CABLING METHODS
SOLDERING

CONTENTS PAGE

1. GENERAL

1.01 This reissue is presented to provide a more comprehensive analysis of soldering operations encountered in central office installations. Marginal arrows have not been used because of the vast number of changes. Remove and destroy all copies of Section 256-010-201, Issue 2 **General** System Practices.

1.02 Soldering is the process of fusing three metals (wire, terminal, and solder) and is brought about by the application of molten solder in the presence of a flux. This bond is accomplished by raising the temperature of the wire and terminal to the melting point of 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 pre-tinned to permit the soldering action to take place at temperatures permissible for soldering coppers used on telephone apparatus. Before soldering, all wires, leads, and terminals must be sufficiently clean to permit quality soldering and be free of excessive oxides, dirt, grease, oilfilms, and other contaminants which would inhibit good soldering.

2. TOOLS AND SOLDERING APPARATUS

2.01 The following is a list of tools or equivalent and equipment described in this section:

(a) Bag, Connecting

(b) Bag, Soldering

(c) Brush, Non-Met, Flat

(d) File, ***Corn*** bination

(e) Goggle, SAT, One-piece

(f) Hammer, Claw 20 oz.

(g) Holder, Iron, Solder

(h) Iron, Soldering, 60 WATT 1/4 ”

(i) Mat, Installers

(j) Plier, Longnose

(k) Sink, Heat

(l) Spudger, Pencil

(m) Stick, Probing

(n) Tip, Soldering Iron

(o) Tool, Soldering Iron Cage

3. PREPARATIONS

3.01 Exercise extreme care while using the tools associated with these operations so as to prevent personal injury and possible damage to the equipment.

3.02 Before soldering, protect equipment beneath and adjacent to work location from falling solder and wire ends with connecting bag and installer’s mat and, where necessary, a piece of sheet fiber. When making additions to existing terminal blocks already carrying working circuits, use sheet fiber as illustrated in Figure 1.

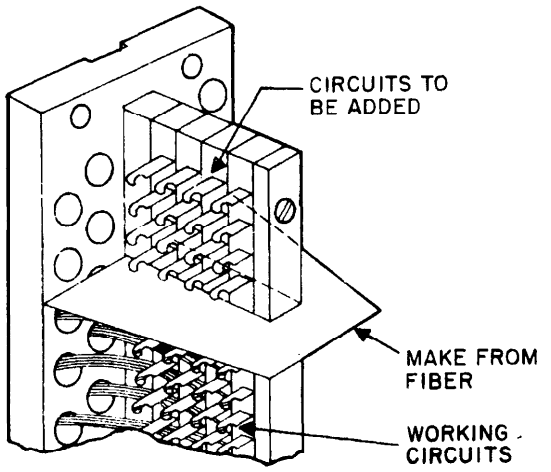


Figure 1. Protecting Working Circuits with Sheet Fiber.

3.03 Temporarily remove frame work details that may block connecting and soldering operations. For example: removal of guard rail from horizontal side of a distributing frame facilitates connecting wires to bottom rows of terminal blocks on block underside.

3.04 Before soldering, observe if any portion of the connecting wire insulation is in contact with the terminals. If so, place that portion slightly away from the particular terminal against which the insulation is in contact. Use a spudger or orange stick for this operation.

3.05 The properly soldered connection must have the connecting wire insulation close to, but not touching the terminal and not more than 3/32" away from the terminal.

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

3.07 A high tin content solder, 60/40 per cent, has been found satisfactory for all Central Office soldering operations. This 60/40 per cent solder, 60 per cent tin and 40 per cent lead, provides faster soldering, little heating of the object being soldered, and reduces cold solder joints.

3.08 When soldering untinned wires or terminals, the tinning of the surfaces preliminary to the fusing of the elements requires that the solder be applied to the connection as it approaches the melting point of solder. The same principle applies when tinning the tip of a soldering iron.

4. TINNING AND CARE OF THE SOLDERING COPPER

4.01 The soldering copper, (tip), in many cases, will come in a pre-tinned condition. The only requirement prior to using this tip is to flow solder onto it, allow the solder to remain for about 2 minutes and then wipe off this solder on the approved wiping pad. Flow another small amount of solder on the tip and then begin working.

4.02 Through use, the copper (tip) may become misshapen, and the surface become pitted eventually destroying the tinning.

4.03 Inspect the soldering iron and form and dress the tip, as necessary, before each job.

4.04 Should the tip become bent **or** badly pitted, reshape it as follows:

(a) Remove the tip from the iron.

(b) Using a hammer and a hard surface, such as the anvil portion of a vise, hammer the tip until it is straightened.

(c) Once the tip is straightened, continue hammering it until all of the large pits have been removed.

(d) With a cross-cut file, remove any irregularities and remaining small pits.

(e) Continue to dress the tip until it conforms, as closely as possible, to its original shape, as seen in Figure 2.

4.05 Before any soldering is done, non-oxide copper tips (See 4.05(c) Note) should be properly tinned as follows:

(a) File the tip smooth on all sides and on the end.

(b) Place the tip in the iron, and heat the copper (tip) to soldering temperature. Quickly file the side of the tip which

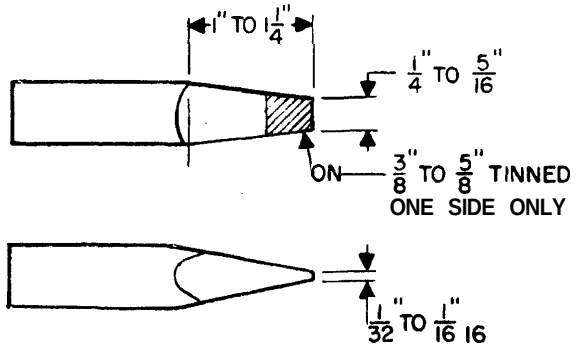


Figure 2. Shaping Plain Copper Tips.

was previously cleaned and apply rosin core solder until the surface is well tinned. The flux in the solder loosens the oxides on the tip and the fresh solder covers and tins the tip of the iron. Remove the loose oxides and excess solder by drawing the tip across the approved wiping pad or by using the soldering bag. See Figure 3. Rotate the iron with each stroke so that all sides of the tip are cleaned.

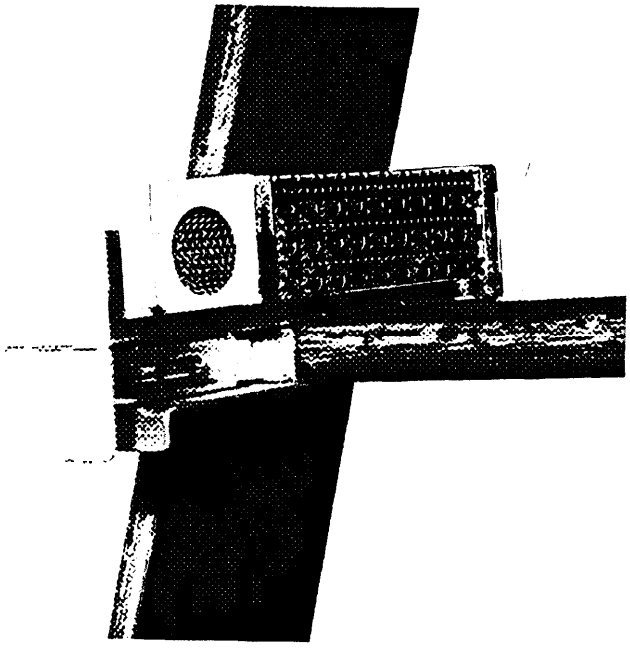


Figure 3. Soldering Iron Cage Equipped with Wiping Pad.

(c) Only one side of the tip should be tinned. The tinned area, approximately 3/8", may be confined by rubbing the untinned portion of the tip of the hot copper with a rubber eraser.

NOTE: Ceramic coated tips are not to be reshaped or dressed by pounding or filing. These tips are to be wiped clean on the approved wiping pad and then retinned.

4.06 At least once each day, remove the soldering iron tip to prevent. it from becoming frozen in the iron as a result of high oxidation of the copper tip. This should be done while the iron is still hot.

4.07 Before replacing a soldering copper (tip) in a holder, remove any excess solder on the tinned side of the tip. If the tip is reheated the excess solder will tend to cause pitting. The surplus solder may be removed by wiping the tip on the approved wiping pad.

4.08 Keep soldering tips clean and free from accumulations of rosin and burned insulation. Such accumulations may interfere with the soldering operation, and fires may be caused by incandescent particles of carbon falling from the tip onto insulation or clothing.

5. PRECAUTIONS

5.01 To maintain a high degree of safety while performing the soldering operation, the installer shall apply the following practices:

(a) Do not "whip" solder from copper (tip) because of the possibility of personal injury or damage to nearby equipment. Use an approved wiping pad or soldering bag to clean excess solder from the iron tip. The approved soldering iron holders are equipped with wiping pads.

(b) Do not hold the copper (tip) near the hands or face to test its temperature as serious burns may result. 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.

(c) Do not solder, unsolder or clean terminals or wires without wearing safety goggles.

(d) Do not bring a hot soldering copper (tip) into close proximity to fire detection wiring.

(e) Do not bring a hot soldering copper (tip) in close proximity to semi-conductor devices such as: transistors diodes, etc. These devices can easily be damaged by excessive heat.

(f) Do not solder components attached by means of their wire leads: diodes, resistors, etc. without using a heat sink, pair of long nose pliers or similar heat absorbing material between the heat source and the component.

(g) Do not strike the point of the tip forcibly against any surface such as might occur when inserting the copper (tip) into a soldering iron holder.

(h) Do not place a warm or hot copper (tip) on the floor, equipment or in any other place except in the cage or holder.

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

6. PROCEDURE

6.01 The soldering copper (tip) may be held in the following manner:

(a) The hand grip, shown in Figure 4, may generally be found applicable on horizontal terminals such as those on the vertical side of a distributing frame.

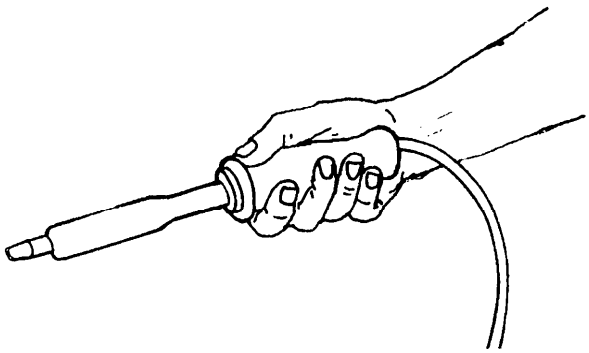


Figure 4. Hand Grip Method of Holding Soldering Copper.

(b) The pencil grip, shown in Figure 5, may generally be found applicable on vertical terminals such as those on the horizontal side of a distributing frame.

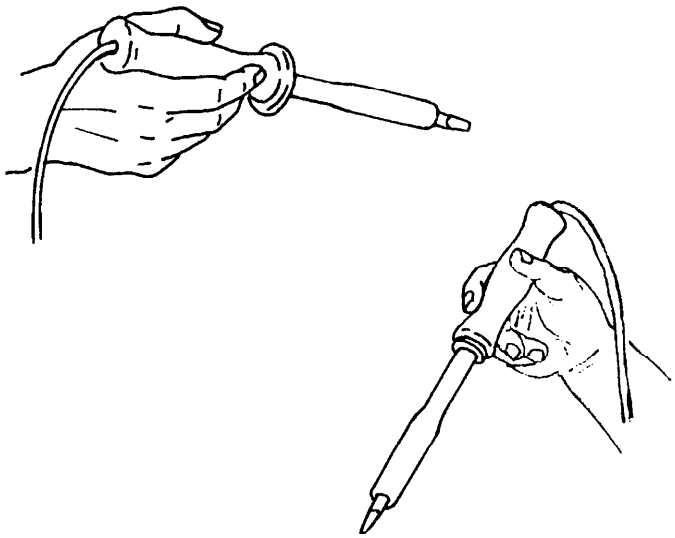


Figure 5. Pencil Grip Method of Holding Soldering Copper.

6.02 The soldering iron should be allowed to heat sufficiently before use. From 10 to 20 minutes is required to heat a cold soldering iron to a sufficient temperature for satisfactory soldering.

6.03 Always use a hot iron when soldering to prevent cold solder or rosin joints. These occur when the wire and the terminal are not hot enough for the solder to properly adhere. Always maintain the soldering surface of the tip in a tinned condition.

6.04 Figure 6 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 (tip).

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

(c) Improper manipulation of copper (tip).

(d) Untinned or unclean terminal or wire.

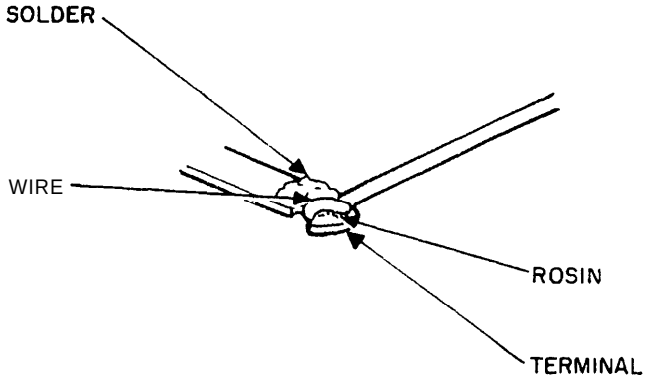


Figure 6. Example of Improperly Soldered Connection.

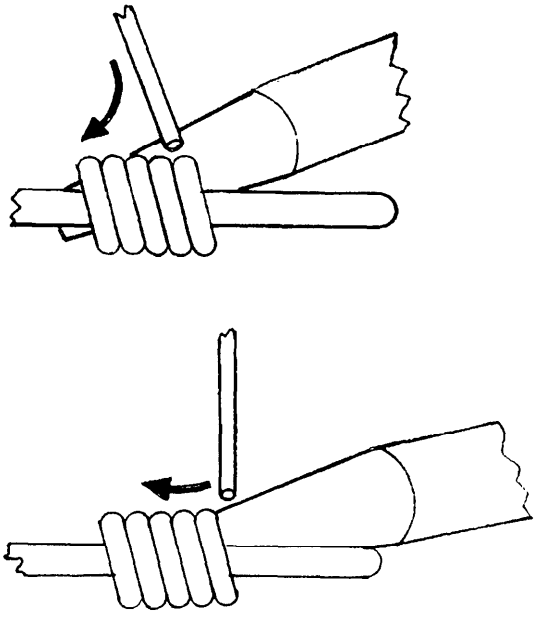
6.05 If a good soldered connection does not result from the first soldering effort, allow a short waiting period for connection to cool before reapplying heat. Be sure that connections are free from dirt and foreign matter before soldering. Do not hold the soldering iron tip on connections for extended periods of time.

6.06 Before soldering, apply a small amount of solder to the tip of the iron. This allows the heat to be conducted to the terminal more readily. Remember to melt only a small portion of the solder on the iron as the flux will burn off without cleaning the connection. This will result in a lumpy, cold solder joint.

6.07 Apply the flat soldering surface of the adequately heated soldering iron directly against the terminal and wire (Figure 7). This positioning of the iron is necessary to get almost instantaneous heating of the connection. Remember to get as much contact as possible between the flat side of your iron tip and the connection.

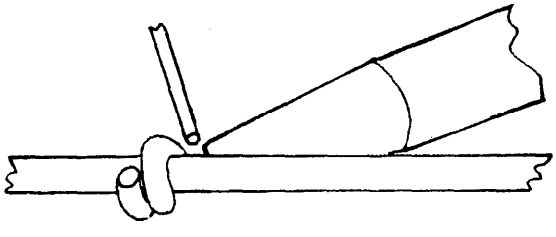
6.08 While holding the iron on the connection, apply a moderate amount of solder at the exact point where the tip of the iron contacts the connection (Figure 8). This will quickly transfer more heat from the iron tip to the connection. Remember to melt a minimum amount of solder. It is easier to add more solder, if necessary, than to remove excess solder.

6.09 Continue feeding additional solder to the connection but only after shifting the cored solder slightly away from the tip of the iron so that the connection itself will melt the solder.

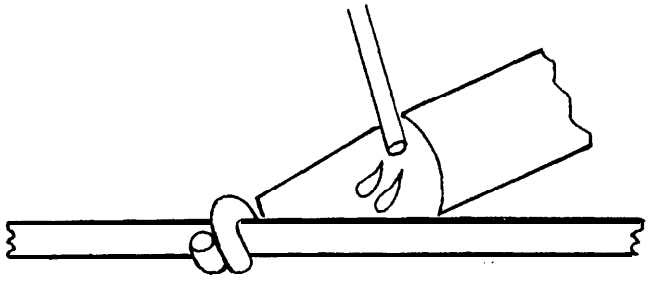


NOTE:
METHOD USED DEPENDENT ON JOB. ALWAYS USE A WIPING MOTION TO MOVE THE SOLDER FROM A POINT ON THE IRON CLOSE TO THE CONNECTION ONTO THE CONNECTION ITSELF.

Figure 7. Methods of Applying Soldering Copper to Connection.



GOOD LOCATION OF SOLDER



POOR LOCATION OF SOLDER. 00 NOT LET SOLDER ROLL DOWN THE IRON **ONTO** THE CONNECTION.

Figure 8. Method of Applying Solder to Connection.

6.10 Watch closely when feeding solder into the connection so that you will be able to quickly judge at what point you have fed an adequate amount of solder onto the connection. The instant that you have determined that adequate solder has been applied, quickly pull the solder out of contact with the connection. However, continue to hold the iron on the connection until you see a smooth solder flow. At this time move the iron forward over the terminal so that the solder completely covers the wire leaving solder fillets on each side of the wire (Figure 9). When you see this complete, smooth solder flow, quickly remove the soldering iron bringing with it any surplus solder (Figure 10).

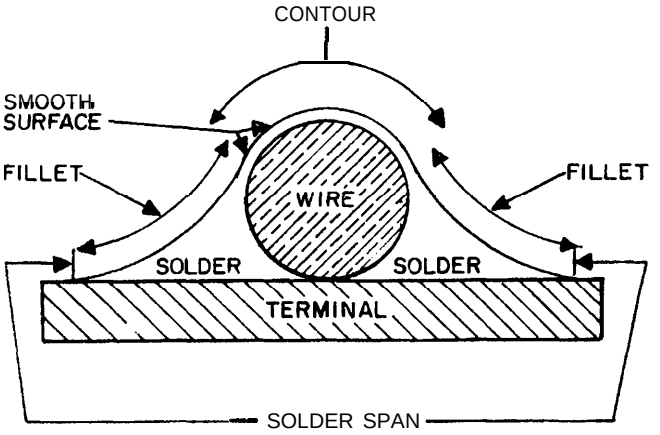


Figure 9. Characteristics of a Good Soldered Joint.

6.11 Only a small amount of solder is needed to make the joint illustrated in Figure 9 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 and possibly inadequate connection.

6.12 While soldering, excess solder and oxides will gradually build up on the soldering copper tip. Suddenly most of this excess solder will move onto one of the connections. The buildup of solder on the connection could cause shorting of the terminals. To prevent this solder buildup, you must clean the copper at frequent intervals on the wiping pad or by using the soldering bag. Rotate the iron so all sides are cleaned.

6.13 Improper soldering technique on vertical terminals may result in a cross or short circuit between adjacent terminals, as shown in Figure 11. Sometimes the excess solder settles between sections of the terminal strip causing a cross "X", as shown in Figure 12. Carelessly applying too much solder to a connection can easily create a defect called "solder bridging" or "solder short" (Figure 13). Should this occur, refer to Paragraph 7.05.

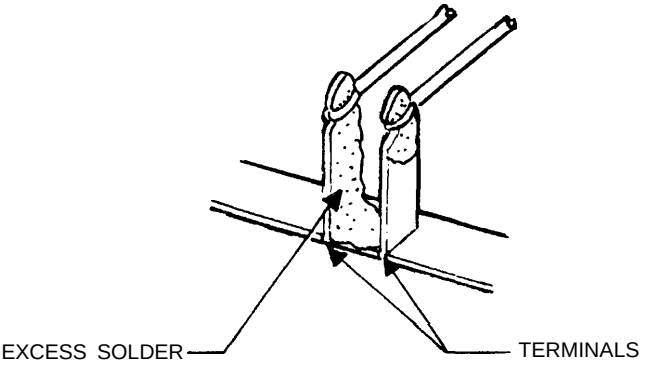


Figure 11. Excessive Solder on Vertical Terminals

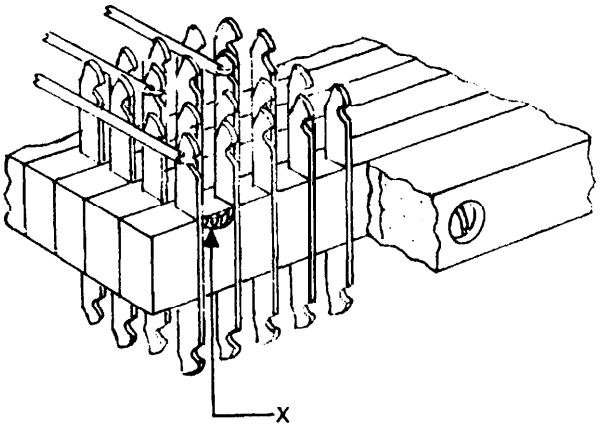


Figure 12. Excessive Solder Causing Cross "X" Short

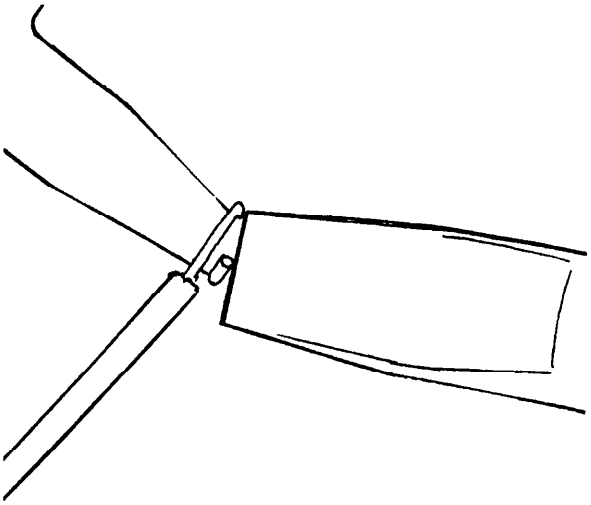
6.14 It is essential that the wire be connected so that it is in the proper position and rests firmly against the terminal.

6.15 Do not disturb a newly soldered connection until the solder has thoroughly cooled to avoid causing a poor connection. The "disturbed" or "fracture" joint is recognized by sharp fracture lines on each side of the wire indicating that the wire, terminal and solder are not joined.

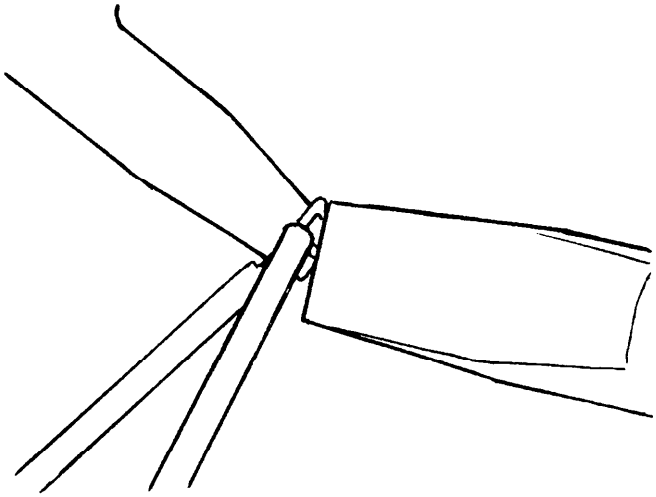
6.16 The point of soldering is generally on the right side or on the top of the terminal.

6.17 The soldered connection should have a smooth clean appearance. There should be no dirt embedded in the solder. The "color" will

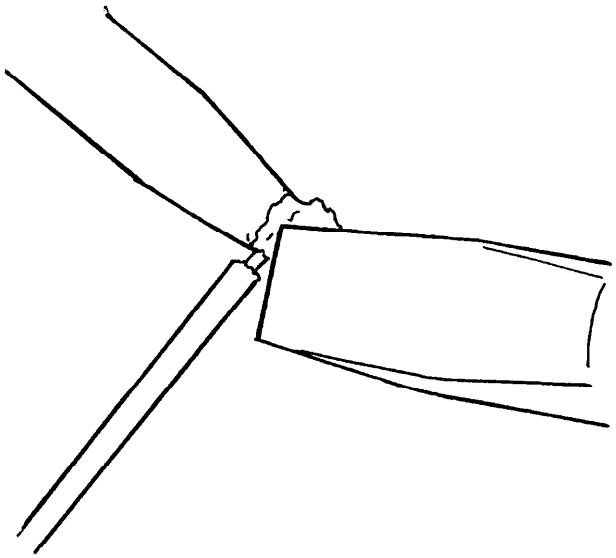
REVIEW OF SOLDERING STEPS



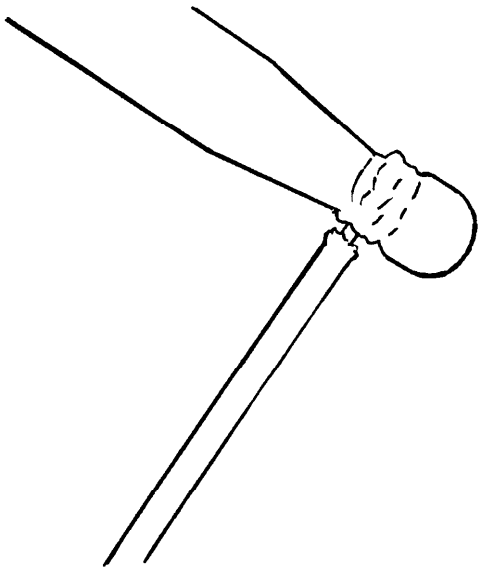
1. CAREFULLY POSITION THE IRON ON THE CONNECTION, WITH AS MUCH CONTACT AS POSSIBLE. AVOID TOUCHING THE INSULATION.



2. APPLY SOLDER TO THE CONNECTION. FEED ONLY ENOUGH TO COVER THE CONNECTION.



3, WITHDRAW SOLDER ONLY. WITH THE IRON ON THE CONNECTION, WATCH FOR PROPER SOLDER FLOW.



4. WITHDRAW THE IRON WITH A WIPING MOTION TO SMOOTHLY COVER THE WIRE AND REMOVE ANY SURPLUS SOLDER.

Figure 10. Review of Soldering Steps.

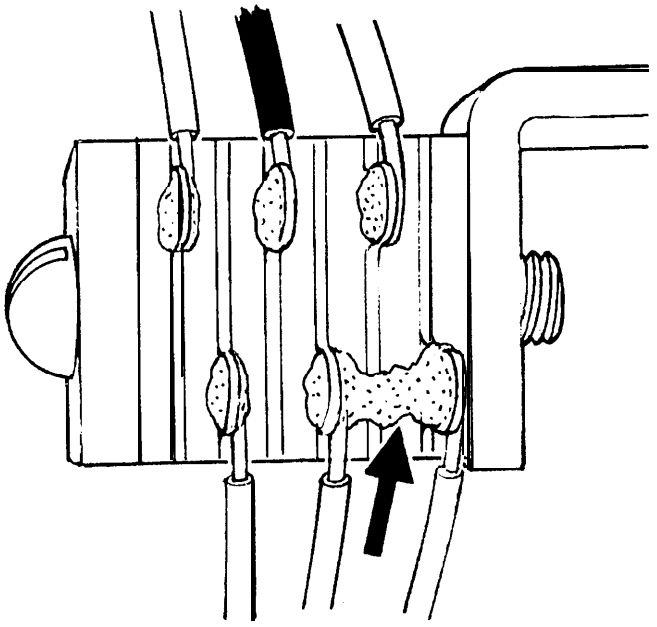


Figure 13. Solder Bridge or Short

vary from fairly bright to a slightly frosted appearance. An excessively frosted appearance could indicate a defective connection. A better guide as to whether it is a good soldered connection is to look for a smooth flow of solder rather than "color" or "shine". (The outline of wire must be visible with smooth solder fillets on both sides.)

6.18 After soldering, remove all unsightly flux so that the soldered connection is neat and clean. Examine each soldered connection as the work proceeds to make sure that the proper wire has been connected to the proper terminal and that each connection is acceptable.

6.19 Examine the terminals and blocks around your work for excess solder and splashes. Remove any excess solder and correct any potential trouble.

Soldering Wire to Notched Terminals

6.20 Wrap all wires and jumpers so that the solder will be on the top of the terminal on vertical terminal blocks or on the right side of the terminal on horizontal terminal blocks as seen from the front of the block (Figure 14).

6.21 Make sure that the wire remains flat on the terminal so that it will be fused directly to the terminal. A wire surrounded by solder results in a mechanically weak connection.

6.22 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. Next, apply the tip to the terminal and wire. 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 Figure 14, Step 2.

NOTE: When soldering connections made with wires of gauges larger than those of distributing frame wire, such as No. 16AM wire, a longer period of time must be allowed for heating the wire and terminal so that the molten flux will flow over the heated wire. Experience will dictate 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 on 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 (tip) is sufficiently hot. On the other hand, the connection should be soldered and the copper (tip) removed from the terminal as quickly as possible so that insulation on the wire will not be damaged.

6.23 Ideally, the notch of the pin should be filled behind the wire only; but as the wear on the tip increases, this is harder to achieve and the whole notch may be filled. At no time, however, should the solder in the notch be allowed to extend past the ends of the notch.

Soldering Wire to Perforated Terminals

6.24 Perforated terminals are those on which the wire is brought through the hole, such as: equipment units, jacks, and lamp sockets. The method of soldering is the same as that for notched terminals; however, sufficient solder should be used to fill the hole. This insures that a good electrical and mechanical connection has been made (Figure 15). 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.

6.25 When soldering perforated terminals, withdraw the soldering tip from the terminal in such a way as to draw off excess solder (Figure 16).

Soldering Wire to Tubular Terminals

6.26 When soldering connections to tubular terminals, as illustrated in Figure 17, the tip of the copper is first applied to the wire and a small amount of solder is applied to the wire. The copper is then held against the terminal until solder can be flowed into the tube. While the solder in the tube is molten, the wire is pushed into the tube and held in place until the solder hardens.

6.27 When soldering connections to "cut-away tubular" terminals, such as on "U.S. Components Co. " plugs and connectors (Figure 18), the wire should be inserted into the tubular portion of the terminal and the solder flowed into the terminal to fill the cut-away portion (Figure 19).

Soldering Wire to Spun-In, Stand-Off, Turret or Cylindrical Terminals

6.28 When the connection is made by wrapping the wire around the terminal (Figure 20), the turn nearest the insulation should be soldered

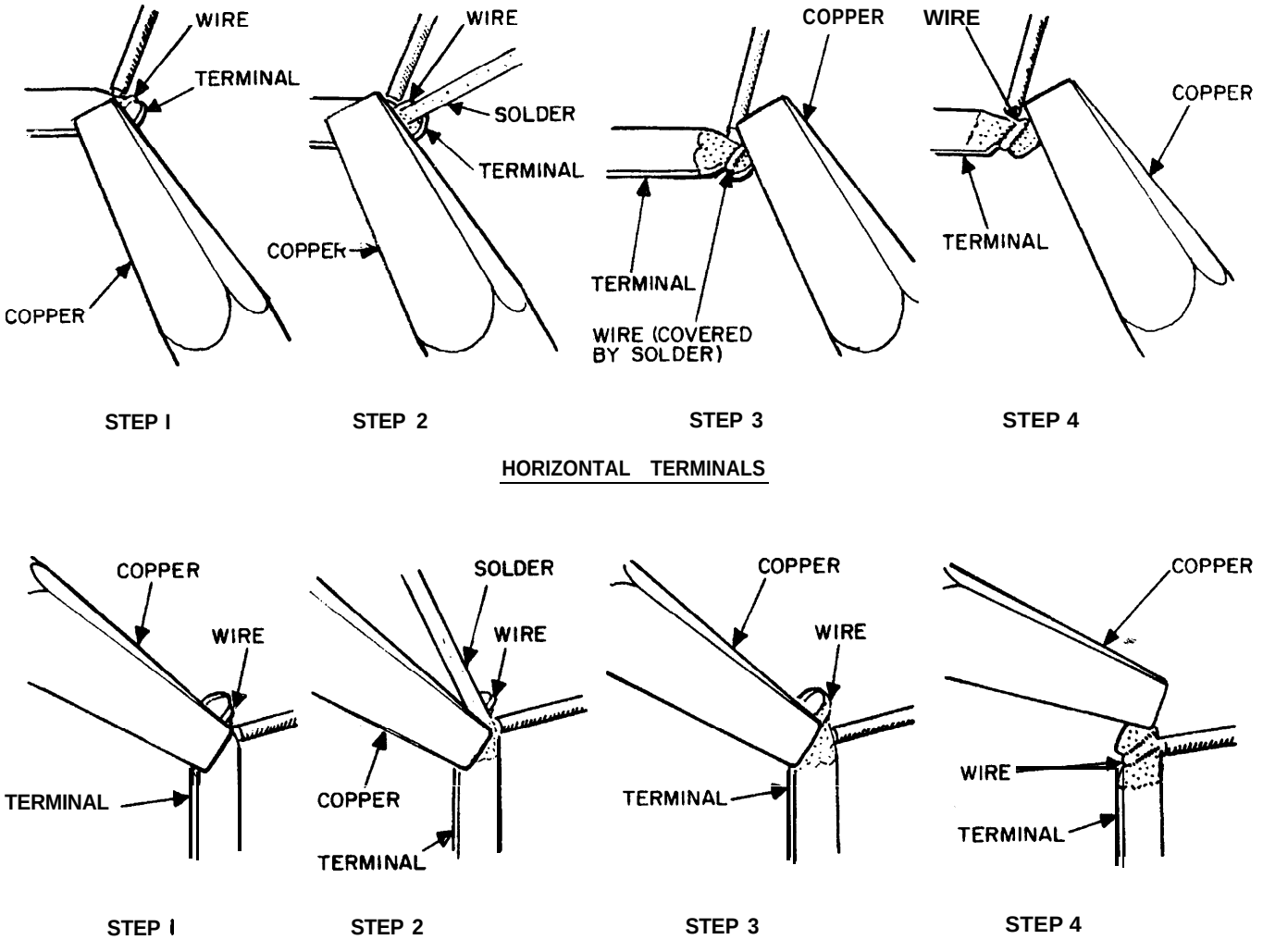


Figure 14. Soldering Wire to Notched Terminals

for at least one half of the circumference of the terminal.

6.29 When soldering connections to stand-off terminals such as the 202 type which has the terminal insulated from its mounting stud by means of insulating material, use special care to avoid overheating. Excessive heat may loosen the terminal from the insulating material.

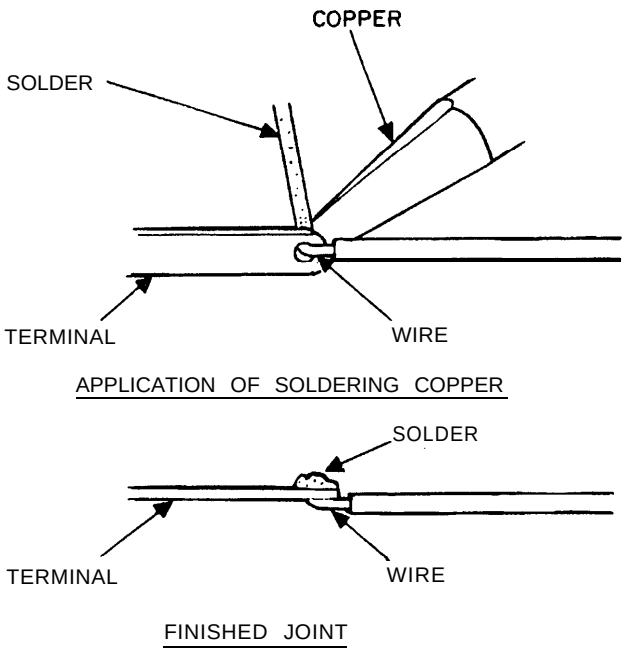


Figure 15. Soldering Wire to Perforated Terminals

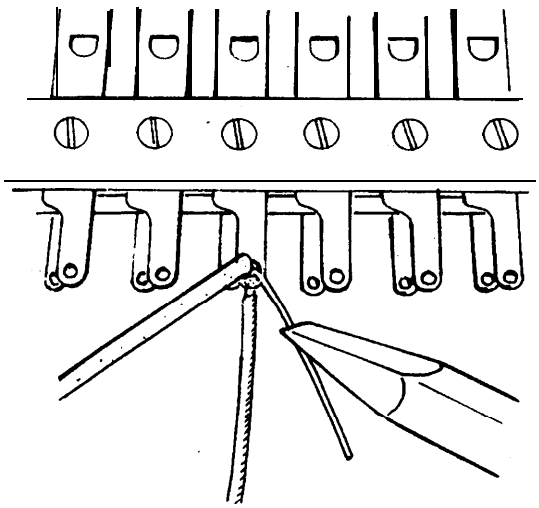


Figure 16. Withdrawing Iron from Perforated Terminal

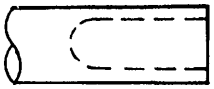


Figure 17. Tubular Terminal

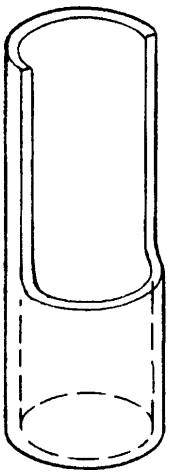


Figure 18. Cut-Away Tubular Terminal

Soldering Components Attached by Wire Leads

6.30 Electrolytic capacitors, carbon and composition resistors, thermistors and diodes, are usually mounted by means of their wire terminals. In general, apparatus of this type can be damaged by excessive heat during the soldering operation either by heat being transferred to the body of the component by conduction or by holding the soldering copper (tip) in close proximity to the component. To dissipate the heat when soldering leads of the component, the placing of a heat absorbing device (heat sink) between the body of the component and its connection is recommended. A convenient method is to grasp the lead with long-nose pliers during and for a short time after the soldering operation. To further aid in keeping the amount of heat to a minimum, use a high tin content solder which has a low melting range and use the 60 Watt soldering copper with a 1/4" tip.

7. UNSOLDERING CONNECTIONS

7.01 Wear safety goggles when unsoldering connections to prevent being struck in the eye by spattered solder.

7.02 Remove all surplus solder from the soldering copper by using a soldering bag or by wiping the tip on an approved wiping pad. Place the copper (tip) against the connection to be unsoldered and remove as much excess solder as can be drawn off on the copper.

7.03 Using a pair of long-nose pliers and keeping the hot copper (tip) 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, and 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.

7.04 After removing the wire from the terminal, remove all excess solder from the terminal using the soldering copper (tip) and an orange stick or spudger. Brush the area to be cleaned with the 1" flat brush to remove any accumulation of solder or foreign material.

7.05 Where excess solder has built up on a connection causing a short as in Figure 13, remove the solder as indicated in Paragraph 7.04.

7.06 Take particular care to see that loose solder or pieces of wire are not left on terminals or blocks.

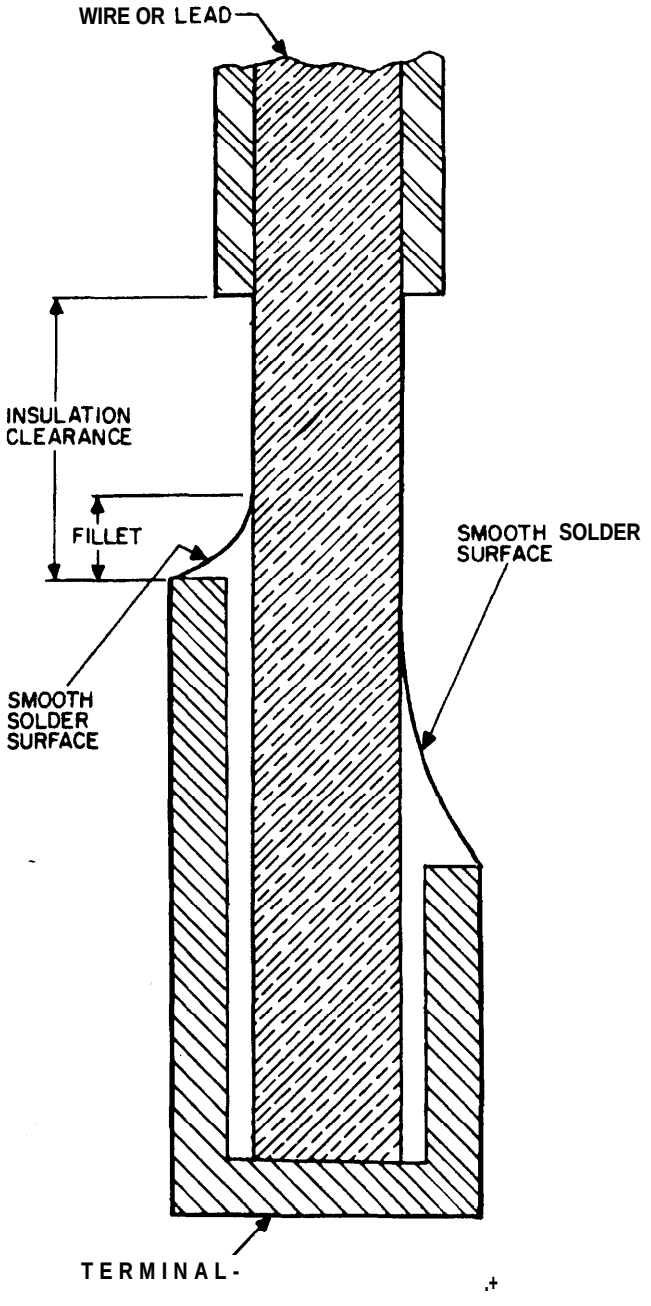


Figure 19. Characteristics of a Good Soldered Joint for a Cut-Away Tubular Terminal.

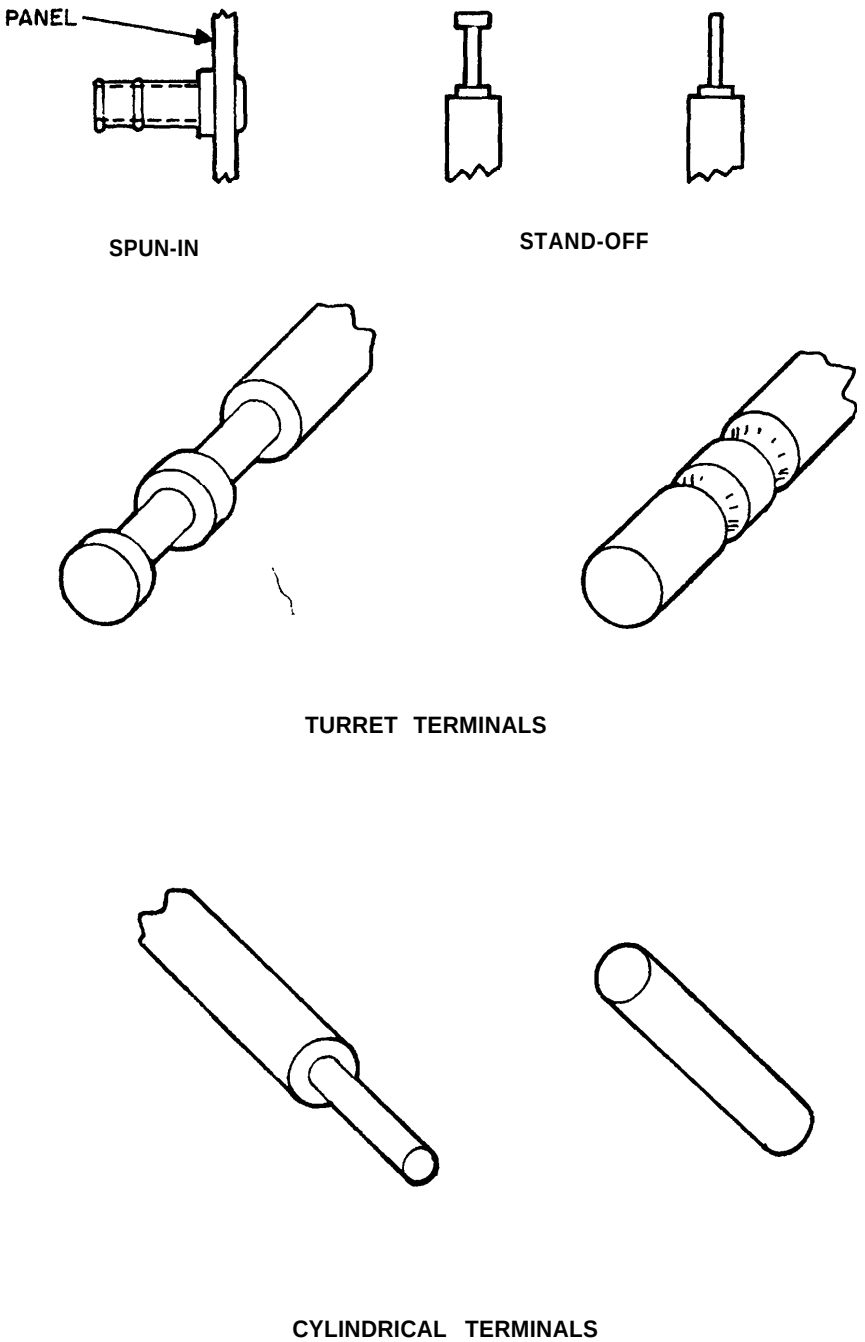


Figure 20, Spun-In, Stand-Off, Turret and Cylindrical Terminals.