

SOLDERING METHODS

1. GENERAL

- 1.01 This practice covers the method of making and removing soldered connections, the use of soldering irons, and safety precautions that must be observed during soldering operations. This practice replaces CTSP 400-300-006.
- 1.02 Soldering is the process of fusing three metals (wire, terminal, and solder) by the application of molten solder. This bond is made by raising the temperature of the wire and terminal to the melting point of solder. The rosin flux in the solder excludes air during the heating which minimizes oxidation. Before soldering, the terminals and wires must be thoroughly cleaned of all enamel, grease, dirt, and oxides.
- 1.03 It is essential that the wire is connected so that it is in the proper position and rests firmly against the terminal. A properly soldered connection will have a definite, thin strip of solder on both sides of the wire to form a secure mechanical connection and a good electrical connection. See Figure 1.

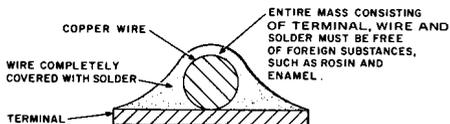


FIGURE 1. Cross Section of a Properly Soldered Connection

- 1.04 The point of soldering is generally on the right side or on the top of the terminal.
- 1.05 When soldering neoprene or plastic insulated wire, considerable care shall be taken that the copper soldering tip or other heat source is not applied to the connection any longer than necessary to make a good connection; these materials have a tendency to recede with excessive heating.
- 1.06 Do not allow neoprene and plastic insulated wire without a textile covering to come in direct contact with another terminal which is being soldered. Special care shall be taken to avoid even momentary contact between the copper soldering tip (or other heat source) and the insulation of these types of wire.
- 1.07 Methods of holding soldering irons are:
- The hand grip is generally found applicable on horizontal terminals such as those on the vertical side of a distributing frame. See Figure 2.
 - The pencil grip is generally found applicable on vertical terminals such as those on the horizontal side of a distributing frame. See Figure 3.



FIGURE 2. Hand Grip Method of Holding Soldering Iron

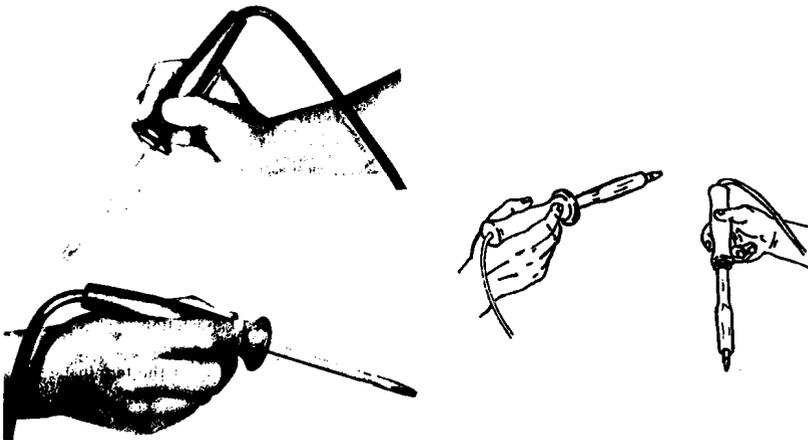


FIGURE 3. Pencil Grip Method of Holding Soldering Iron

2. TOOLS AND MATERIALS

2.01 The following tools and materials are required to perform the soldering procedures outlined in this practice:

- a. Soldering iron holder (includes wiping pad).
- b. Soldering iron, 100 watts.
- c. Soldering iron (Ungar).
- d. Orange stick.
- e. Spudger.

- f. File.
- g. Safety goggles or safety glasses, one piece clear plastic lenses.
- h. Longnose pliers.
- i. Distributing frame bag.
- j. Aloxite cloth (emery cloth).
- k. Solder, rosin core, 40/60 (40% tin, 60% lead).

3. SAFETY PRECAUTIONS

- 3.01 Do not *flip* solder from the soldering iron; personal injury or damage to nearby equipment may result.
- 3.02 Judge the temperature of the soldering iron by applying a piece of solder on the tinned surface of the tip and observing whether or not the solder melts.

CAUTION: Do not test the temperature of the iron by holding it near hands or face; serious burns may result.

- 3.03 Safety goggles or glasses shall be worn when cleaning terminals and unsoldering wires.
- 3.04 Do not place a warm or hot soldering iron on the floor, equipment, or in any other place except in the guard or holder or on the rest provided for this purpose.
- 3.05 Do not remove a soldering iron from its holder to store it (as in a locker) until it has thoroughly cooled.
- 3.06 Wherever possible, use the distributing frame bag to protect the equipment below.
- 3.07 When inserting the copper tip into a handle, do not strike the point of the tip forcibly against any surface. This could damage the iron coating, as well as blunt the point.
- 3.08 It is not possible to do satisfactory work with a dirty or stubby copper tip. Also, it is not possible to properly solder a connection on which either the wire or terminal has not been thoroughly cleaned.
- 3.09 To avoid causing a poor connection, do not disturb a newly soldered connection until the solder has thoroughly cooled.
- 3.10 Do not allow a hot soldering iron to come close to semiconductor devices such as transistors, diodes, etc., as they can be damaged by excessive heat.
- 3.11 Avoid overheating when soldering on pigtail equipment. See paragraph 12.
- 3.12 When soldering to electron tube contacts, be very careful not to misalign or overheat the contacts. See paragraph 13.
- 3.13 An electric soldering iron may break down internally in such a way that the metal parts of the iron become crossed with the heating circuit. Also, the insulation of the power cord may become frayed and defective. These conditions could result in personal injury or equipment damage. Refer to paragraph 4 of CTSP 405-700-001 and CTSP 405-700-002 for inspection and maintenance procedures.

4. TYPICAL USES OF SOLDERING IRONS AND SOLDERS

4.01 Typical uses of soldering irons are:

- a. The 100 watt soldering iron is standard for general and continuous use.
- b. The 74-26-081-2 (Ungar) soldering iron should be used where small size, light weight, and quick heating are desirable. This iron 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 a 1/4-inch wide tip. Heater assemblies with 3/16- and 1/8-inch wide tips are also available.

4.02 Typical uses of solders are:

- a. The 40/60 rosin core is generally used to solder wire to terminals.
- b. Solders with greater than 40% tin content are used where heat sensitive equipment or insulation is involved, or where the nature of the soldering operation requires a solder with a lower melting point.

5. SHAPING COPPER SOLDERING TIPS

5.01 Plain copper tips may be shaped by filing. Refer to paragraph 4 of CTSP 405-700-002.

NOTE: IRONCLAD TIPS, INCLUDING THOSE COATED WITH A DIELECTRIC, SHOULD NOT BE RESHAPED.

6. TINNING COPPER SOLDERING TIPS

6.01 Plain copper tips:

- a. File approximately half an inch (3/8" to 5/8") of the surface of one side of the tip until it is bright and clean. See Figure 4.

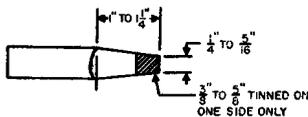


FIGURE 4.

- b. Heat the copper tip to soldering temperature; quickly file the side of the tip which was previously cleaned, then apply rosin core solder until the surface is well tinned. Use a wiping pad to remove any excess solder. Only one side of the tip should be tinned. The tinned area may be confined by rubbing the untinned portion of the tip with a rubber eraser or rubber matting.

NOTE: Continuous heating of an idle iron will destroy the tinned area.

6.02 Before replacing a soldering iron in a holder or on a rest, remove any excess solder on the tinned side of the tip. If the tip is reheated, the excess solder will tend to cause pitting. Surplus solder may be removed by wiping the tip on the wiping pad.

6.03 Ironclad tips:

- a. The ironclad tips are furnished initially with one side of the tip tinned. If the soldering iron is to be idle for an extended period, leave an excess of solder on the tip. To clean the tip, heat the iron and then flow solder over the tip. Rub the tip on the wiping pad to distribute the solder over the tip and to wipe off any excess solder.

NOTE: Do not wipe the tip on anything other than the wiping pad as this may destroy the tinning.

- b. After cleaning the ironclad tip, if it is apparent that retinning is necessary, proceed as follows:
 - (1) While the tip is hot, wipe off as much of the old solder as possible, using the wiping pad. Then allow the tip to cool; otherwise, it cannot be cleaned satisfactorily.
 - (2) When the tip is cold, rub the surface to be tinned on a piece of emery cloth until the surface is bright. Do *not* use a file to clean the tip. Take care to remove as little of the iron as possible as the iron coating is less than 1/64 inch thick. If the iron coating is penetrated, a short tip life will result.
 - (3) When the surface is clean heat the tip and apply solder as it is heating. As soon as the rosin begins to melt, spread the rosin over the surface to prevent it from tarnishing before the solder is melted.
 - (4) As soon as the solder begins to melt, spread the solder over the surface until the desired area is tinned. Rub the tip on the wiping pad to wipe off any excess solder.

7. SOLDERING WIRE TO NOTCHED TERMINALS

- 7.01 Apply rosin core solder to the tip of a hot soldering iron momentarily, leaving a small amount of molten solder on the tip. Apply the tip to the terminal and wire as shown in Figure 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 Figure 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 iron before the solder is applied to the copper tip. This will permit the melted flux to flow over the heated wire. Experience will give the period of time required for heating the wire sufficiently to take the flux and solder; 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 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 to avoid damage to the insulation on the terminal strip.

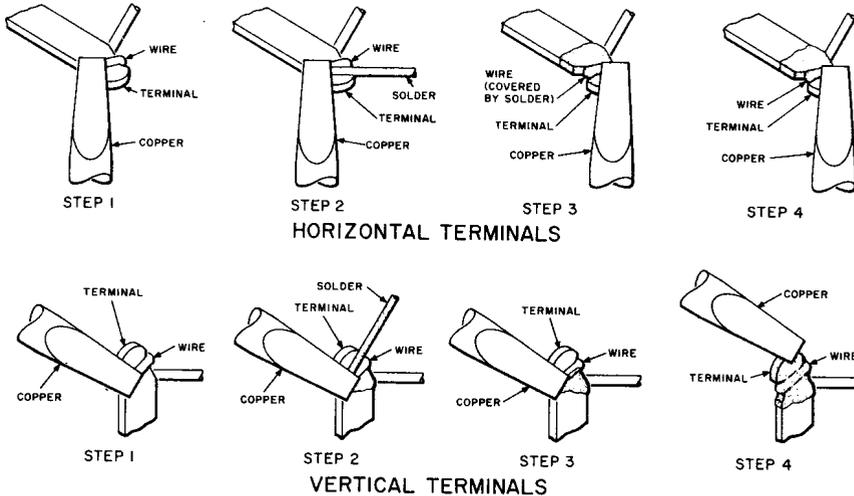


FIGURE 5. Soldering Wire to Notched Terminals

- 7.02 When the solder has melted and flows freely, bring the copper tip down over the terminal with a forward movement so the solder flows over the wire, completely covering it as shown in Figure 5, Step 3. Draw the copper tip off the terminal, carrying with it any surplus solder to leave a clean, smooth joint as shown in Figure 5, Step 4.
- 7.03 Only a small amount of solder is needed to make the joint illustrated in Figure 6, which shows a thin coat of solder spread smoothly over the wire, completely covering it. If too much solder is used, a lumpy connection will result which may cause trouble.

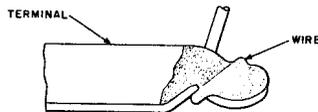


FIGURE 6. Example of Properly Soldered Connection

- 7.04 Improper soldering technique on vertical terminals may result in a cross or short circuit between adjacent terminals as shown in Figures 7 and 8.

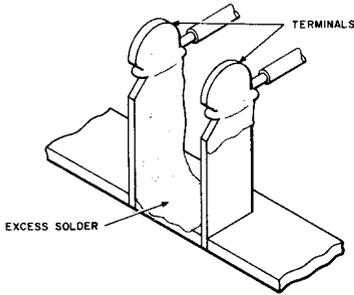


FIGURE 7. Excessive Solder on Vertical Terminals

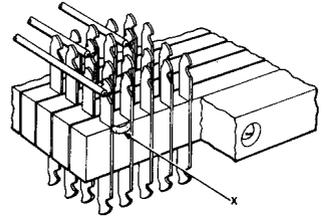


FIGURE 8. Excessive Solder on Terminal Strips

7.05 Figure 9 illustrates an improperly soldered connection; 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 type is due to one of the following causes:

- a. Cold copper soldering tip.
- b. Copper soldering tip held on the connection an insufficient length of time.
- c. Improper manipulation of soldering iron.
- d. Untinned or uncleaned 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 for notched terminals outlined in paragraph 7. Sufficient solder should be used to fill the hole. This ensures that a good electrical and mechanical connection has been made. See Figure 10.

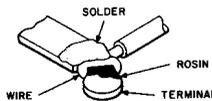


FIGURE 9. Example of Improperly Soldered Connections

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

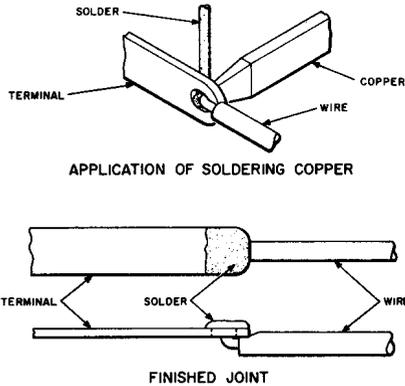


FIGURE 10. Soldering Wire to Perforated Terminals

become covered with solder at the soldered side of the terminals. Where more than two turns have been wrapped, it is necessary to solder only two adjacent turns to the terminal.

10. SOLDERING WIRE TO TUBULAR TERMINALS

10.01 When soldering wire to a tubular terminal, first apply a little solder to the wire with the copper tip. Then, connect and solder the wire to the terminal as outlined in a., b., or c.:

- a. *Skinned End of Wire Folded Back* (Figure 11): When the connection is made by folding back the skinned end of the wire, the length of bare wire from the skinning point to the fold should be slightly less than the depth of the terminal. Insert the folded wire into the tubular portion of the terminal so the spring effect of the folded wire will hold it in place before soldering. Then hold the copper tip against the side of the terminal until the solder can be flowed into the tube.

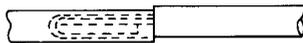


FIGURE 11.

- b. *Skinned End Inserted Without Fold* (Figure 12): When soldering connections to cutaway tubular terminals such as on U.S. Components Co. plugs and connectors, insert the wire into the tubular portion of the terminal and fill the cutaway portion with solder.

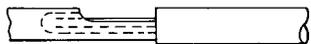


FIGURE 12.

- c. *Wire Wrapped Around Terminal* (Figure 13): 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.

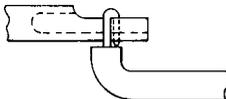


FIGURE 13.

- d. Hold the copper tip against the terminal for another instant; then remove the copper tip and hold the wire in place until the solder sets.

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, completely cover the wire with solder for at least one-half of the circumference of the terminal.

NOTE: When soldering connections to stand-off terminals (terminals insulated from their mounting studs by means of insulating material), take special care to avoid overheating as excessive heat may loosen the terminal from the insulating material.

- 11.02 *Spun-In Terminals*: These terminals are frequently used for mounting pigtail equipment. Make the connections as follows (see Figure 14):

- a. Where the pigtail equipment is located on the side of the panel opposite the terminal, the pigtail leads should be brought through the terminal and bent over the terminal end.
- b. Where the pigtail equipment 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. Connecting wires 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.

NOTE: Some spun-in terminals do not have wire retaining ridges. In such cases, connect wires in the same relative locations as described above. 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 Figure 15, using one full turn of wire.

- 11.04 See CTSP 410-600-420 for the method of soldering and unsoldering wrapped connections.

NOTE:

THE ILLUSTRATION SHOWS THE PREFERRED CONNECTING LOCATION FOR PIGTAIL LEADS AND CONNECTING WIRES (LEADS OTHER THAN PIGTAIL LEADS), HOWEVER, THE CONNECTIONS MAY BE REVERSED OR BOTH CONNECTIONS MAY BE MADE AT THE INNER OR OUTER END OF THE TERMINAL.

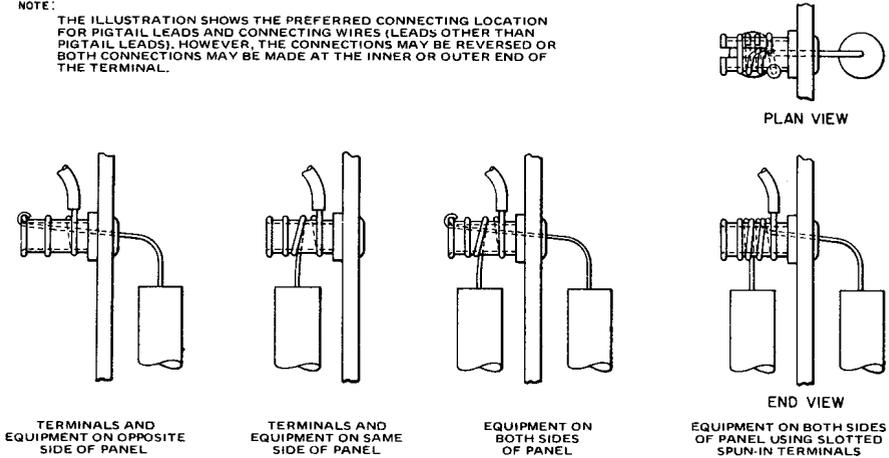


FIGURE 14. Plier Connections to Spun-In Terminals (Solder Not Shown)

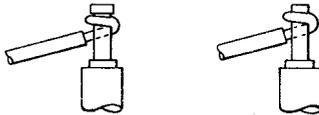


FIGURE 15. Stand-Off and Grooved-Type Terminal (Solder Not Shown)

12. PIGTAIL EQUIPMENT

12.01 Pigtail equipment such as electrolytic capacitors, carbon and composition resistors, thermistors, and diodes are usually mounted by means of their wire terminals. Equipment of this type can be damaged by excessive heat during a soldering operation, either by heat being transferred to the equipment body by conduction through the pigtail or by holding the soldering iron too close to the equipment. When soldering leads closer than one-half inch from the body of the component, a *heat sink* is recommended to restrict the flow of heat into the pigtail equipment. To further aid in keeping the amount of heat to a minimum, use a solder with a high tin content such as the 60-40 percent solder which has a low melting point.

13. ELECTRON-TUBE SOCKETS

13.01 To prevent damage or misalignment of the contacts on electron-tube sockets, and to reduce the possibility of overheating the contacts and body material, use a *heat sink* during wiring and soldering operations.

14. UNSOLDERING CONNECTIONS

- 14.01 Use a wiping pad to remove all surplus solder from the copper tip. Place the copper tip against the soldered connection and remove as much of the solder as can be drawn off on the copper tip.
- 14.02 Using a pair of longnose pliers and keeping the hot copper tip on the connection, grasp the wire to be removed a short distance back from 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. *Extreme care must be taken not to flip or spatter the solder.*

NOTE: 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, use the copper soldering tip and an orange stick or spudger to remove all excess solder from the terminal.
- 14.04 Solder-wrapped connections need not be unsoldered to remove the connections. Cut the wire, unwrap with longnose pliers, and then remove solder as directed in paragraph 14.03.