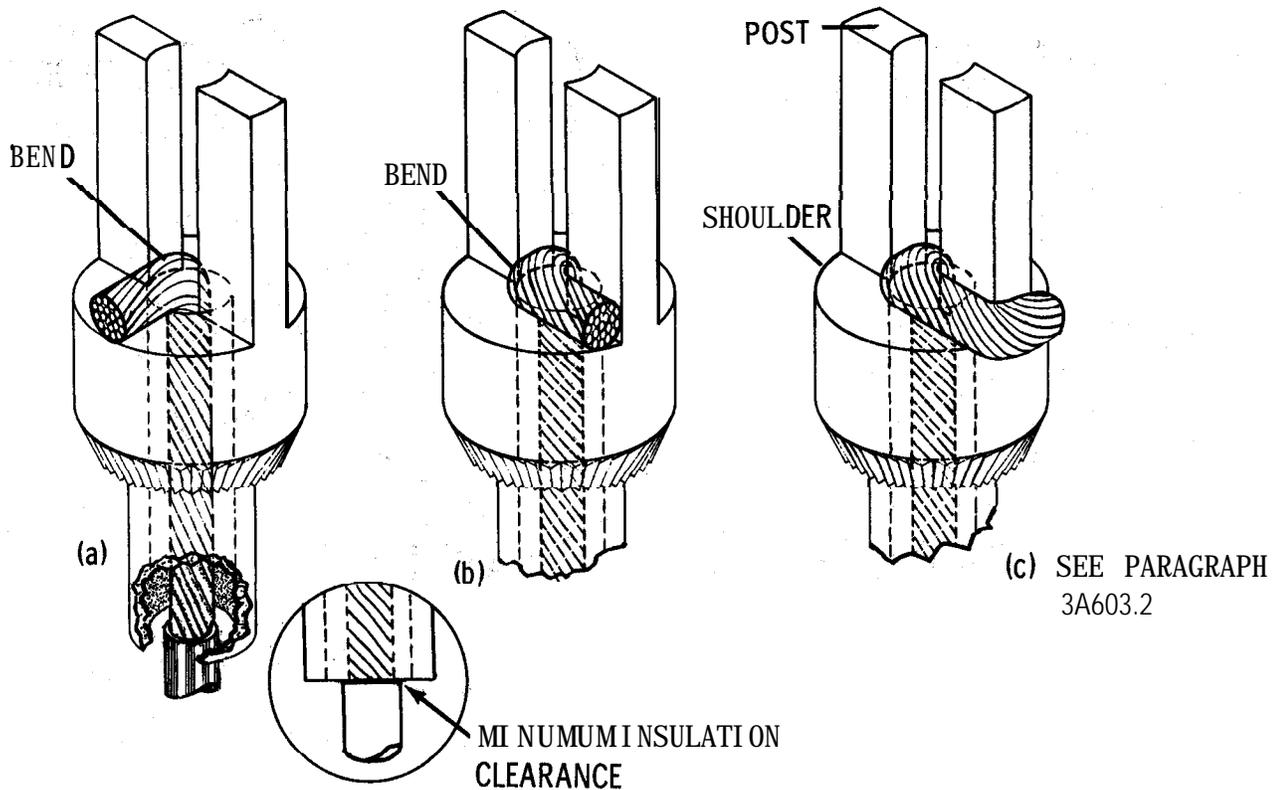


FIGURE 6-2 -- BOTTOM ROUTE CONNECTIONS TO BIFURCATED TERMINAL

2. **BOTTOM ROUTE.** Bottom route shall be connected as shown in Figure 6-2. Conductors shall not extend beyond the diameter of the base except as shown in Figure 6-2 (c), which is acceptable only when physical clearance is adequate for the intended environment and electrical characteristics.

3. **SIDE ROUTE.** Side route shall be connected as shown in Figure 6-3. The conductor shall enter the mounting slot perpendicular to the posts. When more than one conductor is connected to a terminal, the direction of bend of each additional conductor shall alternate. Conductors shall not extend beyond the diameter of the base except as shown in Figure 6-3(c), which is acceptable only where physical clearance is adequate for environment and electrical characteristics.

4. **TOP ROUTE.** Top route shall be connected as shown in Figure 6-4. Conductors which fill the gap between vertical posts shall be inserted to the depth of the shoulder. Conductors which do not fill the gap shall be accompanied by a tinned filler wire (solid or stranded) to help hold the conductor in position or shall be

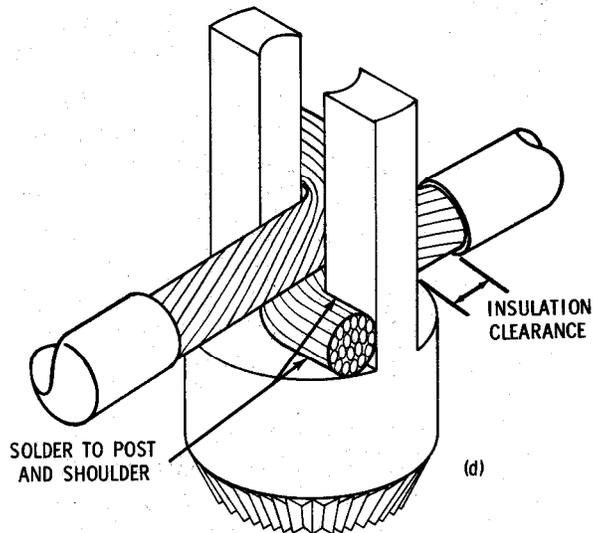
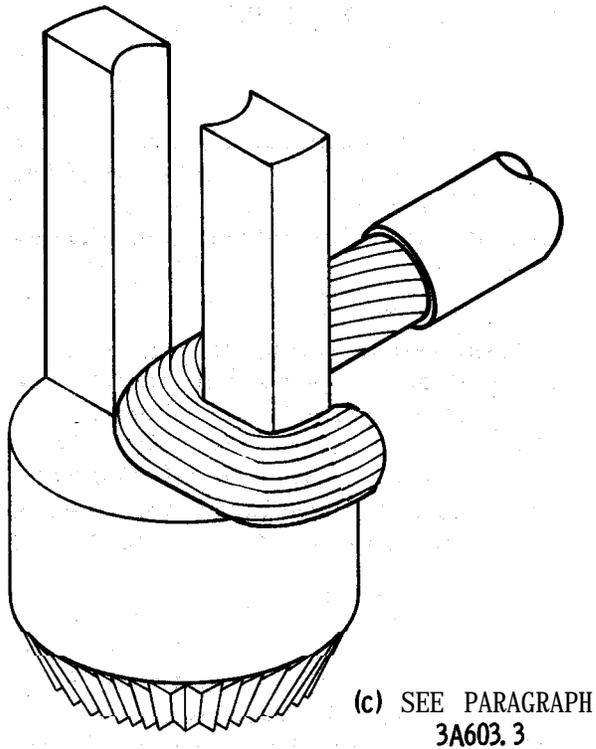
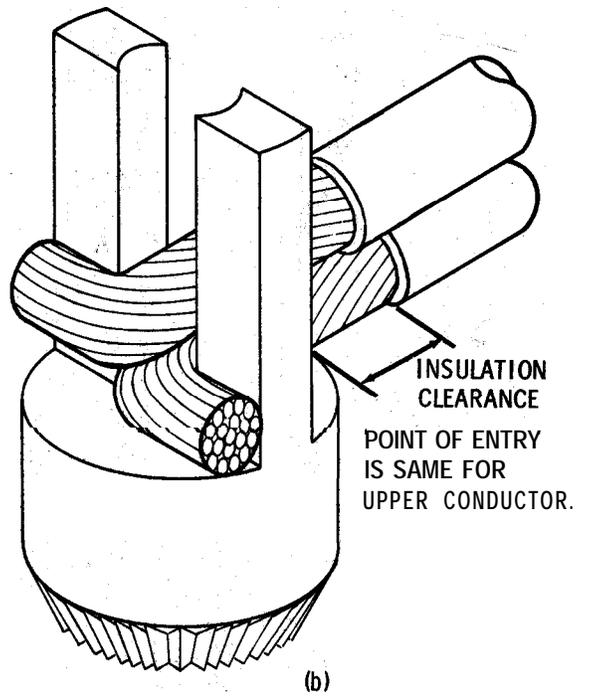
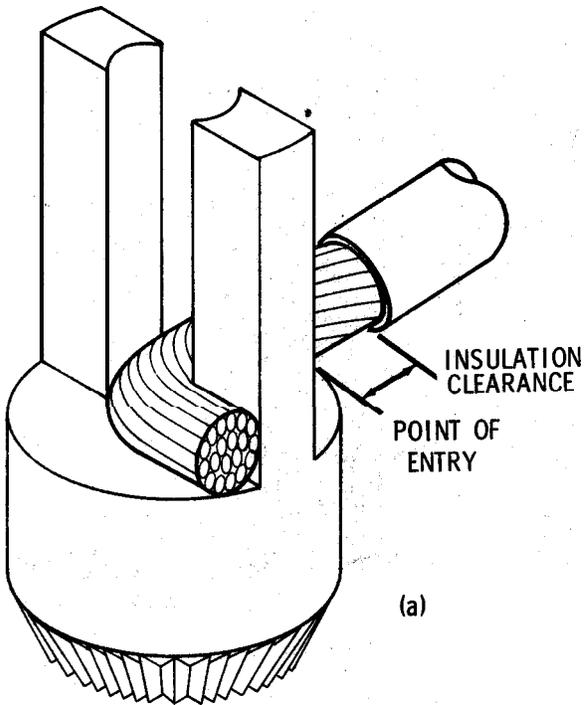


FIGURE 6-3-- SIDE ROUTE CONNECTION TO BIFURCATED TERMINAL

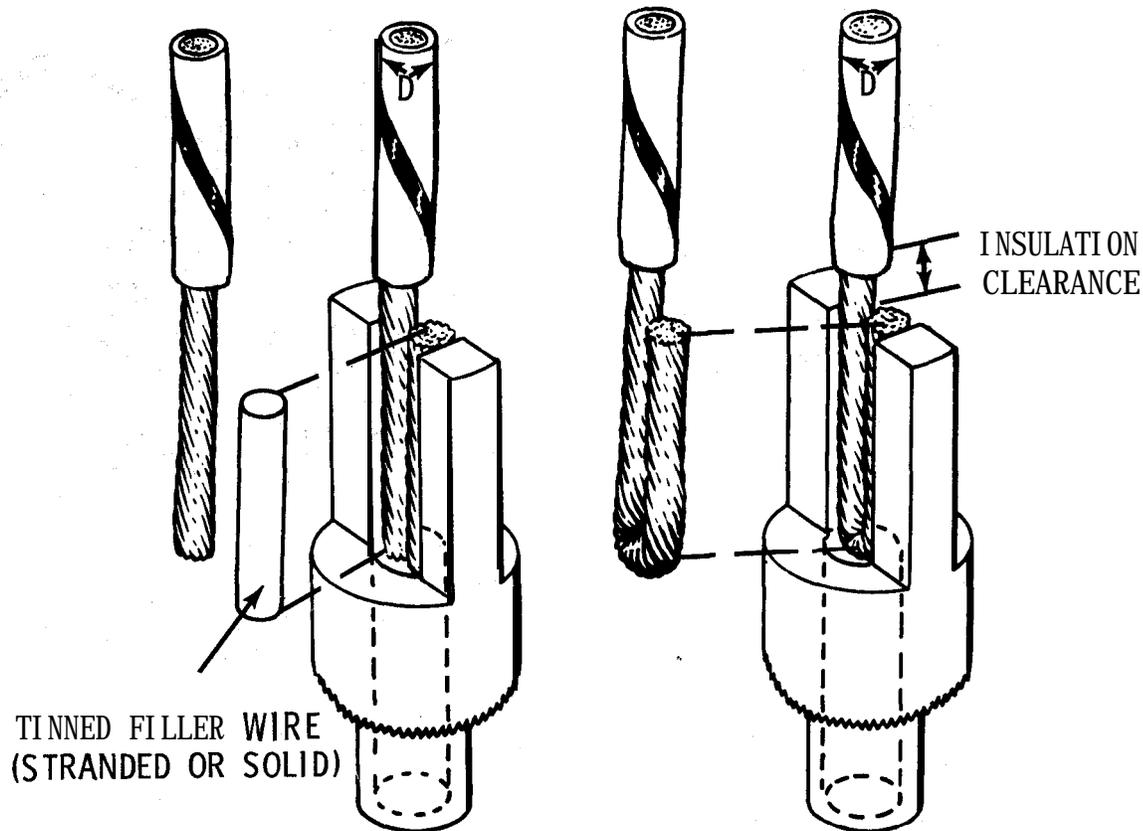


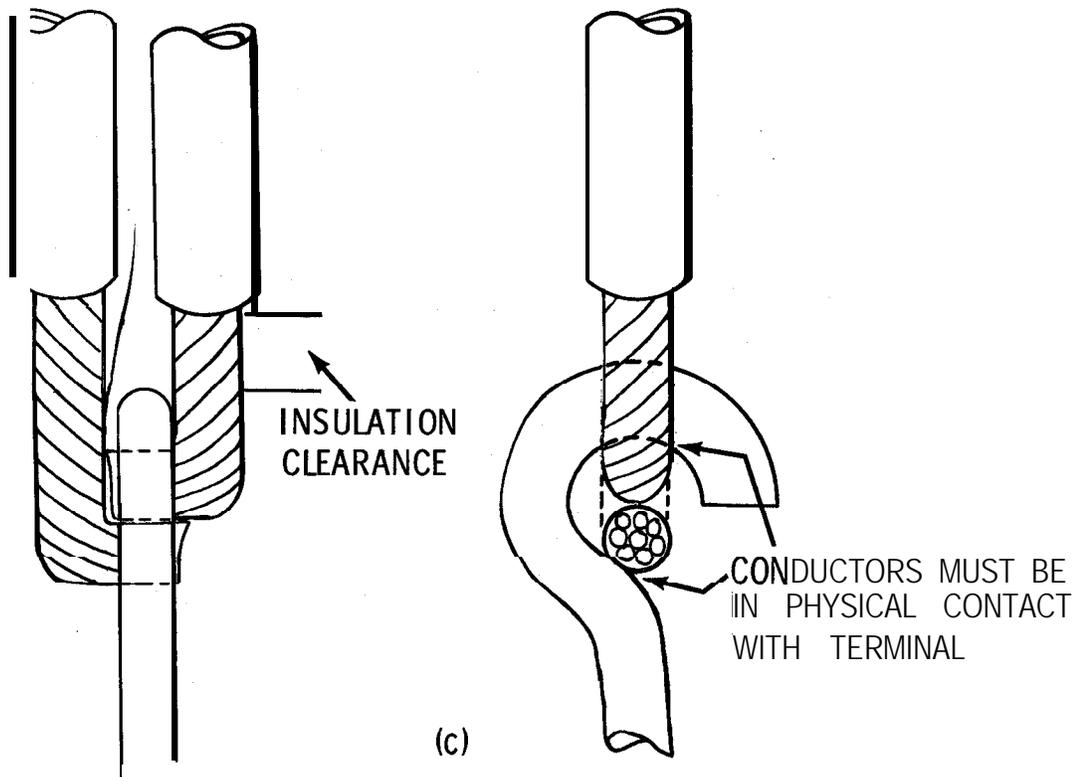
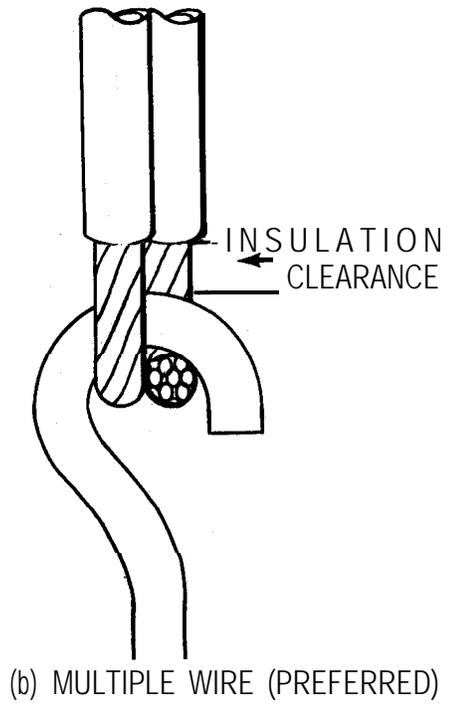
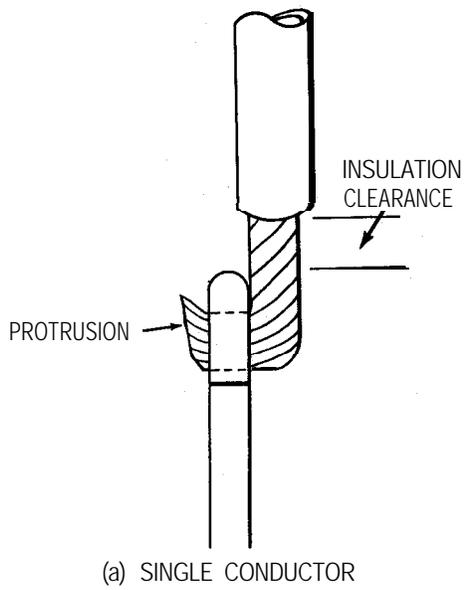
FIGURE 6-4--TOP ROUTE CONNECTION TO BIFURCATED TERMINAL

bent double as shown providing the combined diameters are sufficient to fill the gap. The top route and side route shall not be used on the same terminal. The top route shall not be used if there is sufficient room for side entry.

5. **TOP AND BOTTOM ROUTE.** The bottom route shall be installed first as shown in Figure 6-2, then the top route as shown in Figure 6-4 with the top route conductor bottoming on the bottom route conductor.
6. **SIDE AND BOTTOM ROUTE.** The bottom route shall be installed first as shown in Figure 6-2, then the side route as shown in Figure 6-3.

3A604 HOOK TERMINALS

Connections to hook terminals shall be as shown in Figure 6-5. The bend to attach conductors to hook terminals shall be a minimum of 1/4 turn to a maximum of 3/4 turn. Protrusion of conductor



MULTIPLE CONDUCTOR,
 PERMISSABLE ONLY WHERE
 REQUIRED BY SPACE LIMITATIONS

FIGURE 6-5 -- CONNECTIONS TO HOOK TERMINAL

ends shall be limited to avoid damage to insulation sleeving where used.

3A605 PIERCED TERMINALS

Connections to pierced terminals shall be as shown in Figure 6-6. The bend to attach conductors to pierced terminals shall be a minimum of 1/4 to a maximum of 3/4 turn. Protrusion of conductor ends shall be limited to avoid damage to insulation sleeving where used.

3A606 SOLDER CUPS (CONNECTOR TYPE)

Conductors shall enter the solder cup as shown in Figure 6-7. 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 which can be in contact with the full height of the inner wall of the cup.

3A607 SOLDER CUPS (SWAGED TYPE)

Connection shall be as shown in Figure 6-8. 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.

3A608 CONNECTION WITHOUT TERMINALS

When solid conductors are approved by NASA to be used as straight pin type terminals, conductors shall be terminated as specified in paragraph 3A602.

3A609 LAP JOINTS

A lap joint may be used for attaching conductors only where space does not allow room for bending the conductor, and the application has been reviewed by the procuring NASA Installation.

3A610 INSULATION TUBING APPLICATION

Insulation tubing shall be used for electrical insulation, as appropriate; for example, hook terminals and solder cups which are not protected by insulating grommets, potting or conformal coating.

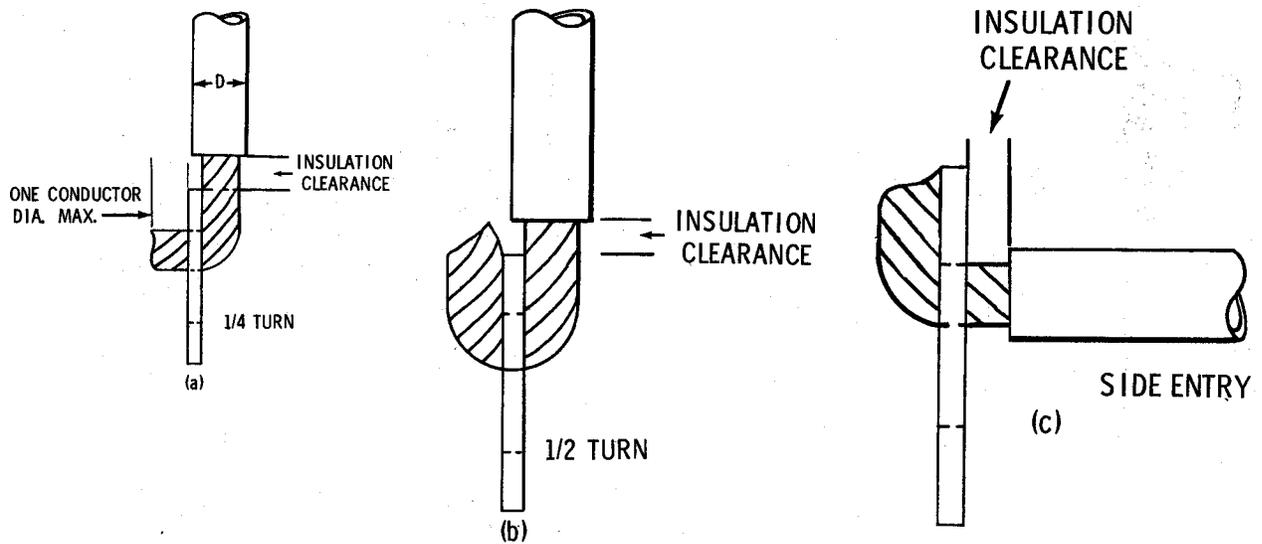


FIGURE 6-6--CONNECTIONS TO PIERCED TERMINALS

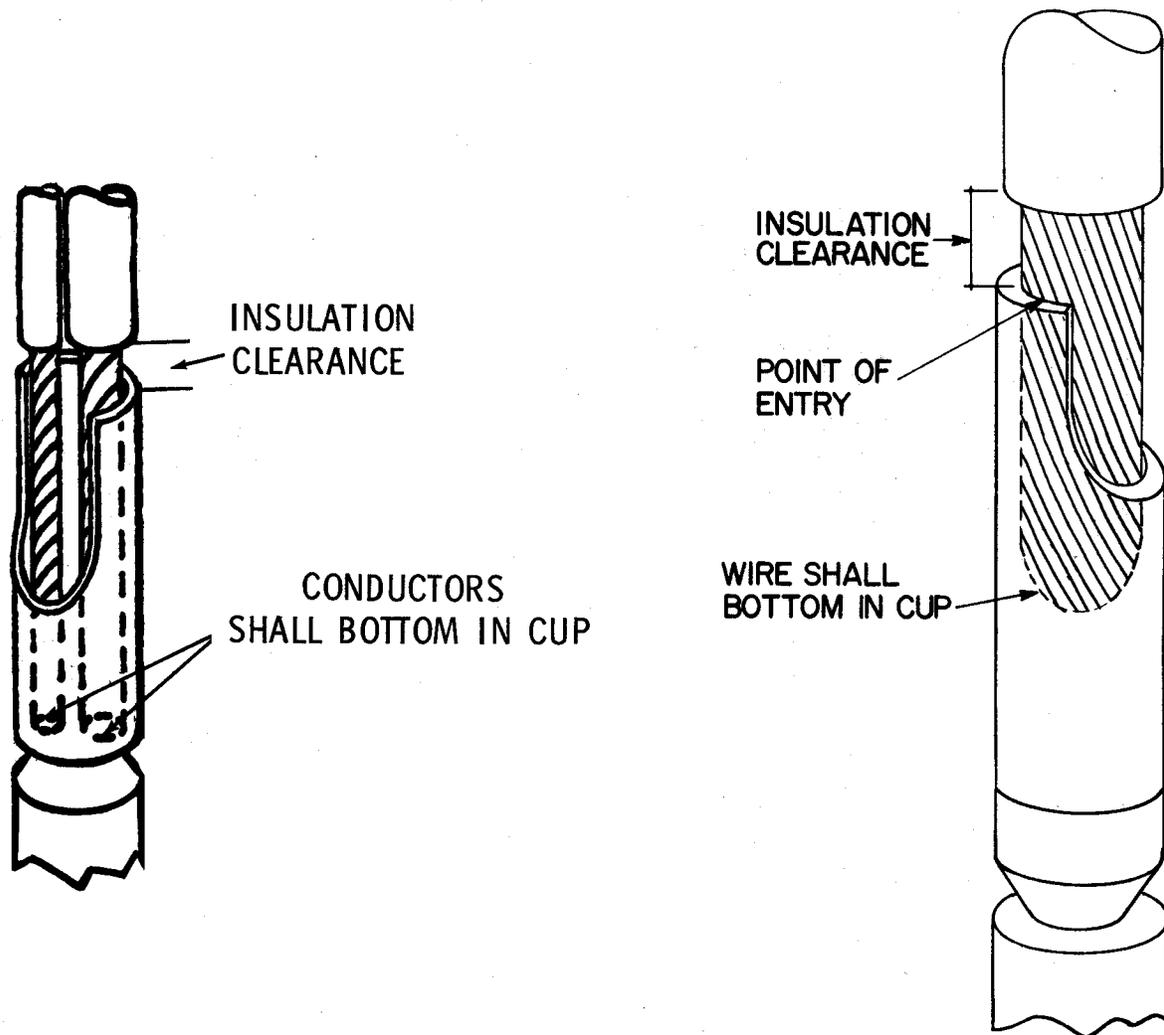
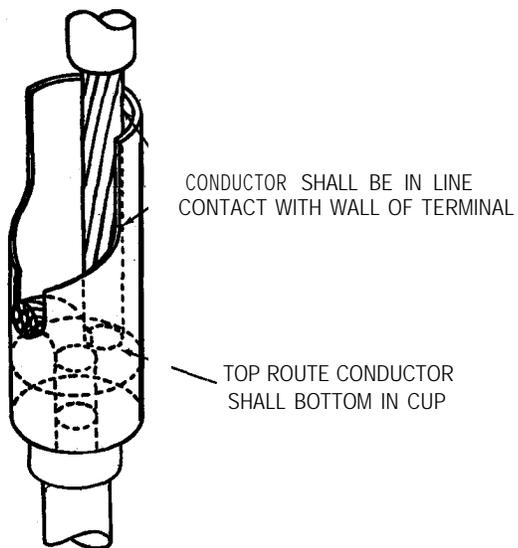
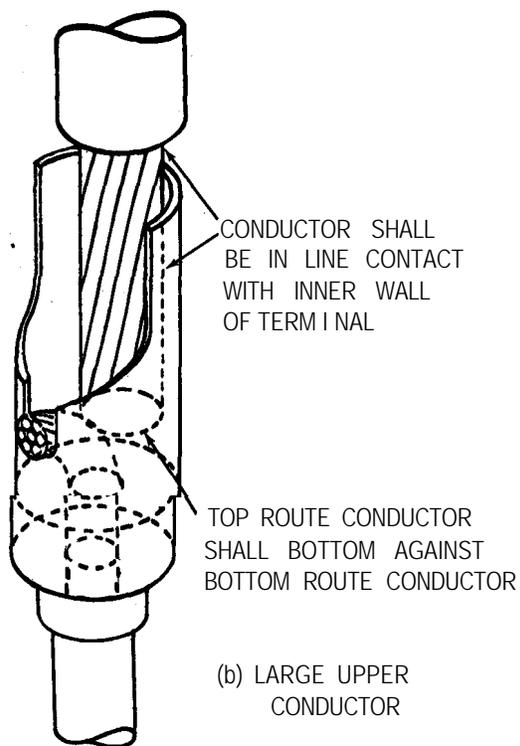


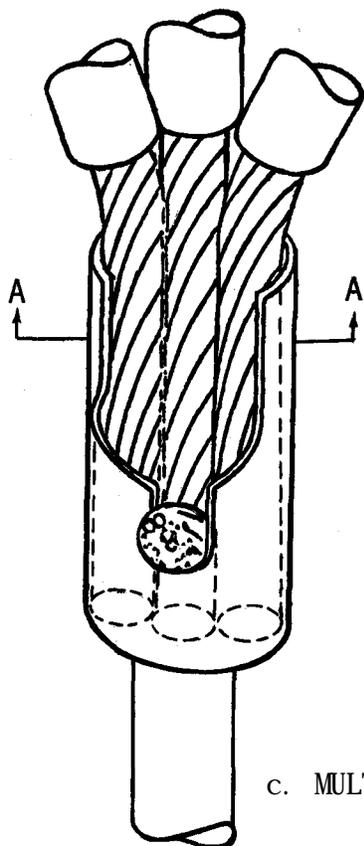
FIGURE 6-7--CONNECTIONS TO SOLDER CUPS (CONNECTOR TYPE)



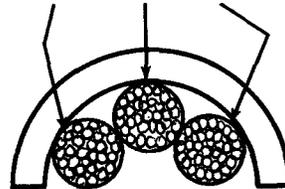
(a) SMALL UPPER CONDUCTOR



(b) LARGE UPPER CONDUCTOR



CONDUCTORS SHALL BE
IN CONTACT WITH
BACK WALL



CROSS-SECTION
VIEW A-A

c. MULTIPLE WIRES IN TOP ROUTE

FIGURE 6-8 -- CONNECTIONS TO SWAGED TYPE SOLDER CUPS

CHAPTER 7: SOLDERING OF TERMINALS

3A700 GENERAL

1. **SECURING CONDUCTORS.** There shall be no relative motion between conductors and the terminal during soldering and while the solder is solidifying.
2. **INSULATION SLEEVING, POTTING OR COATING.** Protective coverings or coatings on the soldered terminals shall comply with requirements of the contract or purchase order.

3A701 SOLDER APPLICATION

1. **SWAGED TERMINALS.** Terminals swaged to a solid flat conductor shall be soldered to one surface of the conductor.
2. **ALL TERMINALS EXCEPT CUP**
 - a. A concave fillet of solder shall be formed between the terminal and each side of the conductor.
 - b. The contour of the conductor shall be visible after soldering.
 - c. Terminals with more than one wire shall have each wire in contact with and soldered to the terminal.
3. **CUP TERMINALS**
 - a. The solder shall form a fillet between the conductor and the cup entry slot. The fillet shall follow the contour of the cup opening within the limits illustrated in the satisfactory solder connections, Appendix B.
 - b. Solder spillage along the outside surface of the solder cup is permissible to the extent that it approximates tinning and does not interfere with the assembly or function of the connector.
4. **WICKING.** Flow of solder along the wire is permitted. Solder shall not obscure the contour of the conductor at the termination of the insulation.

38702 REMOVAL OF FLUX AND RESIDUE

After the solder has solidified and cooled, flux and residue shall be carefully removed from each solder connection using a solvent as specified in paragraph 3A311.

3A703 INSPECTION

Each soldered connection shall be visually inspected in accordance with the criteria of this chapter. Magnification shall be as specified by the procuring NASA Installation. Parts and conductors shall not be physically disturbed to aid inspection. Illustrations of typical satisfactory and unsatisfactory soldered connections are shown in Appendix B.

3A704 ACCEPTANCE CRITERIA

An acceptable solder connection will be characterized by:

- 1. Clean, smooth, undisturbed surface.**
- 2. Concave fillet between conductor and termination.**
- 3. Contour of conductor visible.**
- 4. Complete wetting.**

3A705 REJECTION CRITERIA

The following are some characteristics of unsatisfactory solder conditions which are cause for rejection:

1. CONDUCTORS -AND PARTS:

- a. Damaged, crushed, cracked, charred, melted, etc.**
- b. Improper insulation clearance.**
- c. Improper tinning.**
- d. Separation of wire strands.**
- e. Part improperly supported or positioned.**
- f. Part marking not visible.**
- g. Part damaged.**
- h. Loose conductors.**
- i. Cut, nicked, stretched or scraped leads or wires.**
- j. Flux residue or other contamination.**
- k. Improper wrap or stress relief.**

2. SOLDER CONNECTIONS:

- a. Cold joint.**
- b. Overheated joint.**
- c. Fractured joint.**
- d. Bare copper or base metal.**
- e. Improperly bonded joint.**
- f. Pitted or porous joint.**
- g. Excessive solder.**
- h. Insufficient solder.**
- i. Splattering of flux or solder or adjacent areas.**
- j. Rosin solder connection.**
- k. Unclean connection (e.g., lint, flux, dirt, etc.).**
- l. Dewetting.**

RA
RAM

CHAPTER 8: PRINTED WIRING ASSEMBLY SOLDERING

3A800 FABRICATION AND CONFORMAL COATING

Printed wiring boards shall be designed, fabricated, and inspected in accordance with the requirements of the contract or purchase order. The assembly of parts, soldering and inspection of the completed wiring assemblies shall be in accordance with the requirements herein.

3A801 GENERAL REQUIREMENTS

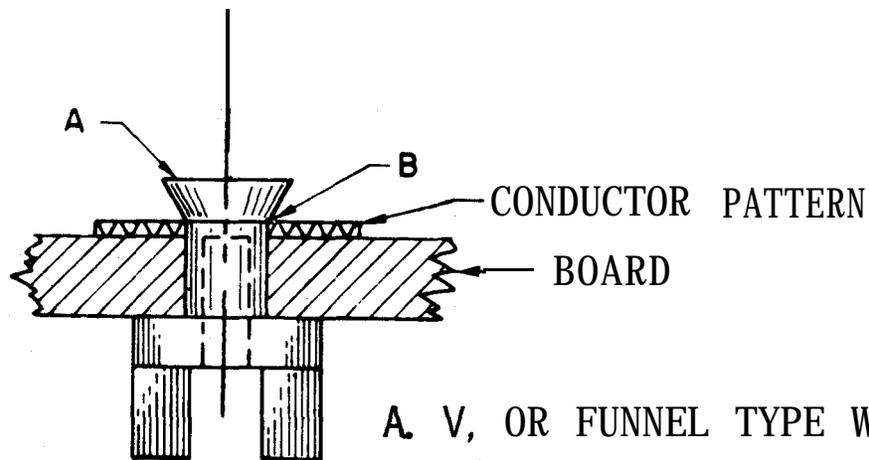
1. **DIP SOLDERING.** Manual dip soldering of printed wiring assemblies is not permitted.
2. **PATTERN REPAIR.** Repair of damaged or broken conductor patterns on printed wiring boards is not permitted.
3. **MACHINE SOLDER REWORK.** Rework of machine soldered printed wiring assemblies shall be performed in accordance with the soldering requirements of this publication.
4. **GOLD REMOVAL.** Gold plating shall be removed from the printed board areas to be soldered prior to mounting of parts. Removal shall not damage the copper conductor or add permanent contaminants to the insulating board. Boards shall be cleaned of contaminants before further processing.
5. **EYELETS, TUBELETS AND PLATED-THROUGH HOLES.** Eyelets or tubelets shall not be used as part of the electrical circuit on printed wiring boards. Plated-through holes shall not be used unaided as the electrical connection between conductor patterns on double-sided boards. A solid copper conductor, or a part lead, shall be used to make the interfacial electrical connection.

3A802 PRINTED WIRING BOARD PROTECTION

Printed wiring boards shall be protected to prevent damage or contamination during fabrication, inspection, in-plant transportation, and interim storage.

3A803 TERMINAL SOLDERING

Terminals swaged to conductor patterns shall be funnel swaged ("V" swaged) and soldered at all points of contact between the terminal and the conductor pattern. Roll type swaging shall not be used on the conductor pattern (see Figure 8-1). Terminals shall not be used for interfacial connection.



- A. V, OR FUNNEL TYPE WAGE.
- B. POINT TO APPLY SOLDER IF SOLDER RING IS NOT USED.

FIGURE 8-1 -- TYPICAL SWAGED TERMINAL ON PRINTED WIRING BOARD

3A804 PREPARATION AND SOLDERING OF TERMINATION AREAS

1. **TERMINATION AREA.** The termination area shall be clean prior to soldering. Soldering to printed wiring termination areas shall be to the base metal or to tin-lead coated base metal.
2. **SOLDERING TO TERMINATION AREAS.** The melted solder shall flow around the conductor and over the termination area so that a fillet is formed. The outline of the lead shall be visible in the finished connection. After soldering, flux residue and other contaminants shall be removed.

3A805 INSPECTION

Each completed printed wiring assembly shall be visually inspected to the criteria listed in paragraphs 3A806 and 3A807 and for other indications of poor workmanship or nonconformance to the design drawings. Magnification shall be as specified by the procuring NASA Installation.

3A806 ACCEPTANCE CRITERIA

The following are characteristics of acceptable solder connections to printed wiring assemblies:

1. Clean, smooth, undisturbed surface.
2. Regular, even fillet between conductor and termination area.
3. Contour of conductor visible.
4. Complete wetting.

3A807 REJECTION CRITERIA

The following are some characteristics of unsatisfactory printed wiring assemblies which are cause for rejection:

1. Charred, burned, or melted insulation or parts.
2. Conductor pattern separation from board.
3. Burns on base materials.
4. Discoloration which is continuous between conductors (e.g., measling, delamination, halo effect, etc.)
5. Excessive solder (including peaks, icicles, and bridging).
6. Flux residue, solder splatter, or other foreign matter.
7. Dewetting.
8. Insufficient solder (a small amount of exposed base metal around the periphery of the termination area or at the end of a conductor is acceptable if conformal coating will be applied).
9. Pits, holes or voids, or exposed base metal in the soldered connection.
10. Cold, rosin, disturbed, or fractured solder connection.
11. Cut, nicked, gouged, or scraped conductors or conductor pattern.
12. Improper conductor length or direction of clinch.
13. Repaired or damaged conductor pattern.

CHAPTER 9: AUTOMATIC MACHINE SOLDERING

3A900 GENERAL

This chapter contains requirements peculiar to automatic machine soldering. General requirements including acceptance and rejection criteria specified in this publication are applicable.

3A901 DOCUMENTATION

1. The supplier shall establish complete and detailed documentation for operation and maintenance of the soldering machines and their environment, and for inspection of both the process and the end-products.
2. The documentation shall set limits on the:
 - a. Preheat temperature,
 - b. Temperature of the solder,
 - c. Conveyor speed,
 - d. Height of the solder wave,
 - e. Control of the dross inhibition oil and flux (if fluxing is done as a machine step),
 - f. Amount of contaminants permissible when the solder bath is analyzed,
 - g. Frequency of maintenance and of analysis and other factors affecting the quality of the connections in the end-product,

Maintenance and calibration data shall be recorded and available to Government and supplier inspection.

3A902 PREPARATION AND ASSEMBLY

1. Only tin-lead (solder) coated and reflowed electro-plated tin-lead coated conductor patterns shall be used in machine soldering of printed wiring board assemblies.
2. Parts shall be mounted as specified in Chapters 5 and 6 of this document. The mounting shall prevent relative motion between part and board during solder solidification.
3. The assembled boards shall be clean immediately prior to loading on to the carrier.

4. Metal surfaces not to be soldered shall be masked or coated with a solder resist prior to loading.
5. Liquid flux specified in paragraph 3A310 shall be applied.

3A903 MACHINE REQUIREMENTS

1. The preheat temperature shall be controlled to a selected temperature between 160° and 180° F. The selected temperature shall be maintained within $\pm 5^\circ$ F.
2. The conveyer speed shall be controlled to a preselected rate, which shall not vary more than 1 inch per minute.
3. Solder temperature shall be controlled so that the solder in the wave making contact with the board is 490° F $\pm 10^\circ$ F.
4. The oil used as a dross inhibitor shall have a flash point higher than the maximum solder temperature.
5. The height of the solder wave shall be controlled to a constant preselected height.
6. The solder bath shall be chemically analyzed periodically for conformance with the requirements of paragraph 3A309 except that copper content shall not exceed 0.2%.

3A904 CLEANING

After soldering, flux and dross inhibitor oil shall be promptly removed in a manner which does not damage the hardware.

3A905 INSPECTION

Inspection criteria listed in Chapter 8 are applicable to machine soldered assemblies. Warp or twist of the board shall not exceed the limits specified by the detail drawing.

DEFINITIONS

The following definitions apply to terms used in this Handbook.

Article. A unit of hardware or any portion thereof required by the contract.

Bifurcated (split) Terminal. A terminal containing a slot or split in which wires or leads are placed before soldering.

Certification. The act of competent authority in verifying and documenting that personnel have completed required training and have demonstrated specified proficiency and have met other specified requirements.

Cold Solder Connection. Unsatisfactory connection resulting from dewetting and exhibiting an abrupt rise of the solder from the surface being soldered.

Conduction Soldering. Method of soldering which employs a soldering iron for transfer of heat to the soldering area.

Conductor. A lead or wire, solid or stranded, serving as an electrical connection between terminals.

Conformal Coating. A thin protective coating which conforms to the configuration of the covered assembly.

Cordwood Construction. Circuitry in which parts are mounted between, and perpendicular to, two printed wiring or conductive networks.

Deviation. A specific authorization, granted before the fact, to depart from a particular requirement of specifications or related documents.

Dewetting. The condition in a soldered area in which the liquid solder has not adhered intimately, characterized by an abrupt boundary between solder and conductor, or solder and terminal/termination area.

Disturbed Solder Connection. Unsatisfactory connection resulting from relative motion between the conductor and termination during solidification of the solder.

Electrical Connection. Connections in electrical or electronic circuits.

Excessive Solder Connection. Unsatisfactory connection wherein the solder obscures the configuration of the connection.

Eyelet. A tubular metal part having both ends headed or rolled over.

Fractured Joint. A solder joint in which the solder has fractured or broken between the joint elements.

Hook Terminal. A terminal formed in a hook shape.

Mission Essential Support Equipment. Mission-essential support equipment is defined as satisfying any of the following:

1. Equipment used in a closed loop with the system where failure would degrade the mission or 'imperil personnel.
2. Equipment used when transferring toxic or explosive fluids, in which failure could result in personnel hazards or affect mission success.
3. Equipment used as a last check prior to installation whose failure would result in lowering the probability of mission success or compromising personnel safety.

Part Lead. The wire, solid or stranded, which extends from and serves as a connection to a part.

Part. One piece, or two or more pieces joined together which are not normally subject to disassembly without destruction of designed use. Synonymous with detail part and component part (e.g. resistor, capacitor, valve, relay).

Potting Compound. A nonconductive compound used for encapsulation of parts, conductors or assemblies.

Pierced (Perforated) Terminal. A terminal containing a hole through which leads or wires are placed before soldering.

Pits. Small holes or sharp depressions in the surface of the solder.

Repair. Operations performed on a nonconforming article to place it in useable and acceptable condition. Repair is distinguished from rework.

Resistance Soldering. Method of soldering, by passing a current between two electrodes through the area to be soldered.

Rework. The reprocessing of articles or material that will make it conform to drawings, specification or contract.

Rosin Solder Connection. Unsatisfactory connection which has trapped flux.

Overheated Joint. An unsatisfactory solder joint, characterized by rough solder surface.

Solder. A nonferrous, fusible metallic alloy used when melted to join metallic surfaces.

Solder Cup Terminal. A hollow, cylindrical terminal to accommodate one or more conductors.

Soldering. The process of joining metallic surfaces through the use of solder without direct fusion of the base metals.

Straight Pin Terminal. A round post-type smooth terminal, with no grooves, slots, or guides.

Supplier. A contractor or subcontractor actually performing the services or producing the contract articles.

Terminal. A tie point device used for making electrical connections.

Termination. The point at which an electrical conductor ends, usually at an electrical connection.

Termination Area. A conductive surface on a printed wiring board used for making electrical connections. (Also referred to as printed circuit pad).

Thermal Shunt. A device with good heat dissipation characteristics used to conduct heat away from an article being soldered.

Tinning. The coating of a surface with a uniform layer of solder, before it is used in a soldered connection.

Tubelet. A tubular metal part with both ends formed in a conical flare of approximately 90 degrees included angle.

Turret Terminal. A round post-type grooved stud around which conductors are fastened before soldering.

Waiver. Granted use, or acceptance, of an article which does not meet specified requirements.

Wetting. Adhesion of a liquid to a solid surface.

Wicking. The flow of molten solder by capillary action.

APPENDIX B

TYPICAL SATISFACTORY AND UNSATISFACTORY SOLDER CONNECTIONS

The Illustrations in this Appendix depict typical satisfactory and unsatisfactory solder connections and are to be used as visual workmanship standards. See paragraphs 3A703, 3A805 and 3A905.

FIGURE B-1-SOLDERED TURRET TERMINALS

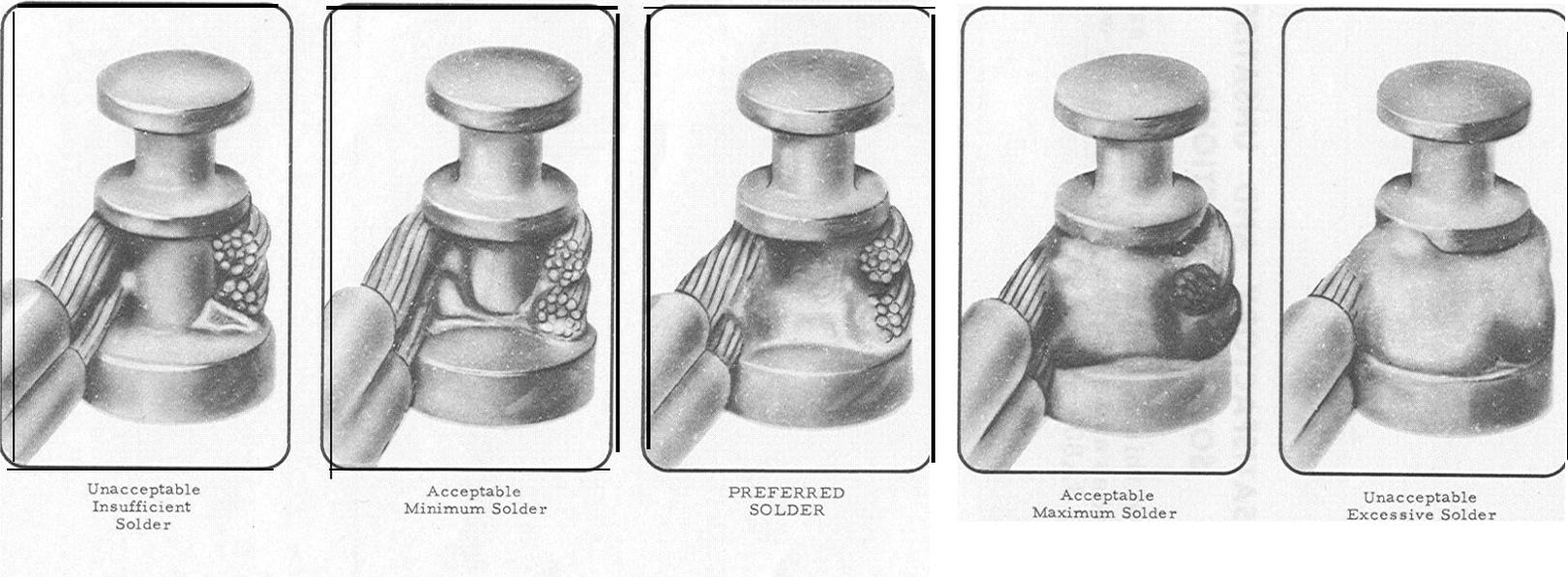
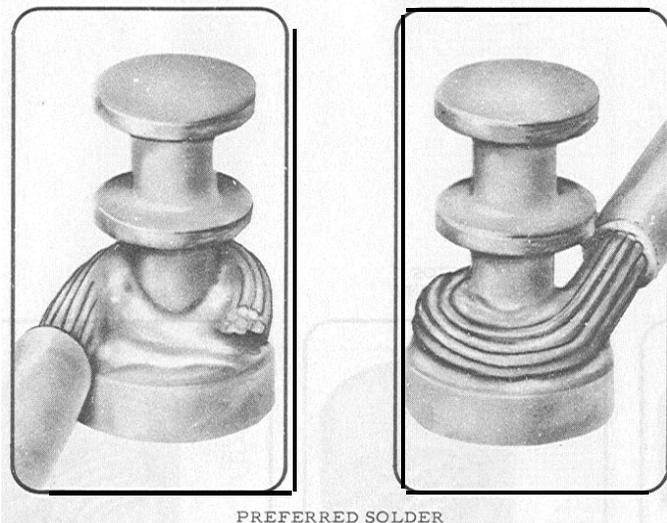
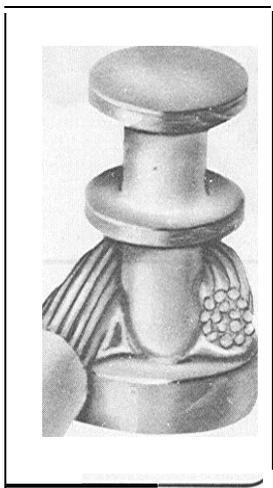


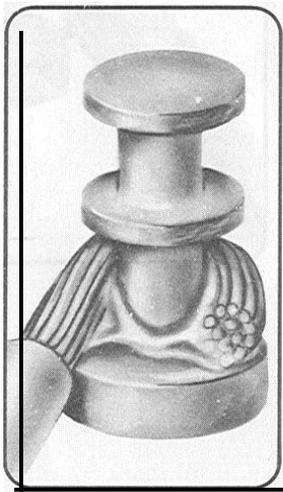
FIGURE B-1-SOLDERED TURRET TERMINALS-Con.



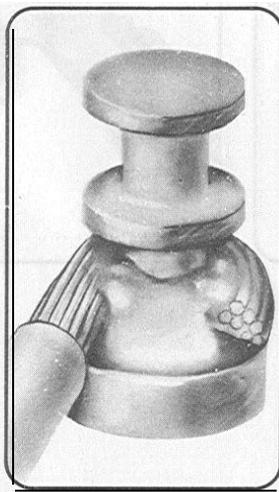
PREFERRED SOLDER



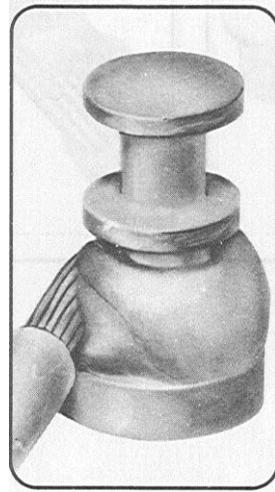
Unacceptable
Insufficient
Solder



Acceptable
Minimum
Solder

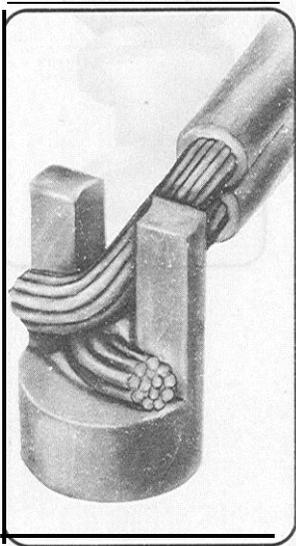


Acceptable
Maximum
Solder

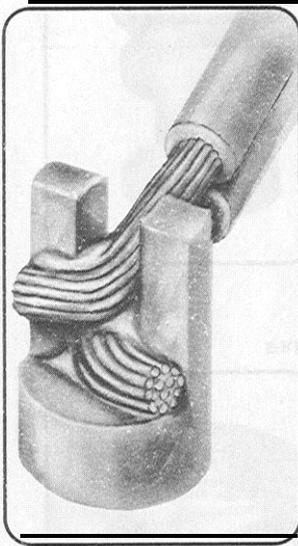


Unacceptable
Excessive
Solder

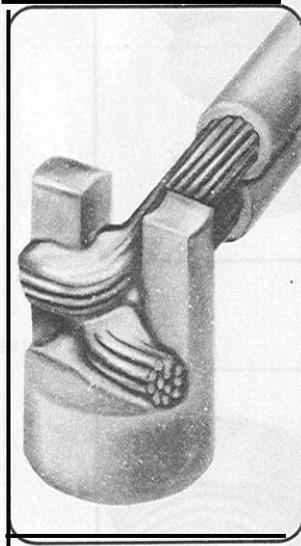
FIGURE B-2-- SOLDEREE BIFURCATED TERMINALS



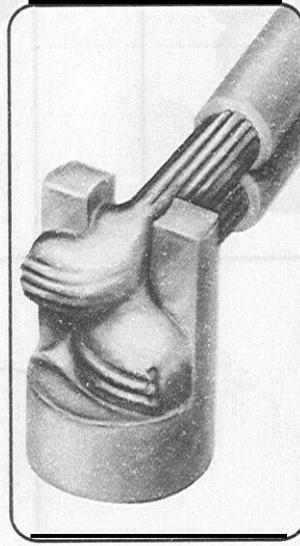
Unacceptable
Insufficient
Solder



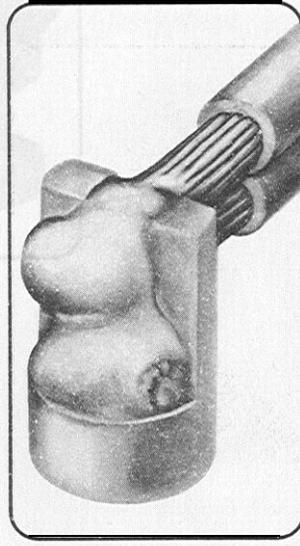
Acceptable
Minimum
Solder



PREFERRED
SOLDER



Acceptable
Maximum
Solder



Unacceptable
Excessive
Solder

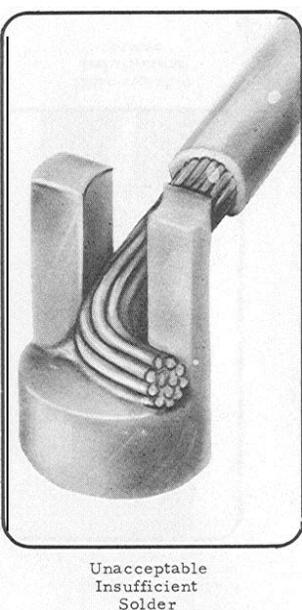
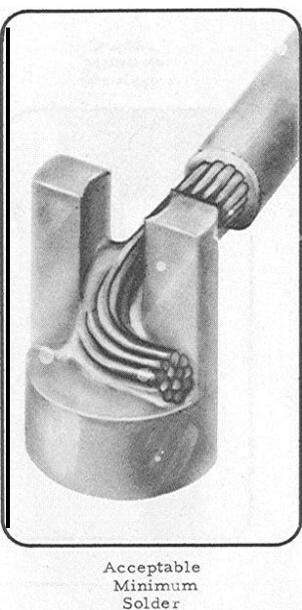
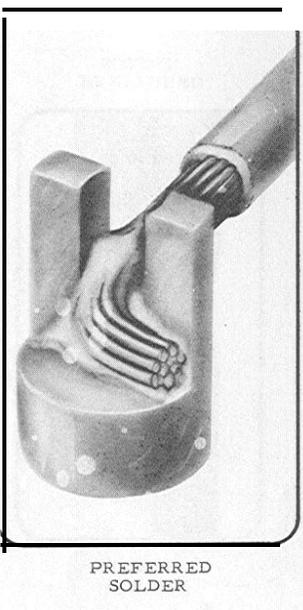
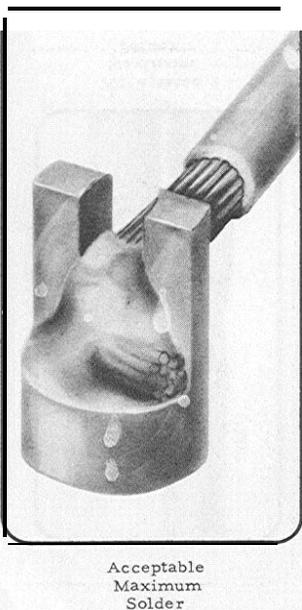
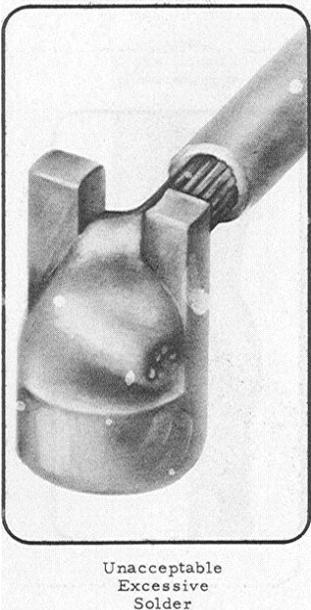
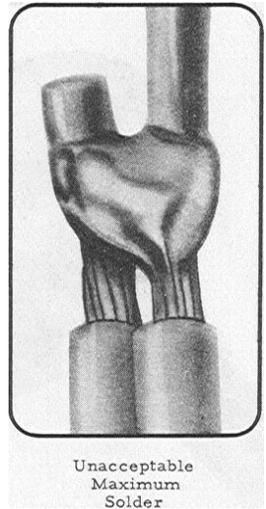
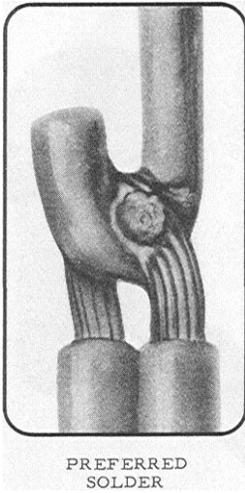
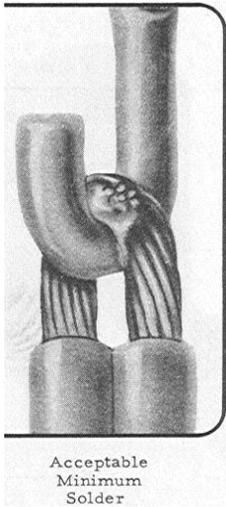
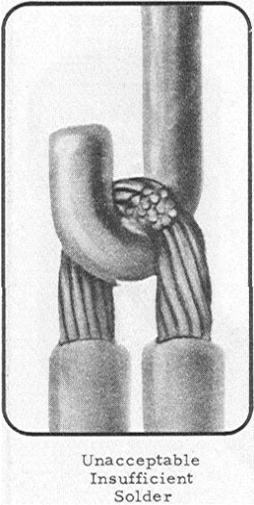
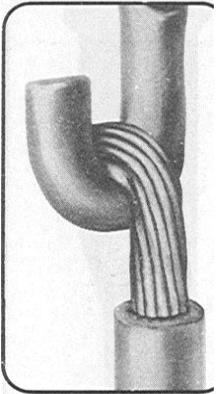


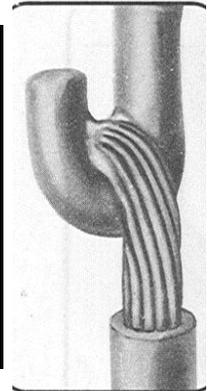
FIGURE B-2-- SOLDERED BIFURCATED TERMINALS--Con.

FIGURE B-3 -- SOLDERED HOOK TERMINALS

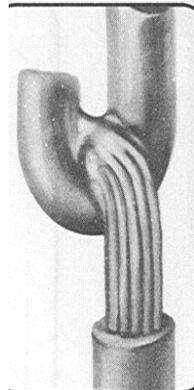




Unacceptable
Insufficient
Solder



Acceptable
Minimum
Solder



PREFERRED
SOLDER



PREFERRED
SOLDER



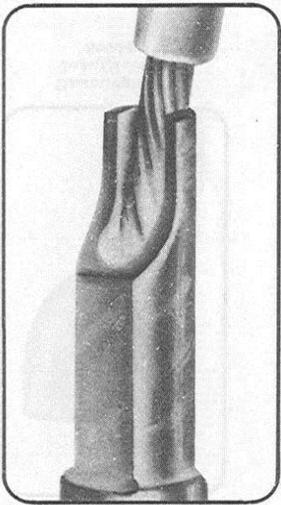
Acceptable
Maximum
Solder



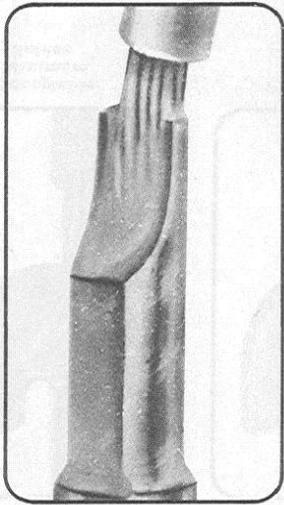
Unacceptable
Excessive
Solder

FIGURE B-3 -- SOLDERED HOOK TERMINALS--Con.

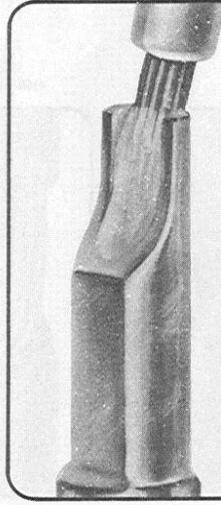
FIGURE B-4--SOLDERED CUP TERMINALS



Unacceptable
Insufficient
Solder



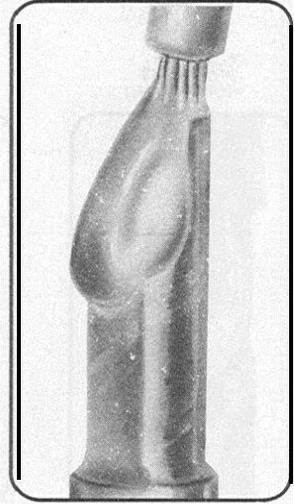
Acceptable
Minimum
Solder



PREFERRED
SOLDER



Acceptable
Maximum
Solder



Unacceptable
Excessive
Solder

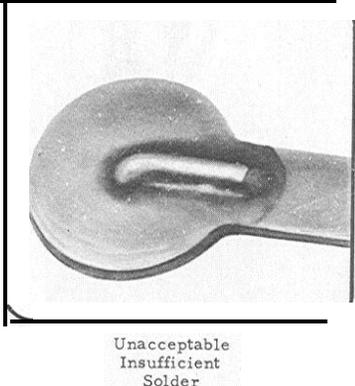
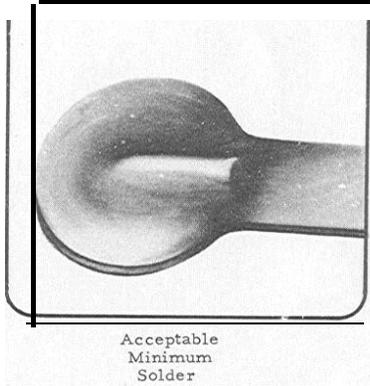
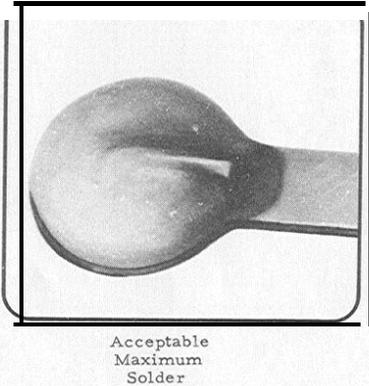
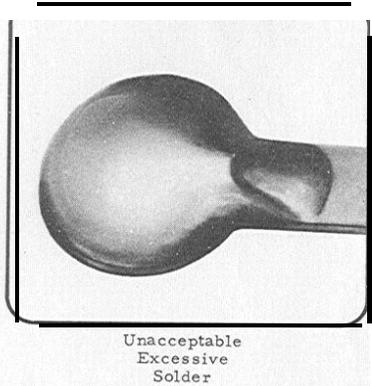
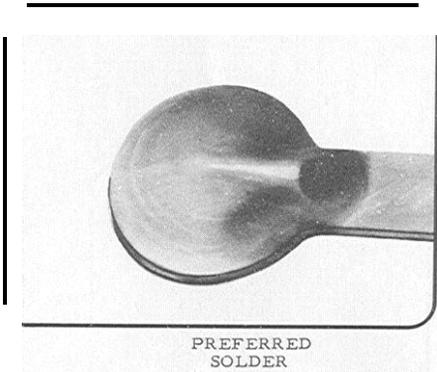


FIGURE B5 -- SOLDERED PRINTED WIRING AREAS

U. S. GOVERNMENT PRINTING OFFICE : 1968 O - 308-060

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 40 cents

DATE: _____

NAME: _____

STATION: _____

TEST SCORE: _____

WDL
SOLDER CERTIFICATION TEST

- 1) The principal reason for soldering is:
 - a) To lock the connection
 - b) To assure a good electrical connection
 - c) To prevent wraps from crossing each other
 - d) To fuse the lead to the terminal

- 2) Flux is used to:
 - a) Wet the solder
 - b) Remove surface oxides so solder will flow properly
 - c) Form a protective coating on the bond
 - d) To act as a catalyst in the solder process

- 3) A _____ joint is a soldered joint where the solder has flowed around the wire or lead, but has not bonded the wire and terminal together.
 - a) Cold
 - b) Excess solder
 - c) Rosin
 - d) Insufficient solder

- 4) The smallest radius that a component lead may be bent is _____ times the diameter of the lead.
 - a) Two
 - b) Four
 - c) Three
 - d) Five

- 5) Why should components be mounted with color codes, rating, or polarity clearly visible?
 - a) They would not be acceptable if not
 - b) For ease of trouble shooting and maintenance
 - c) So the circuit can be reproduced by the customer
 - d) It looks better

- 6) The purpose of a heat sink is to:
- a) Concentrate more heat on the component during soldering
 - b) Protect components from overheating during soldering
 - c) Dissipate heat from terminal being soldered
 - d) Hold heat in the soldering iron
- 7) Wicking is:
- a) Caused by pieces of insulation protruding into the solder
 - b) A desirable feature of soldered wiring
 - c) The flowing of solder under the insulation
 - d) The term used for immersing wires in solder pots for tinning
- 8) Why should care be taken that the soldered joint does not move when cooling?
- a) A rosin joint will be formed
 - b) Voids and a weakened joint are caused
 - c) Component spacing will not be uniform
 - d) A moving joint is difficult to solder
- 9) The prefilling process for solder cups is as follows:
- a) Insert tip of iron in top of cup and feed solder in as required
 - b) Hold iron and solder above cup and let molten solder drip into cup
 - c) Dip cups into solder pot, then shake off excess solder
 - d) Place flux and solder in cup, apply heat on back side of cup, slowly to feed in solder for correct amount
- 10) A resistor with color bands red, green, blue, would have a value of:
- a) 25pF
 - b) 25,000,000 ohms
 - c) 2500K ohms
 - d) 2.5uh
- 11) The heat required to solder a ground lug on a metal chassis is _____ that required to solder a terminal on a terminal board.
- a) Less than
 - b) The same as
 - c) Greater than
 - d) None of above

- 12) Minimum length to the first stress relief bend is:
- a) 0.125 – inch
 - b) 0.250 – inch
 - c) 0.500 – inch
 - d) 0.060 – inch
- 13) If you detect a drawing error, you should:
- a) Correct it yourself
 - b) Continue working
 - c) Bring it to the dispatcher’s attention
 - d) Bring it to your Supervisor’s attention
- 14) Work may be accomplished without a shop order when:
- a) The dispatcher approves
 - b) The shop order is lost
 - c) A shop order has not been written
 - d) Never
- 15) When the soldering operation is completed, the tip of the iron is removed from the connection _____ removing the solder:
- a) Prior to
 - b) Immediately after
 - c) Either a or b
 - d) None of the above
- 16) TRUE FALSE Components with welded lead(s) e.g., tantalum capacitors shall have a stress relief bend beginning 0.06-inch minimum from the welded point.
- 17) TRUE FALSE Where possible, components must be mounted flush with the chassis or circuit board.
- 18) TRUE FALSE Leads shall be formed around a turret terminal 180° to 270°.
- 19) TRUE FALSE The purpose of a service tab is to act as stress relief for the component.
- 20) TRUE FALSE All flux must be removed after solder joint is made.

Workmanship

Workmanship quality has been observed and has been found to be acceptable by the undersigned.

GSI/STAFF Signature _____