SOLDERED CONNECTIONS USING SOLDERING COPPERS
METHOD OF MAKING AND REMOVING

CONTENTS PAGE

1. GENERAL

1.01 This section covers the method of making and removing soldered connections and the use of soldering coppers.

1.02 This section is being reissued to:

(a) Revise List of Tools and Materials

(b) Revise and reorganize Part 6.

1.03 The KS-8740 L33 and L34 tips are ironclad tips with an additional coating of insulation over approximately 3/4 inch of the working end.

2. SOLDERING FUNDAMENTALS

2.01 Soldering is a metal joining process wherein the nonferrous filler metal or alloy has a melting point lower than that of the metals or alloys being joined. This bond is accomplished by raising the temperature of the wire and terminal or wires to the melting point of the solder. The rosin flux in the solder minimizes oxidation during the heating by excluding air. Most of the wires and terminals to be soldered have been pretinned to permit soldering action to take place at temperatures permissible for soldering coppers used in telephone apparatus. Before any soldering, all terminals and wires must be thoroughly cleaned of all enamel, grease, dirt, and oxides.

2.02 When soldering a wire to a terminal, it is essential that the wire be connected so it is in the proper position and rests firmly against the terminal. A cross-sectional view of a properly soldered wire to terminal connection will have a definite fillet of solder on both sides of the wire forming a secure mechanical connection and a good electrical connection as shown in Fig. 1.

2.03 The point of soldering is generally on the right side or on top of the terminal.

2.04 When soldering neoprene- or plastic-insulated wire, considerable care shall be taken that the soldering copper or other heat source is not applied to connection any longer than necessary to make a good connection since these materials have a tendency to recede with excessive heating.

2.05 Neoprene- and plastic-insulated wire without textile covering shall not be allowed to come in direct contact with another terminal which is being soldered. Special care shall be exercised to avoid even momentary contact between the soldering copper or other heat source and the insulation of wires of these types.

2.06 The soldering copper may be held in the following manner.

(a) The handgrip, as shown in Fig. 2, may generally be found applicable on horizontal terminals such as those on the vertical side of a distributing frame.

(b) The pencilgrip, as shown in Fig. 3, may generally be found applicable on vertical terminals such as those on the horizontal side of a distributing frame.

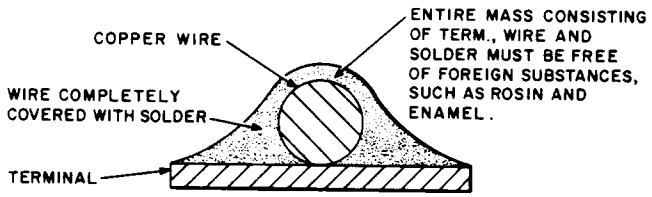


Fig. 1—Cross Section of a Properly Soldered Connection

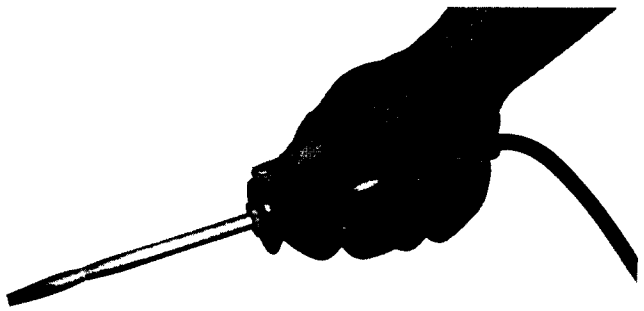


Fig. 2—Hand-Grip Method of Holding Soldering Copper

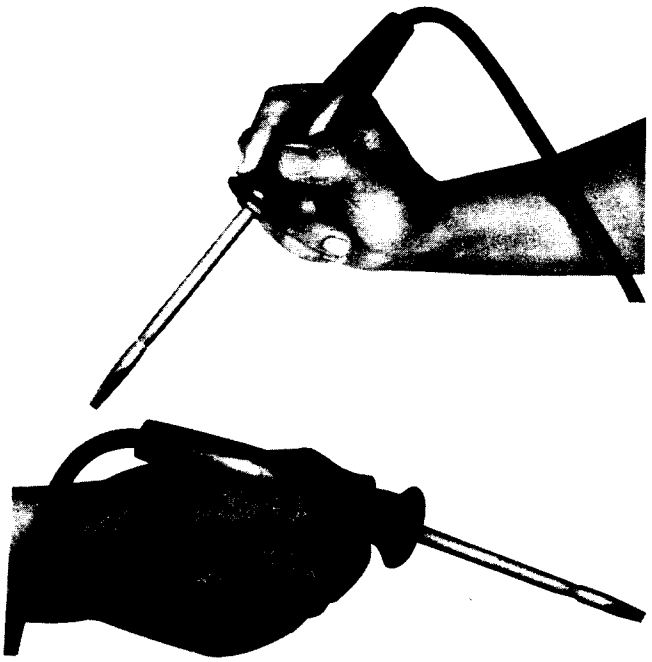


Fig. 3—Pencil-Grip Method of Holding Soldering Copper

3. LIST OF TOOLS AND MATERIALS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
504A	Soldering copper holder (Includes tin plate wiping pad.)
721A	Adapter for use with the 504A tool (soldering copper holder) to reliably hold the KS-14440 and KS-16346 soldering coppers
♦AT-7860	B long-nose pliers♦
KS-6320 or	Orange stick
R-1102	Spudger
KS-8526	Soldering copper rest (not recommended for central office use)
KS-8740	Soldering copper, 95 watts

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
KS-14440	Soldering copper
KS-14582	Soldering copper (for use where electric power is not available)
KS-16346	Soldering iron
R-1482	File
—	◗B plastic goggles or American Optical Company 484B chemical goggles (or equivalent)◖
MATERIALS	
KS-19454 L1	Plug (See 13.01.)
◗KS-20962	Connecting bag◖
—	Wiring plug (JE-8, JE-9, JE-10), Star Expansion Products Company (See 13.01.) (as required)
—	320 aloxite cloth
—	Solder, rosin-core (See Table A.)

TABLE A

ROSIN-CORE SOLDER DESCRIPTION

% TIN	% LEAD	% ROSIN	DIA-METER INCHES	MELTING RANGE DEGREES F	NUMBER
40	60	3-6	.070	360-460	RM-546293
45	55	1-3	.070	360-440	RM-531801
60	40	1-3	.040	360-370	RM-542891
60	40	1-3	.070	360-370	RM-546289
40	60	1-3	.040	360-460	AT-7424 E Rosin-Core

4. TYPICAL APPLICATION OF SOLDERING COPPERS AND SOLDERS

4.01 Typical applications of soldering coppers are as follows.

(a) The KS-8740, 95-watt copper is standard for general and continuous use.

(b) The KS-14440 copper is intended for applications where small size, lightweight, and quick heating are desirable. The copper can be equipped with a short shank for general use or a long shank for special use such as on switchboard multiples. Normally this iron is equipped with approximately 1/4-inch wide tip. Heater assemblies with approximately 3/16- and 1/8-inch wide tips are also available.

(c) The KS-14582 copper is for use where electric power is not available.

(d) The KS-16346 iron is primarily intended for soldering wrapped connections or other connections is congested areas without damaging the insulation of the wiring.

4.02 Typical applications of solders are as follows.

(a) The 40-60 percent solder is intended for the usual soldering of wire to terminals.

(b) Higher tin content solders are intended for use where heat-sensitive apparatus or insulation is involved or where the nature of the soldering operation requires a solder which has a lower melting point. (See Part 3.)

5. SHAPING SOLDERING COPPER TIPS

5.01 Plain copper tips may be shaped by filing as shown in Fig. 4. (IRONCLAD TIPS INCLUDING THOSE COATED WITH A DIELECTRIC SHOULD NOT BE RESHAPED.) Defective tips should be replaced in accordance with the appropriate section in Division 075.

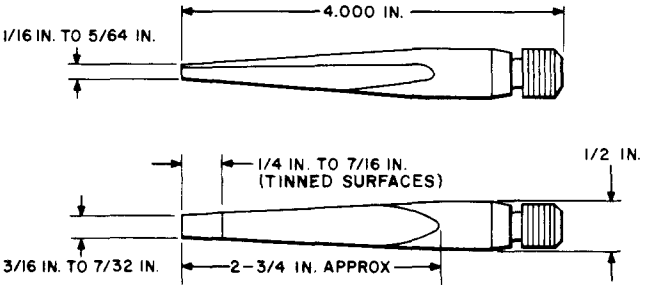


Fig. 4—Shaping Plain Copper Tips

6. TINNING SOLDERING COPPER TIPS

6.01 ◗*Plain Copper Tips*

(1) File the surface of one side of the tip of the copper until it is bright and clean for a distance of approximately 1/2 inch.

Note: Only one side of the tip should be tinned. The tinned area may be confined by rubbing the untinned portion of the tip of the hot copper with a rubber eraser. Continuous heating of an idle copper will destroy the tinned area.

(2) Heat the copper to soldering temperature, and quickly file the side of the tip which was previously cleaned; then apply rosin-core solder until the surface is well tinned.

(3) Remove the excess solder by means of an approved wiping pad.

(4) Before replacing the soldering copper in a holder or on a rest, remove any excess solder on the tinned side of the tip since, if the tip is reheated, the excess solder will tend to cause pitting. Surplus solder may be removed by wiping on the approved wiping pad.

6.02 ***Ironclad Tips:*** The ironclad tips are initially furnished with one side of the tip tinned. If the soldering copper is to be idle for an extended period, leave an excess of solder on the tip.

(1) To clean the tip, heat the copper and then flow solder over the tip.

(2) Rub the tip on the tin plate wiping pad to distribute the solder over the tip and to wipe off any excess solder. ***Do not*** wipe the tip on anything other than the tin plate as this may destroy the tinning.

(3) Inspect to determine condition of tinning. If it becomes apparent, after cleaning the ironclad tip, that retinning is necessary, perform (4) through (8).

(4) While the tip is hot, wipe off as much of the old solder as possible using the tin plate wiping pad.

(5) Allow the tip to cool; otherwise, it cannot be cleaned satisfactorily.

(6) When it is cold, rub the surface to be tinned on a piece of aloxite cloth until the surface is bright.

Caution: Do not use a file to clean the tip. Exercise care to remove as little as possible of the iron because the iron coating is less than 1/64 inch thick. If the iron coating is penetrated, a short tip life will result.

(7) When the surface is clean, heat the tip and, as it heats, apply solder. As soon as the rosin begins to melt, spread the rosin over the surface to prevent it from tarnishing before the solder can be melted. As soon as the solder begins to melt, spread the solder over the surface until the desired area is tinned.

(8) Rub the tip on the tin plate wiping pad to distribute the solder over the tip and to wipe off any excess solder. Do not wipe on anything other than the tin plate as this may destroy the tinning.

6.03 ***Insulated Tips (L33 and L34):*** The working ends of these tips are ironclad and then coated with a dielectric material to guard against short-circuiting when soldering in close places. The insulation has limited impact strength and, therefore, care should be exercised against striking the area when inserting the copper in a 504A tool or similar holder.

(1) The tinned area must be cleaned or retinned per instructions for iron-plated tips in 6.02. Should solder adhere to the insulation, it should be removed by ***flushing*** the coating with molten rosin-core solder.

(2) A periodic check should be made of the insulating coating to ensure it is in satisfactory condition for the application in which it is to be used. See the appropriate section in Division 075.

(3) Tips found to have defective dielectric coatings may be used, if not otherwise defective, in applications not requiring the insulating feature.◖

7. SOLDERING WIRE TO NOTCHED TERMINALS

7.01 Apply rosin-core solder to the tip of a hot soldering copper momentarily so as to leave a small amount of molten solder on the tip. The tip is then applied to the terminal and wire as shown in Fig. 5, Step 1. As the terminal and wire attain proper soldering temperature, the molten solder will spread over the surfaces of the terminal and wire. As this occurs, a small amount of additional solder is immediately applied to the heated joint as shown in Fig. 5, Step 2 so the molten rosin will protect the joint as the soldering process is completed.

> ***Note:*** When soldering connections made with wires of gauges larger than those of distributing frame wire, particularly if the wire is untinned, a longer period of time must be allowed for heating the wire and terminal with the soldering copper before the solder is applied to the copper. This will permit the melted flux to flow over the heated wire. Experience will indicate the period of time required for heating the wire sufficiently to take the flux and solder, but it should not be so long as to cause excessive oxidation of the surface of the wire. A satisfactory job cannot be done if the solder is run onto a cold or improperly heated terminal even though the copper is sufficiently hot. On the other hand, the connection should be soldered and the copper removed from the terminal as quickly as possible so insulation on the terminal strip will not be damaged.

7.02 When the solder has melted and flows freely, bring the copper down over the terminal with a forward movement, so the solder flows over the wire, completely covering it as shown in Fig. 5, Step 3. Draw the copper off the terminal, carrying with it any surplus solder so as to leave a clean, smooth joint as shown in Fig. 5, Step 4.

7.03 Only a small amount of solder is needed to make the joint illustrated in Fig. 6, which shows a thin coat of solder spread smoothly over the wire, completely covering it. The use of too much solder results in a lumpy connection which may cause trouble.

7.04 An improper soldering technique on vertical terminals may result in a cross or short circuit between adjacent terminals as shown in Fig. 7. Sometimes the excess solder settles between sections of the terminal strip causing a cross "X" as shown in Fig. 8.

7.05 Figure 9 illustrates an improperly soldered connection where the solder has sweated to the terminal only, while between the solder and the wire there is a layer of rosin which insulates the solder from the wire. A connection of this kind is due to one of the following causes:

(a) Cold soldering copper

(b) Soldering copper held on connection an insufficient length of time

(c) Improper manipulation of copper

(d) Untinned or unclean terminal or wire.

8. SOLDERING WIRE TO PERFORATED TERMINALS

8.01 Perforated terminals are those on which the wire is brought through the hole, such as on equipment units, jacks, and lamp sockets. The method of soldering is the same as that for notched terminals. (See Part 7.) Sufficient solder should be used to fill the hole. This ensures that a good electrical and mechanical connection has been made (Fig. 10). However, at perforated terminals with oblong holes, such as relay terminals, it is not objectionable if an occasional hole is not filled with solder since the soldering surface on these terminals is sufficient to make a satisfactory connection.

9. SOLDERING WRAPPED CONNECTIONS TO WIRE TERMINALS (INCLUDING SQUARE CROSS SECTION) AND PUNCHED-TYPE TERMINALS 1/16 INCH OR LESS IN WIDTH

9.01 When soldering wrapped connections to punched- and wire-type terminals, it is not necessary to cover the entire wrapped end with solder. Ordinarily, all turns of wire will become covered with solder at the soldered side of the terminals, but where more than two turns have been wrapped, it is only necessary that two adjacent turns be soldered to the terminal. (See Section 069-132-811.)

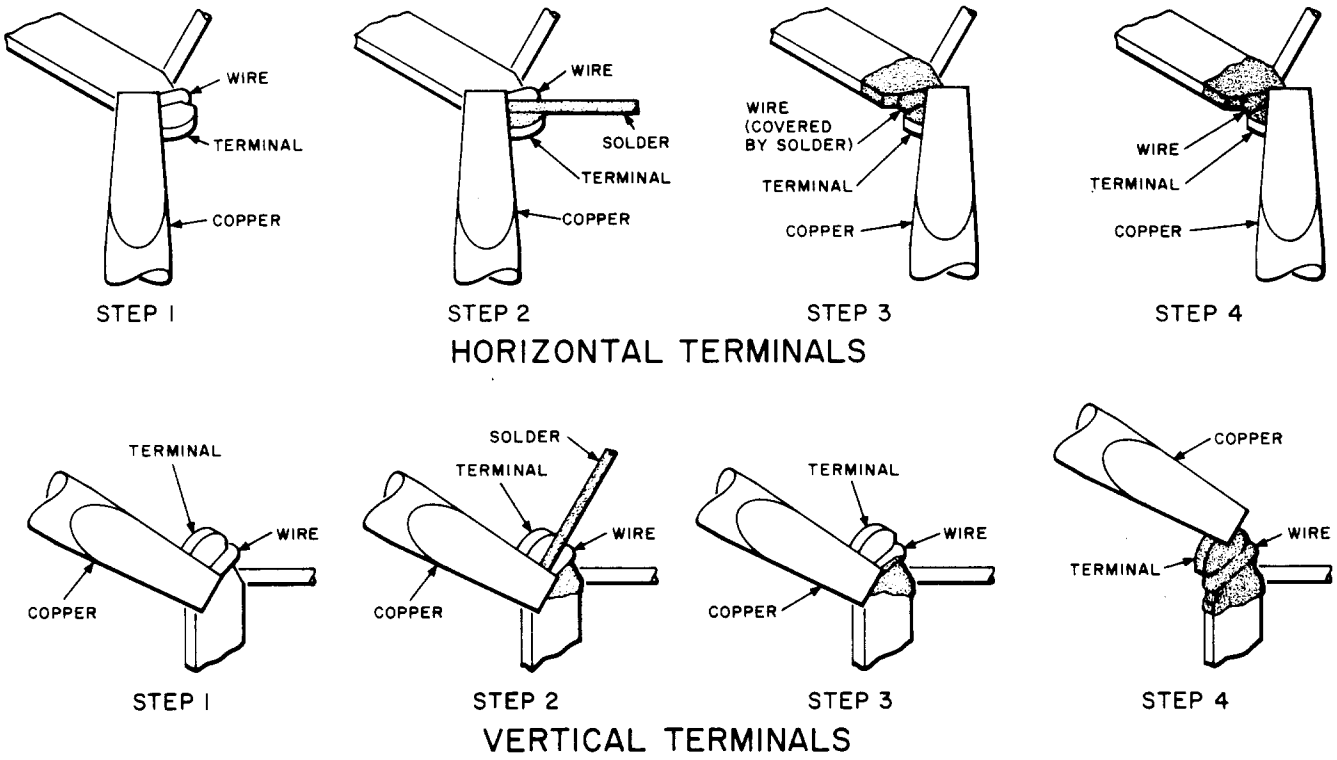


Fig. 5—Soldering Wire to Notched Terminals

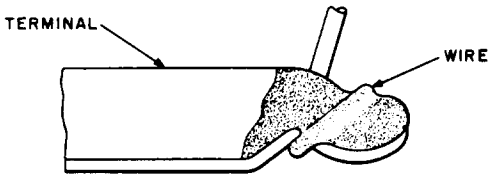


Fig. 6—Example of Properly Soldered Connection

10. SOLDERING WIRE TO TUBULAR TERMINALS

10.01 When soldering wire to a tubular terminal, first apply the tip of the copper to the wire with a little solder. Then connect and solder the wire to the terminal as covered in (a), (b), or (c). After this, hold the copper against the terminal for an instant longer. Then remove the copper and hold the wire in place until the solder sets.

(a) ***Skinned End of Wire Folded Back (A, Fig. 11):*** When the connection is made by folding back the skinned end of the wire, the length of bare wire from skinning point to fold should be slightly less than the depth of terminal. Insert the folded wire into the tubular portion of the terminal so the spring effect of the folded

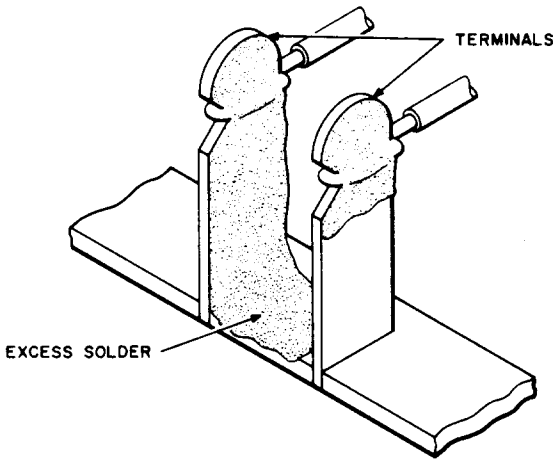


Fig. 7—Excessive Solder on Vertical Terminals

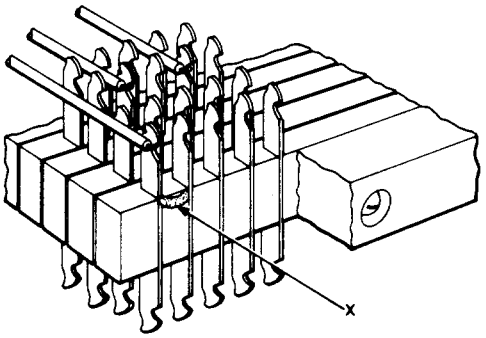


Fig. 8—Excessive Solder on Terminal Strips

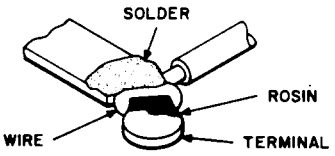
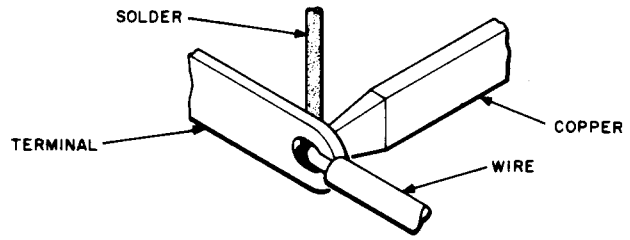
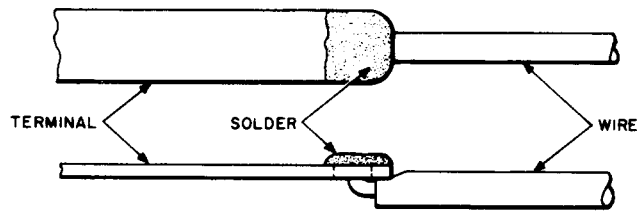


Fig. 9—Example of Improperly Soldered Connections



APPLICATION OF SOLDERING COPPER



FINISHED JOINT

Fig. 10—Soldering Wire to Perforated Terminals

wire will hold it in place prior to soldering. Then hold the copper against the side of the terminal until solder can be flowed into the tube.

(b) ***Skinned End Inserted Without Fold (B, Fig. 11):*** When soldering connections to "cutaway tubular" terminals, such as on U. S. Components Company plugs and connectors, insert the wire into the tubular portion of the terminal and fill the cutaway portion with solder.

(c) ***Wire Wrapped Around Terminal (C, Fig. 11):*** When the connection is made by wrapping the wire around the terminal, solder the turn nearest the insulation for at least one-half the circumference of the terminal.

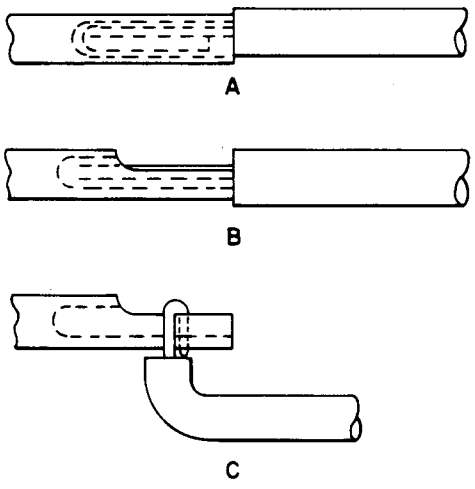


Fig. 11—Connections to Tubular Terminals (Solder Not Shown)

11. SOLDERING WIRE TO SPUN-IN, STAND-OFF, AND SIMILAR-TYPE TERMINALS

11.01 When soldering connections to spun-in, stand-off, and similar-type terminals as illustrated in Fig. 12 and 13, completely cover the wire with solder for at least one-half of the circumference of the terminal.

(a) When soldering connections to stand-off terminals (such as the 202-type which consists of a terminal insulated from its mounting stud by means of insulating material), exercise special care to avoid overheating since excessive heat may loosen the terminal from the insulating material.

11.02 ***Spun-in Terminals:*** These terminals are frequently used for mounting pigtail apparatus. The connections shall be made as follows. (See Fig. 12.)

(a) Where the pigtail apparatus is located on the opposite side of the panel from the terminal, the pigtail leads should be brought through the terminal and bent over the terminal end.

(b) Where the pigtail apparatus is located on the same side of the panel as the terminal, connect the pigtail leads by wrapping approximately one full turn around the terminal.

(c) The connecting wires (other than pigtail leads) should be connected in a manner similar to the pigtail leads.

(d) Where surface wiring and/or pigtail leads are to be connected and it is necessary to provide for future connections, such as installer wiring, connect the surface wiring and/or pigtail leads to the inner end of the terminal.

(e) Some spun-in terminals do not have the wiring-retaining ridges shown. In such cases, the same relative locations for the wires, as described above, should be followed.

(f) On slotted spun-in terminals, connect wires in the same relative locations as described above except that pigtail connections may be made through the slot in the terminal.

11.03 ***Stand-off and Grooved-Type Terminals:*** Connect wires as shown in Fig. 13 using one full turn of wire.

11.04 ***Soldering and Unsoldering Wrapped Connections:*** See Section 069-132-811.

12. PIGTAIL APPARATUS

12.01 Pigtail apparatus such as electrolytic capacitors, carbon and composition resistors, thermistors, and diodes are usually mounted by means of their wire terminals (pigtails). In general, apparatus of this type can be damaged by excessive heat during a soldering operation, either by heat being transferred to the apparatus body by conduction through the pigtail or by holding the soldering copper in close proximity to the apparatus. When soldering leads are closer than 1/2 inch from the body of the component, a heat-conducting device is recommended to restrict the heat flow into the pigtail apparatus. To further aid in keeping the amount of heat to a minimum, use a high tin content solder such as the 60-40 percent solder which has a low melting range.

13. ELECTRON-TUBE SOCKETS

13.01 In order to prevent damage or misalignment of the contacts on electron-tube sockets as well as to reduce the possibility of overheating the contacts and body material, use a wiring plug during the wiring and soldering operations. For subminiature sockets, use a wiring plug such as the JE-8 wiring plug as supplied by the Star Expansion Products Company. For 7- or 9-pin miniature sockets, use the JE-9 or -10 wiring plug, respectively. For KS-16466 or similar 9-pin jumbo sockets, use the KS-19454 plug (equivalent to JE-18 wiring plug).

14. UNSOLDERING CONNECTIONS

14.01 Remove all surplus solder from the soldering copper by wiping against an approved wiping pad. Place the copper against the connection to be unsoldered, and remove as much of the solder from the soldered connection as can be drawn off on the copper.

14.02 Using a pair of ◆B◆ long-nose pliers and keeping the hot copper on the connection, grasp the wire to be removed a short distance back of the terminal. Apply a light, steady pull to the wire until it becomes unfused from the soldering surface. Then carefully unhook or unwrap the wire to disengage it from the terminal. ***Exercise extreme care not to flip or spatter the solder.*** Disconnecting a wire by melting the solder and jerking it free from the terminal may result in personal injury or damage to nearby equipment.

14.03 After removing the wire from the terminal, remove all excess solder from the terminal using the soldering copper and an orange stick or spudger.

14.04 Solder-wrapped connections need not be unsoldered to remove the connection. Cut the wire as described in Section 069-132-811.

15. TEST AND INSPECTION OF ELECTRIC SOLDERING COPPERS

15.01 An electric soldering copper may break down internally in such a way that the metal parts of the copper become crossed with

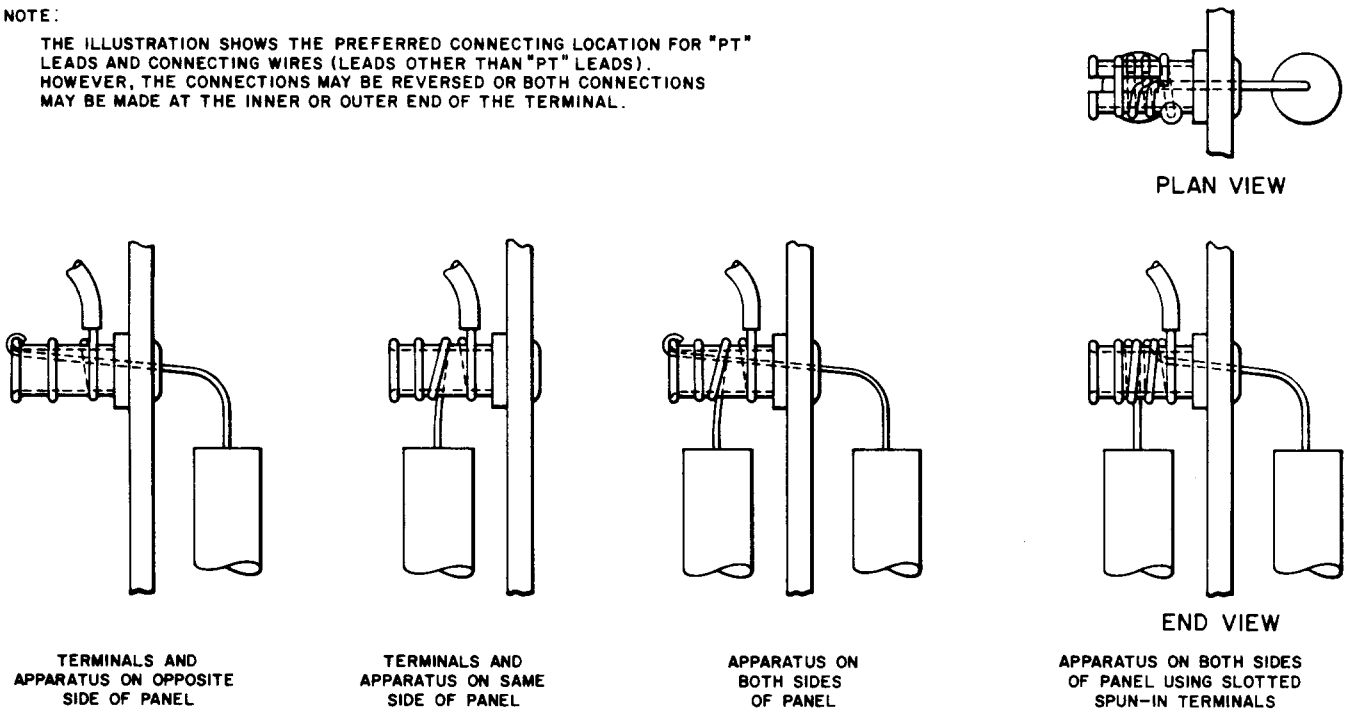


Fig. 12—Plier Connections to Spun-in Terminals (Solder Not Shown)

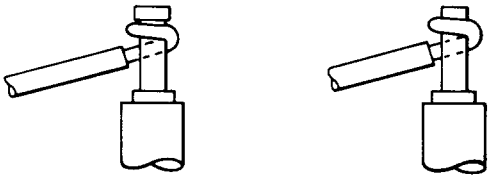


Fig. 13—Stand-off and Grooved-Type Terminals (Solder Not Shown)

the heating circuit. Also, the insulation of the power cord may become frayed and defective. Since these conditions may result in personal injury or equipment damage, tests and inspections should be made in accordance with the appropriate section in Division 075.

16. PRECAUTIONS

16.01 Do not "whip" solder from coppers because of the possibility of personal injury or damage to nearby equipment.

16.02 Judge the temperature of soldering coppers by applying a piece of solder on the tinned surface of the tip and observing whether or not the solder melts.

Caution: Do not hold the copper near the hands or face to test its temperature as serious burns may result.

16.03 Wear safety goggles when cleaning terminals and unsoldering wires where there is a possibility of being struck in the face by flying solder.

16.04 Do not place a warm or hot copper on the floor, equipment, or in any other place except in the guard or holder or on the rest provided for this purpose.

16.05 Do not remove a copper from its holder to store it, as in a locker, until it has thoroughly cooled.

16.06 Wherever possible, use the connecting bag to protect the equipment.

16.07 Avoid striking the point of the tip forcibly against any surface; for example, when inserting the copper into a 504A or similar holder.

This will prevent damage to the iron coating as well as blunting the point of either the ironclad or insulated tip. In addition, the dielectric coating of an insulated tip may become chipped which renders the dielectric ineffective.

16.08 It is not possible to do satisfactory work with a dirty or stubby copper. Neither is it possible to satisfactorily solder a connection on which either the wire or terminal has not been properly cleaned.

16.09 Do not disturb a newly soldered connection until the solder has thoroughly cooled to avoid causing a poor connection.

16.10 Exercise care not to bring a hot soldering copper into close proximity to fire-detection wiring.

16.11 Exercise care not to bring a hot soldering copper into close proximity to semiconductor devices, such as transistors, diodes, etc, as they can be damaged by excessive heat.

16.12 When soldering on pigtail apparatus, avoid overheating. (See 12.01.)

16.13 When soldering to electron-tube contacts, exercise care not to misalign or overheat the contacts. (See 13.01.)