

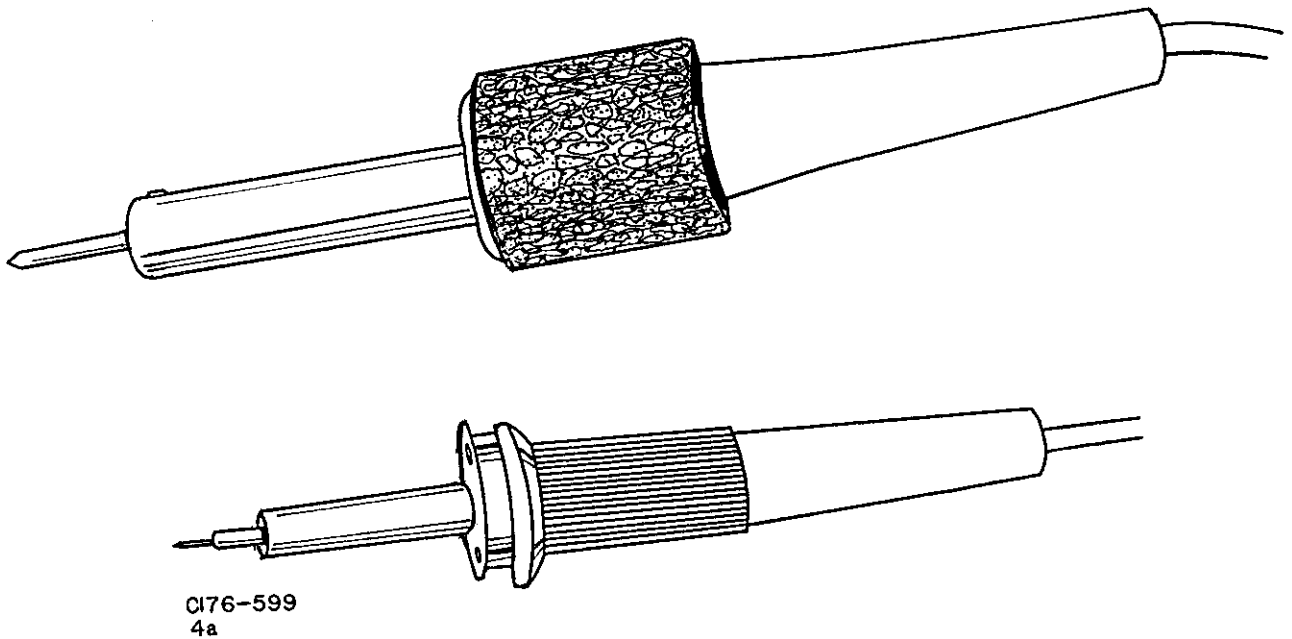


Figure 4-11. Pencil-type soldering irons.

Desoldering. The best method of removing solder from a pad or terminal is known as wicking. This method is quite simple and requires no special tools. A length of wire (preferably consisting of 19 or more strands) is stripped of insulation approximately $\frac{1}{2}$ inch from the end. The bare end is dipped in liquid flux and placed on the soldered connection. The tip of a hot soldering iron is placed on top of the fluxed wire. As the solder melts, it will be drawn onto the wire in the same manner that a cloth absorbs moisture; thus, the wire has actually become a wick. The wire and iron are removed as soon as the desired amount of solder is extracted from the terminal. The used wick is cut away and a new length of wick can be prepared from the remaining wire. The wicking process can be seen in figure 4-13.

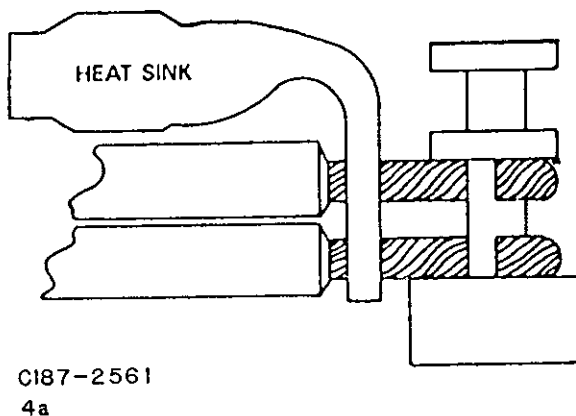


Figure 4-12. Proper heat sink installation.

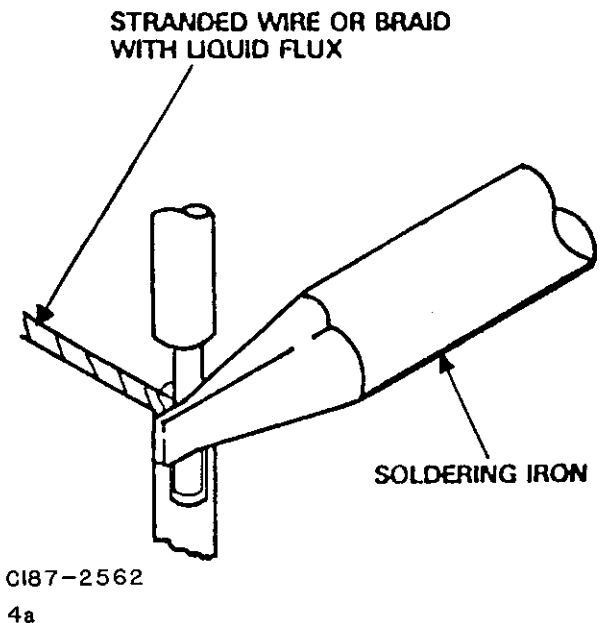


Figure 4-13. Desoldering by wicking.

Notice the position of the iron over the wick. You can also see that the solder joint is almost completely cleaned of all solder. This process is fast, easy, and neat. You are still using heat; therefore, it is necessary to place a heat sink between the component lead and the solder joint.

Tip Dressing and Cleaning. Before attempting to use a soldering iron or gun, make sure that the tip is properly prepared. The tip must be clean and free of pits. If pitted, the tip can be reshaped by filing with a flat, fine, single-cut file. To prevent oxidation of the newly dressed tip, it should

be tinned (coated with solder). A clean, shiny tip will provide the best possible heat conduction, thus making the soldering process quick and easy.

During the course of normal use, the tip will become encrusted with residue from the solder flux or paste. This hard, black crystalline residue will cause poor heat conduction and possibly damage to the terminal. The best and easiest method of cleaning is known as thermal shock cleaning. When soldering, keep a moist sponge or cloth handy. As the tip becomes dirty, simply wipe it across the sponge. The sudden application of cool moisture to the tip breaks up the crust and wipes it away. The tip will cool only slightly and will rapidly reheat. Thermal shock cleaning will result in a bright, shiny tip.

Preparing Wire for Soldering. The wire normally used in AGE is made up of many strands of twisted copper wire. This type wire is flexible and not very susceptible to stress fractures.

The first step in wire preparation is to remove the insulation from the wire. To ensure that the wire is not damaged during this process, use either thermal strippers or properly calibrated precision-cutting strippers. When you remove insulation, twist the stranded wire in the direction in which it is already twisted to maintain the original form and to prevent separation of the individual strands.

The amount of insulation you must remove is determined by the type of terminal used, whether minimum or maximum wrap, and the required amount of insulation clearance. (Insulation clearance is the length of the exposed bare wire between the insulation and the terminal after the connection is completed.) Minimum insulation clearance is one wire diameter (including insulation) and maximum clearance is two times that amount. The preferred insulation clearance is one wire diameter (including insulation).

After stripping the insulation from a wire, examine the wire for insulation damage. Never use wires that have cut, split, or burned insulation. (Slight discoloration from thermal stripping is acceptable.) In addition, you should always ensure that the outside strands or wires have not been scratched, nicked, cut, scraped, or otherwise damaged. Damaged wire degrades the connection reliability and must not be used. Figure 4-14 illustrates acceptable and unacceptable wire conditions.

Tinning. You must tin all portions of the stranded wire that will come in contact with the area to be soldered. To ensure proper tinning of the wire, place a heat sink on the wire to be tinned. Place the wire on the soldering iron tip near the insulation. Place the solder on top of the wire (fig. 4-15) and move it toward the cut end.

This will draw the solder down the wire, giving an even tinning action. Perform the tinning action quickly to prevent thermal damage to the insulation. Figure 4-16 illustrates acceptable and unacceptable wire tinning.

Note that the acceptable tinned wire has the proper insulation clearance and the strands of wire are completely covered with solder but are still visible. Also, there are no flared or stray conductor strands.

Soldering. Proper soldering is an acquired skill. It is a simple process that can be performed satisfactorily with a little practice. Remember, poorly soldered connections can be very difficult to locate. It is imperative that you check the

soldered connection carefully before moving on to another connection.

Securing conductors. Leads or wire should first be tinned. The tinned leads are then bent to the desired shape and joined to the terminal. A good mechanical connection will hold the wires or leads firmly to the terminal. You must make sure that there is no movement of the wires or leads during soldering, cooling, and solidification of the solder. If the conductors are allowed to move, a poor solder connection will result. When you attempt to reheat the joint, you stand a good chance of damaging the wire insulation or the components. Make sure you have a good connection and solder it right the first time.

Heat application. One of the most common soldering errors is improper heat application. The soldering iron tip must be placed so that it ensures maximum transfer of heat. Normally, the iron should be placed beneath the terminal. You should try to make contact between the iron and the terminal connector over as large an area as possible. Always use heat sinks to protect insulation and heat-sensitive components. Do not overheat the connection.

Solder application. Once the terminal or joint is heated, apply solder directly to the terminal. Never apply solder to the iron tip allowing it to flow over the terminals and leads. The flux will be burned away and the terminal will not be properly cleaned. You should position the iron tip to permit application of solder directly to the terminal and conductors.

Solder connection. Two of the most common errors made in soldering are the application of too much or too little solder. The solder should form a fillet (band) between the terminal and the conductor. The contour of the wire or component lead should be visible after soldering. Solder should not be allowed to completely cover the wire and terminal. See figure 4-17 for examples of properly and improperly soldered wires.

You must clean the connection after you have soldered the terminal. Remove all flux residue and impurities from the connection and surrounding area. This is best done with a soft brush and approved cleaning solvent.

Inspect the connection before starting to solder another connection; make sure you inspect each soldered joint. Reliable soldered connections should have a bright, shiny appearance. The contour of the wire must be visible; however, be careful not to confuse this with insufficient solder. The solder must form a slight fillet between the wire and the terminal yet show the contour of the conductor. The surface of the solder must be smooth and show no sign of pits or pores. You must assure that there is no portion of the lead extending beyond the terminal dimensions. Table 4-1 shows defects you should check for.

Exercises (232):

1. What is meant by 70/30 solder?
2. Why should acid-core solder never be used for electrical connections?

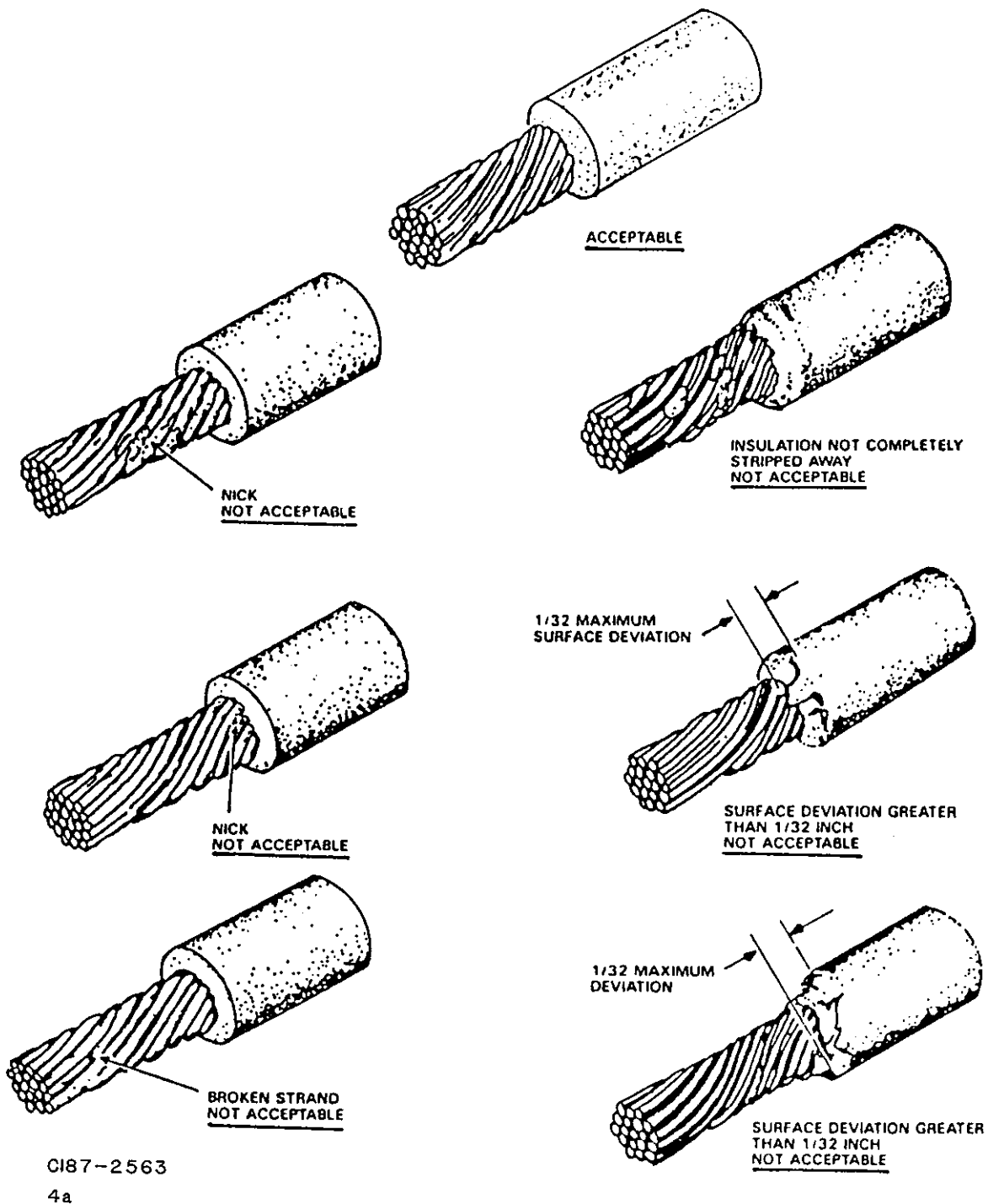
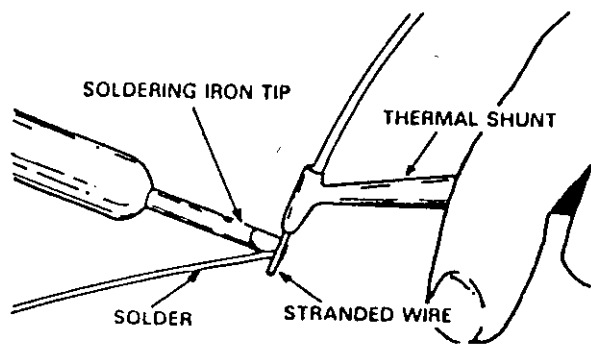


Figure 4-14. Acceptable and unacceptable wire conditions.



C187-2564

4a

Figure 4-15. Correct method for tinning wire.

3. When should a soldering iron be used instead of a soldering gun?

4. What is a heat sink (thermal shunt)?

5. What is the best method for removing solder from a terminal?

6. Why must the soldering iron be placed below a solder connection?

233. Explain how to make solder connections.

Flat, Perforated Terminal Connections. One of the most common soldering jobs in AGE is connecting wires to flat perforated terminals. These terminals are flat metal strips of varying thicknesses and lengths with a hole through one end to accept conductors. The other end of the terminal is mechanically connected to the equipment or component. That sounds pretty complicated, but you can see in figure 4-18 that we're really talking about switches, rheostats, and light sockets.

Use the 180° wrap shown in figure 4-19 to attach wires or component leads to flat, perforated terminals. Measure the insulation clearance from the end of the terminal to the insulation. Use table 4-1 as a guide for inspecting the finished solder connection.

Solder Cup Terminals. The soldering operation for hollow cylindrical terminals (solder cups) and connector pins (We're talking cannon plugs here.) is somewhat different from the soldering operations previously described. You heat the solder cup terminal (or connector pin) and melt a small amount of solder inside the terminal before you insert

the tinned wire. As you insert the tinned wire, keep the soldering tip in contact with the terminal until all flux is boiled out and the solder fuses smoothly onto the conductor and terminal surfaces. The wire placement in a solder cup terminal is shown in figure 4-20. Observe both the placement and the insulation clearance.

After completing the soldering operation, clean and inspect each soldered connection. Use a medium-stiff brush dipped in cleaning solvent to remove flux and impurities from the completed solder connection. Then, ensure that the solder connection has a shiny, bright appearance, with no pits or holes (fig. 4-21).

Above all, make sure that there is no excess solder. Remember, the contour of the wire should be visible, and the end of the wire should not extend beyond the terminal dimensions.

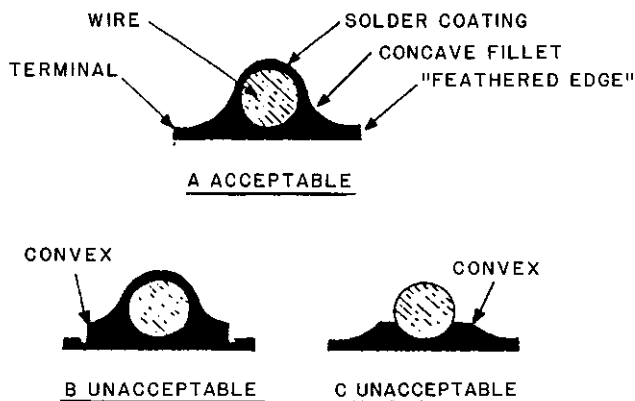
Some of the solder defects you should be on the lookout for are shown in figure 4-22. You may also refer to table 4-1 for a more complete list of common solder defects.

Exercises (233):

1. What type wrap should be used to attach wires to a flat, perforated terminal?

2. What is the proper insulation clearance for a flat, perforated terminal?

3. What must you do to prepare a solder cup terminal before inserting the wire?

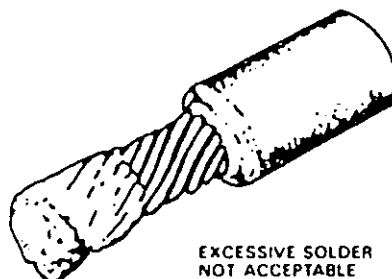
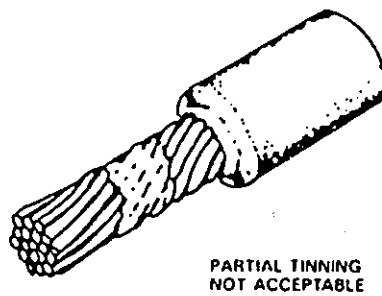
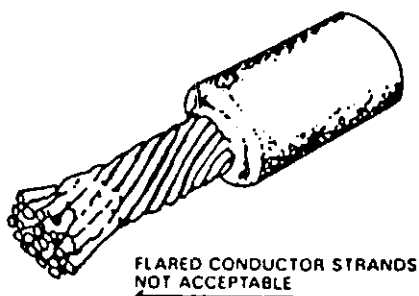
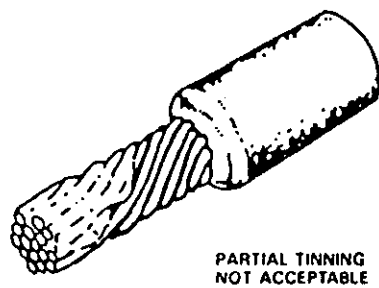
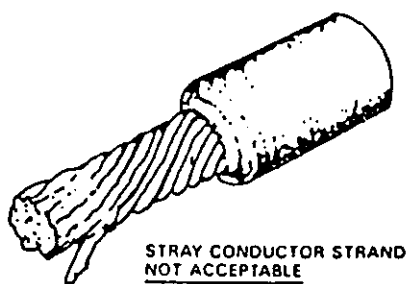
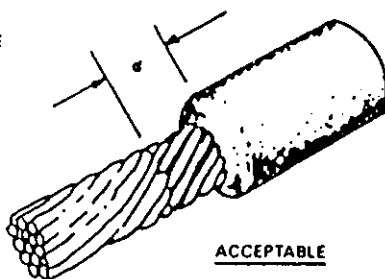


C187-2566

4a

Figure 4-16. Acceptable and unacceptable wire tinning.

NOTE
 "d" IS EQUAL TO DIAMETER OF THE WIRE
 INCLUDING THE INSULATION



C187-2565

4a

Figure 4-17. Acceptable and unacceptable solder connections.

TABLE 4-1
SOLDERING DEFECTS

Charred insulation. Melted insulation. Other damage to insulation. Insulation gap too long. Insulation gap too short. Uneven insulation gap. Insufficient solder. Excess solder. Spilled solder. Pits in solder. Holes in solder. Scratches in solder. Points and/or bumps in solder. Foreign material in solder. No fillet. Weak fillet. Dewetting. Cold solder joint. Rosin joint. Disturbed joint. Fractured joint.	Cut strands. Nicked strands. Scraped lead. Strands twisted excessively. Birdcaged strands. Excessive lead length. Insufficient lead length. Lead improperly formed. Leads misplaced. Bare copper on cut end of lead. Bare copper along lead. Flux on joint. Flux on components. Bare copper or base material on terminal. Solder splattered on components. Dirt, etc. Loose lead. Strands misplaced at cut end. Damaged terminal. Not shiny, dull luster. Stress lines in solder.
---	--

4. How long should the soldering iron remain in contact with the solder cup during the soldering operation?

234. State how to repair printed circuit boards (PCBs).

Printed Circuit (PC) Board Inspection. With the advent of solid-state devices and ICs, the once simple task of soldering has become quite complex. The basic principles of soldering are applied when you solder solid-state components. However, there are a few extra precautions you must follow to prevent damage to the components or PCB.

The first thing you should do is inspect the PCB. Use a magnifying glass to help you see the tiny circuit tracks (conductors). During the inspection, look for any evidence of damaged epoxy finish, loose or broken circuit tracks, dirt, grime, etc. You will be surprised how many future troubles you can eliminate just by performing a thorough inspection of the board. Probably one of the most common malfunctions with the PCB is broken or loose circuit tracks.

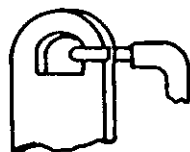
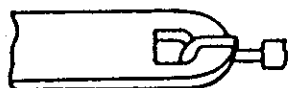
Breaks in the circuit tracks (foil conducting material) can cause permanent or intermittent trouble. In many instances, these breaks will be so small that they cannot be detected by the naked eye. Hairline cracks (breaks) can be located only with the aid of a hand- or stand-held magnifying glass.



C187-2568

4a

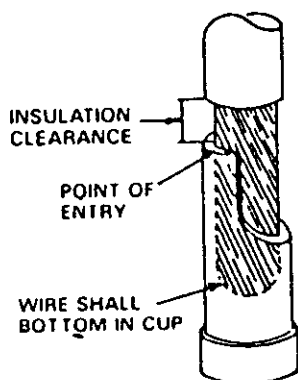
Figure 4-18. Typical parts using flat perforated terminals.



C187-2569

4a

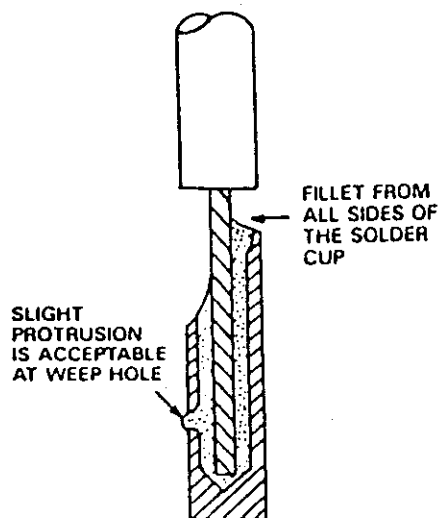
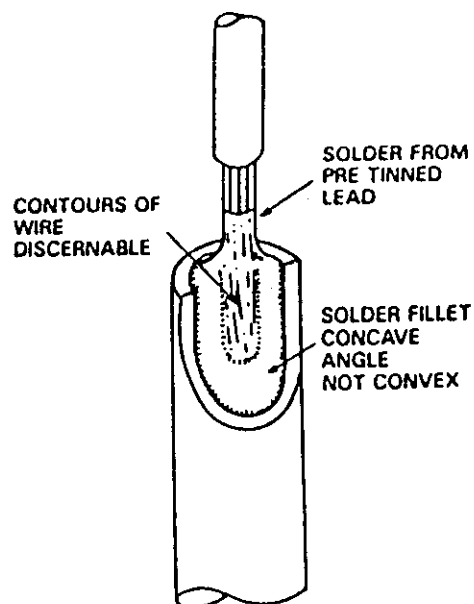
Figure 4-19. Correct wrap for flat perforated terminals.



C187-2570

4a

Figure 4-20. Wire placement in solder cup terminal.



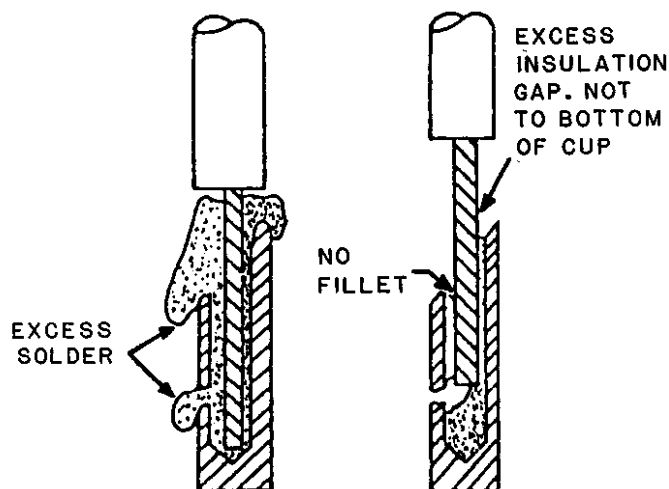
C187-2571

4a

Figure 4-21. Acceptable solder cup terminal connections.

Point-to-Point Resistance Tests. To locate trouble in the conducting strips of a PC board, set up a multimeter (one that DOES NOT pass a current in excess of 1 milliamperes) for making point-to-point tests, as shown in figure 4-23. Then, using needle-point probes, insert one point into the conducting strip, close to the end terminal, and place the other probe on the terminal or opposite end of the conducting strip. The multimeter should indicate continuity. If the multimeter indicates an open circuit, drag the probe along the strip until the meter indicates continuity. Mark this area and then use a magnifying glass to locate the fault in the conductor.

Repairing Damaged Strips. If the break in the conducting strip is small, scrape away any coating cover on the area of



C187-2572
4a

Figure 4-22. Unacceptable solder cup terminal connections.

the conducting strip to be repaired. Clean the area with a firm bristled brush and approved solvent. Then, repair the cracked or broken area of the strip by flowing solder over the break, as shown in figure 4-24 (A).

If there is any indication that the strip might peel, bridge the break with a small section of bare wire (approximately 2 inches long if possible) by the method shown in figure 4-24 (B). Apply solder along the entire length of the wire to bond it solidly to the conducting strip. Considerable care must be taken in applying the solder to prevent it from flowing onto or near an adjacent strip. Keep the solder within the limits of the strip being repaired.

If the defect in the circuit track is too large to fuse together, cut and remove the damaged strip. Connect a length of insulated wire across the break, from solder point to solder point, as shown in figure 4-24 (C).

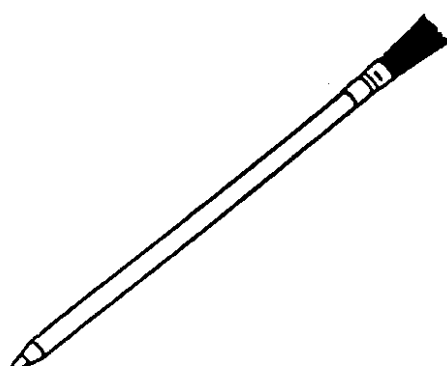
It's best not to glue or bond a conducting strip that has been lifted or peeled from the board at a terminal or soldered point. Instead, clip off the raised section and replace it with insulated wire from soldered point to soldered point.

Printed circuit boards are frequently subject to shorts, especially if the spacing between conductors is very close or if careless soldering has formed a bridge between two strips. After repairs, always look the board over very carefully for solder droppings that can cause a short.

Frequently, a low-resistance leakage path will be created by moisture or dirt that has carbonized onto the phenolic board. This leakage can be detected by measuring the suspected board with a multimeter. To overcome this condition, thoroughly clean the carbonized area with solvent and a stiff brush, as shown in figure 4-25. If this does not remove it, use a scraping tool to remove the carbon.

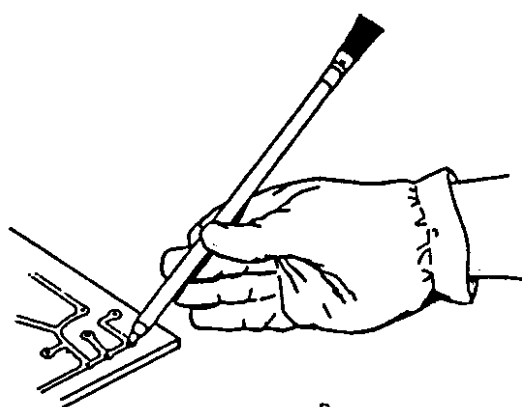
Soldering/Desoldering PC Boards. One of the most difficult soldering operations you will have to perform is soldering and desoldering ICs. Before you start to desolder an IC, mark the location of the number 1 pin on the PCB so you can correctly install the replacement IC. Some of the newer PCBs have the number 1 pin location identified on the board for you.

To desolder the IC, you use a low wattage soldering iron. Heat the solder at each lead individually until the solder becomes molten. Remove the solder by using wicking wire or some other solder removal aid. Some ICs are soldered on both the top and bottom of the PCB. You must use caution when applying heat to the IC. Apply the heat to the component only as long as needed (and remember your heat sink). Even though the component is defective, the heat could transfer through the bad component into another component in the circuit.



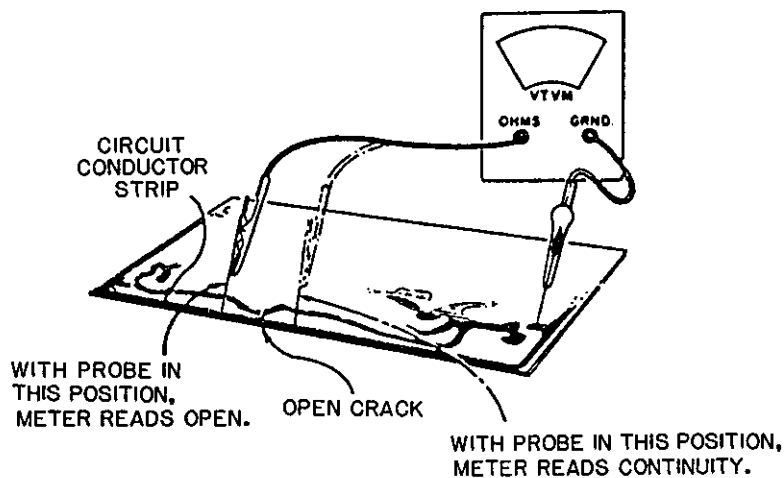
A
TYPICAL PENCIL-STYLE
TYPEWRITER ERASER

C187-3128
04a



B
CLEANING OPERATION FOR PRINTED
CIRCUIT PAD

Figure 4-23. Circuit board cleaning.



CI87-3129
04a

Figure 4-24. Locating a broken conducting strip.

After the IC pins have been desoldered, use a DIP puller to remove the IC from the PCB. Figure 4-26 illustrates the proper technique for removing ICs using a DIP puller.

Installation of ICs. Any time you handle ICs, there is a possibility of damaging them. Damage due to static electricity is the greatest danger. To prevent the buildup of static voltage, observe the following procedures:

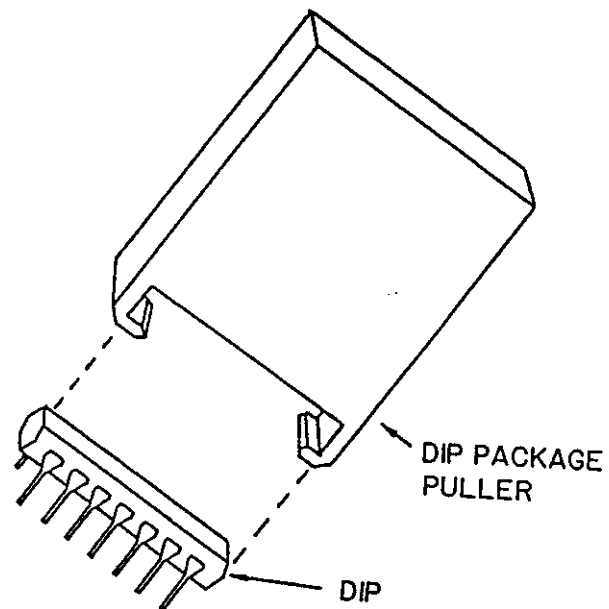
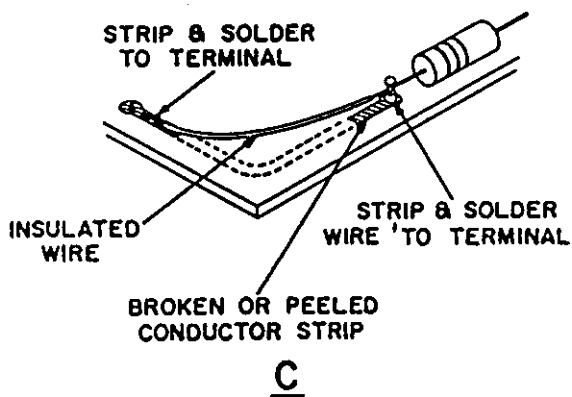
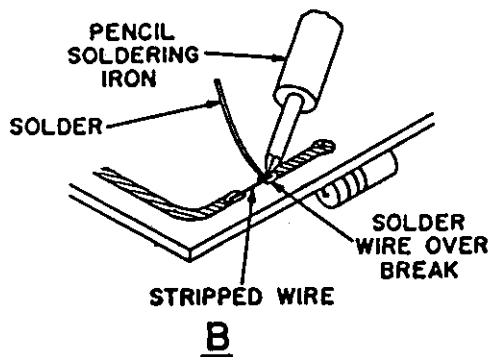
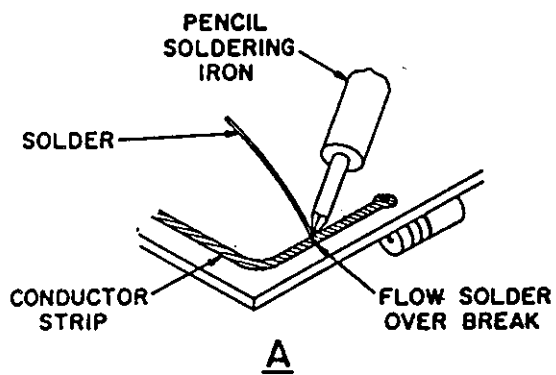
- Handle ICs only when necessary.
- Keep ICs in their original containers until you are ready to install them.
- Ground yourself before handling ICs.
- If it's necessary to handle ICs, use tweezers or an IC insertion tool.
- Handle ICs only at a static-free workbench.

During installation of the IC, you may have to bend the leads slightly to make the IC fit into the connection holes. Do NOT force the IC into the holes.

Carefully solder each lead of the IC, ensuring that you don't overheat the IC. After you have soldered the component in, be sure to clean up the solder area with alcohol to remove the flux residue. Use a magnifying glass to inspect each solder joint on the IC. If you find a defective solder joint, resolder, clean, and reinspect. Now, you are ready to ops check the module in the unit to ensure you have corrected your problem. After you have ops checked the module and you are sure the solder is dry, apply a thin coating of nonconductive epoxy coating to the applicable area of the PCB. This coating prevents moisture, dirt, etc., from collecting on the PCB.

Exercises (234):

1. What types of defects are you looking for when you inspect the PCB prior to desoldering?
2. How can you locate open (broken) circuit tracks using the multimeter?
3. Explain how to repair large sections of damaged circuit tracks.
4. How are carbonized areas of the PCB cleaned?
5. How can you reduce the possibility of static voltage damage to an IC that you are installing in a PCB?



C187-3131
04a

Figure 4-26. DIP package puller.

C187-3130
04a

Figure 4-25. Repairing broken conducting strips.