C698-416L-ST

AIR TRAINING COMMAND

STUDENT TEXT

ABR30533-1

SAGE MAINTENANCE AND ANALYSIS

4 February 1966

RESPONSIBLE AGENCY OF ATC

Keesler Technical Training Center
Keesler AFB, Mississippi

DESIGNED FOR ATC COURSE USE ONLY

Computer Systems Department
KTTC, Mississippi

Student Text
4 February 1966

SAGE MAINTENANCE AND ANALYSIS

This text provides student study in support of Course ABR30533-1, Block XXIV.

CONTENTS

CHAPTER 1

SAGE QUALITY CONTROL

The purpose of quality control is to maintain and improve product quality by preventing defects and unnecessary variability in processing before they occur.

Ordinarily, inspection reveals defects, inaccuracies and irregularities in material or workmanship that often lead to a high percentage of costly rejection. When rejections occur, it is usually too late to do anything about it. This means waste, loss, and increased cost. Quality control seeks to step in, discover the causes that lead to rejection and to prevent them. It checks on material, workmanship, tools and inspection, as well as getting at the causes; so, it goes much further than mere inspection.

For instance, a tool may be made of carefully specified material and designed to do a given amount of work and to stand up a given number of hours, working a metal of given characteristics. If variations in the work occur within the maximum time limit, the tool itself may be at fault and not the machine or the workman. Or, the fault may be within the machine, with the workman, or even the inspection. Whatever it is, quality control seeks to get at the cause and correct it before, not after, the damage is done.

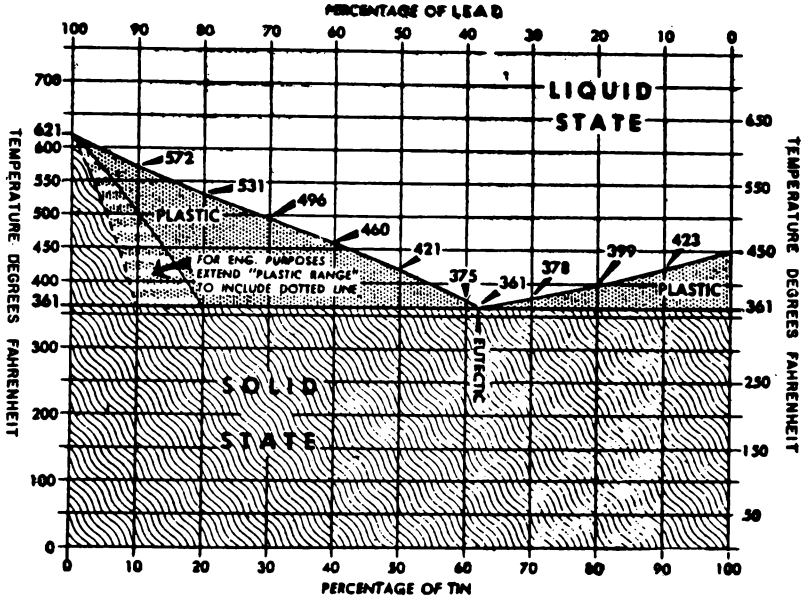
An adequate quality control program can eliminate at least half of this loss. In addition, quality control reduces the cost to the Air Force. In many instances, the presence of scientific quality control has economically solved research and development problems which were previously analyzed only through costly trial and error methods.

By charting good and bad performance in materials, machines and processes, facts are revealed that are guides to effective quality control. These aid in recognizing and measuring variations in the products. The quality control man, with his charts and graphs of variabilities, is able to solve many of industry's problems. Charts and graphs are really tools to be used practically and sensibly.

No matter who you are, quality control means something. If you are the customer, it means that you can buy with confidence. If you are the manufacturer, it means that you have done everything possible to assure uniformity in quality. It also means that you are saving money, and have better production. Some companies which have had quality control programs for a long time find that it is saving tens of thousands of dollars every year in a better product, better production, and less waste.

1. Requirements set up by Government Specifications.

a. The Contractor shall maintain an effective and economical quality control system which shall have been planned and developed in conjunction with the contractor's other planning functions, such as production planning and subcontracting planning; and shall be based upon consideration of complexity of design, interchangeability and reliability requirements and manufacturing techniques. The system shall assure that adequate control or detection of significant types of recurring discrepancies - together with the corrective action taken - be provided. All supplies to be delivered under the contract which are manufactured within the contractor's plant or procured



SOLDER ALLOY CHART					TEMPERATURE AT WHICH SOLDER BECOMES PLASTIC		TEMPERATURE AT WHICH SOLDER BECOMES LIQUID	
% TIN	% LEAD	% SILVER	% ANTIMONY	% BISMUTH	C°	F°	C°	F°
0	100						327	620
5	95				272	522	314	597
10	90				224	435	302	576
15	85				183	361	290	554
20	80				183	361	280	536
25	75				183	361	268	514
30	70				183	361	257	496
35	65				183	361	247	477
38	62				183	361	242	468
40	60				183	361	238	460
45	55				183	361	225	437
48	52				183	361	218	424
50	50				183	361	212	414
55	45				183	361	200	392
60	40				183	361	188	370
63	37				EUTECTIC ALLOY*		183	361
65	35				183	361	184	364
70	30				183	361	186	367
75	25				183	361	192	378
80	20				183	361	199	390
85	15				183	361	205	403
90	10				183	361	213	415
95	5				183	361	222	432
100	0						232	450
95			5		232	450	238	460
35	63		2		187	367	237	459
20	78.7	1.3			181	358	276	529
16	32			52	EUTECTIC ALLOY*		96	204
27	70	3			178	352	253	487
	97.5	2.5			EUTECTIC ALLOY*		305	581
	95	5			308	581	360	680

Figure 1-1. Solder Alloy-Eutectic Chart

from any other source shall receive sufficient inspection to assure conformance with contractual requirements. Objective evidence of such inspection shall be available to the Inspector, prior to submission of supplies for acceptance by the Government.

SOLDERING TECHNIQUES

1. Introduction to soldering.

a. The FSQ-7 contains approximately 10 million soldered joints. Air Force specifications require no more than one error out of each 500,000 soldered joints.

b. Average time spent to find a bad solder joint is eight hours. (Compared to 1/2 hour to locate a bad component.)

c. Solder is one of the oldest and most useful of metals. Because of the ease with which it has been used, few people have bothered to acquire the basic, but necessary, background for good soldering techniques. Soft solder is a fusible alloy mainly composed of tin and lead. A chart showing the percentage of each metal is shown in Figure 1-1. This alloy makes it possible to join two or more metals at temperatures well below their melting point. The solder to metal attachment is formed by an intermetallic compound phase which takes place at comparatively low temperatures. The solvent action of hot solder on copper or steel resembles the action of a few drops of water on salt. The solder dissolves microscopic particles of the copper or steel, forming a chemical attachment instead of physical adhesion. Therefore, heating the soft, flexible solder during the soldering act caused a chemical change to take place which resulted in a hard metal alloy. Thus when two or more pieces of metal are soldered together, a joint is formed which acts like one continuous piece of metal. (This is not true of a purely physical connection, such as a bolt or spring, because a layer of oxides always remains between the surfaces.) In addition, the solder alloy withstands the stress and strain of the temperature changes without rupture of the joint.

d. The primary purpose of a soldered joint is to achieve an airtight metallic connection by means of a film of solder alloy, varying in thickness from 0.002 to 0.004 inch, between the metal parts; i.e., wire and terminal. When such a connection has been made, it is a waste of time and material to add solder just to improve its appearance; the electrical conductivity has been established with the original bond and will be unaffected by the addition of solder.

2. Specification Requirements.

a. All solder connections shall exhibit a reasonably bright, shiny finish (a cold solder joint appears dull and crystallized) with no excess solder or flux. The minimum requirements for a good soldered connection are as follows:

(1) Mechanical security (see Figure 1-2B).

(2) Filleting (see Figure 1-2A).

(3) Feathering at the edge of the joint (see Figure 1-2A).

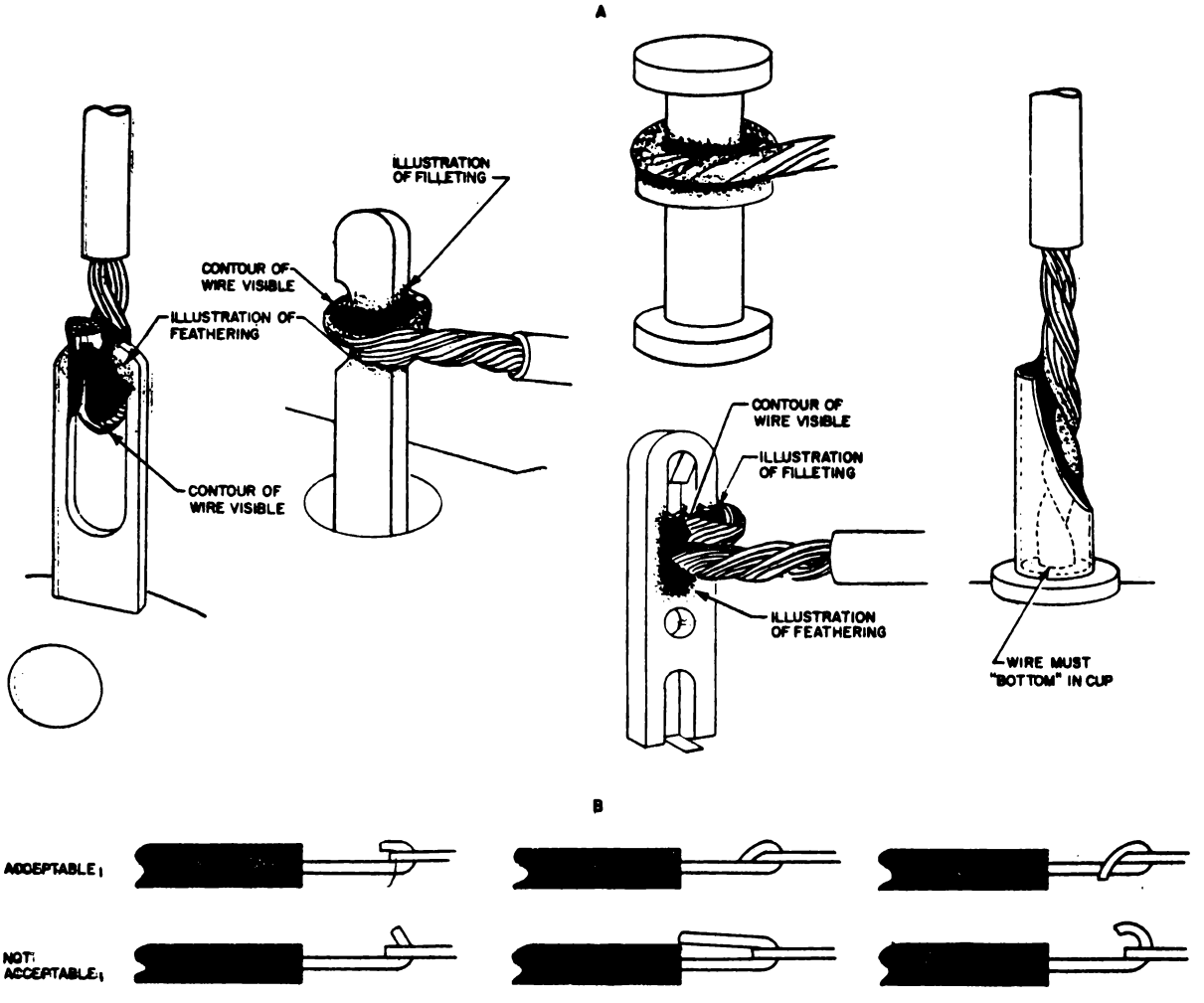


Figure 1-2. Correct and Incorrect Soldering Connections

(4) Wire insulation shall be kept as close as practicable to the solder joint. In no case shall the possibility of shorting exist.

(5) Wire insulation shall not be included in the solder joints.

(6) Contour of the wire shall be visible (see Figure 1-2A).

b. Wire Stripping.

(1) Sufficient insulation shall be stripped to provide the amount of base conductor required for a good solder joint. In removing insulation from the wire, the conductor shall not be damaged. A wire will be considered damaged if it exhibits one or more of the following faults.

(a) A cut strand.

(b) A "nick" which will result in a wire break, as a result of flexing during assembly, operation, or maintenance of the equipment.

(c) A reduction of circular mil area (resulting from the scraping action of stripping tools) which increased the resistance of the wire to a value beyond the maximum allowed for that wire.

(d) Tinning which is in excess of the distance needed to take advantage of the depth of the terminal or receptacle. Tinned stranded wire shall show no evidence of "fanning," and the contour of the outer strands shall be visible.

NOTE: Wires which terminate in crimp-type, solderless terminals shall not be tinned.

c. Mechanical Security.

(1) Mechanical security shall be obtained, prior to soldering, by looping the wires firmly around the turret terminals at least once and not more than twice. See Figure 1-2B. Wires terminated at the eyelet-type terminals shall pass through the "eye" of the terminal and end in a loop crimped tight to the terminal. (See Figure 1-2B.) Under no conditions shall the stripped portion of the wire "double back" on or come in contact with the unstripped (uninsulated) portion.

d. Temperatures.

When soldering with rosin core solder, temperature in excess of 600 °F must be avoided or the rosin will tend to carbonize and hinder, rather than aid, the soldering process. Efficient soldering is promoted by using a soldering iron with adequate heat storage. No attempt to solder must be made by heating an undersized or otherwise inadequate soldering iron to excessive temperature.

e. Heating.

The surfaces of the parts to be joined shall be heated to a temperature of the solder (400-600 ° for 60/40 flux cored solder). The joint shall reach the soldering temperature in less than 30 seconds. The soldering iron should be applied to the area containing the greatest surface or mass, thus allowing the heat to be conducted to the smaller area of the joint, in this case the wire. Heat may be applied by soldering iron, torch, molten alloy bath, electrical resistance, or other suitable means. When using cored wire solder, the end should be kept open. To be effective, the flux must flow before the solder melts when touched to the joint. Flux core solder should never be flowed from the soldering iron to the joint. (See Figure 1-3.)

TINNING

f. Copper and iron-clad bit soldering irons.

The transfer of heat from a copper or iron-clad bit to the joint is made difficult if the bit surface is oxidized. Maintaining a coating of liquid solder on the surface of the bit not only retards oxidation, it materially aids in quick, sure soldered connections.

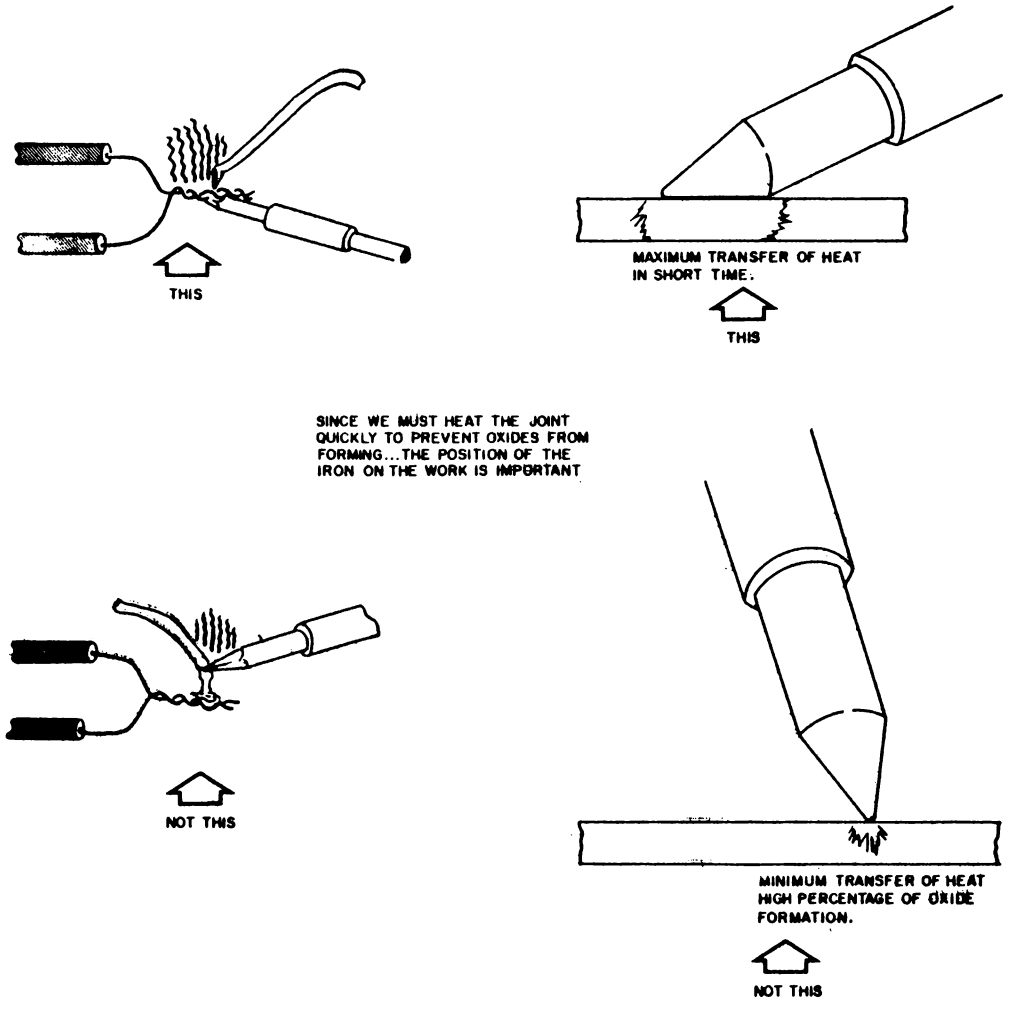


Figure 1-3. Correct and Incorrect Soldering Methods

CHAPTER 2

SAGE HAND TOOLS

1. Objective: The right tool for every job.

2. Hand tool safety (General).

   a. Select the right tool for the right job.

   b. Keep tools in a safe place.

   c. Wear safety glasses when soldering or using power hand tools or any time the hazard of flying particles exists.

   d. Keep work area clean.

   e. Keep soldering irons in the holder when not in actual use.

   f. Know the location and operation of safety equipment.

   g. Report all accidents, no matter how slight.

3. Hammers.

   a. Two types available at the site.

      (1) Ball Peen - Used to expand rivets, tapping punches and chisels and other rough work.

      (2) Rubber Mallet - Used to force close-fitting parts.

4. Screwdrivers.

   a. Five different types available at site.

      (1) Standard - Various sizes and lengths available. The proper size should be selected for each job.

      (2) Phillips - Has a specially shaped blade that only fits Phillips screws.

      (3) Offset - Available in standard and Phillips blades. Used to turn screws in inaccessible places.

      (4) Ratchet - Allows a screw to be completely removed from an inaccessible place without removing the blade from the screw slot.

      (5) Screw Starter - Holds a screw while it is being started in a place that does not allow the screw to be held by hand. It should not be used to tighten or loosen screws.

b. Safety and proper use.

(1) Never use a screwdriver to check electrical circuits.

(2) Never hold work in your hand when using a screwdriver.

(3) Never have any part of your body in front of a screwdriver.

(4) Never use a screwdriver as a prying bar or chisel.

(5) Do not use a standard screwdriver on a Phillips screw.

(6) Don't carry a screwdriver in your pocket.

(7) Don't return a defective screwdriver to the stockroom without informing the stock clerk.

(8) Always use the largest screwdriver that will fit snugly into the screw slot.

(9) Always insure that the screwdriver shank is perpendicular to the screw and centered in the slot.

5. Files.

a. Various shapes, lengths and types of cuts available at the site.

b. The type of work to be done will dictate the type of file to be used.

(1) Half Round - Used to enlarge or smooth the edge of large holes. Used in places where a flat file will not fit, such as angles less than 90°.

(2) Mill - Primarily used for precision work.

(3) Pillar - Used to file slots and key ways or work in close quarters.

(4) Round - Used to enlarge holes.

(5) Swiss Pattern - Small, delicate files used on instruments and delicate mechanisms.

c. Cuts

(1) Single-cut files used for detailed work or removing small amounts of metal.

(2) Double-cut files used for fast removal of metal.

d. Grades

(1) Bastard - Used for fast removal of metal.

(2) Second cut - Removing small amounts of metal.

(3) Smooth - Used mainly polishing after a coarser file has been used.

e. Safety and proper use

(1) A file should never be used without a handle.

(2) A stroke is started with light pressure with the point of the file near the work.

(3) Pressure should be increased as the file is moved across the work.

(4) The file should not touch the work on the return stroke.

(5) Enough pressure to bend the file should not be applied.

(6) When filing curved surfaces, use a file whose curve most nearly matches the curvature of the work.

(7) Files are very brittle and are never to be hammered or used as prying bars.

(8) Store files in proper racks or wrap them if they are to be stored in a drawer with other tools.

(9) Keep teeth of file clean.

(10) Never strike the file against a surface to clean it.

(11) Secure the work to prevent vibration.

6. Punches

a. Four different types available at the site.

(1) Center Punch - Used to mark the location of a hole that is to be drilled. Gives the drill an easy starting point.

(2) Pin Punch - Used to remove pins or align holes in two sheets of metal.

(3) Brass Rod - Used to drive pins when they are being inserted.

(4) Chassis Punch - Used to cut holes in metal. Sizes 1/2'' to 2 1/4'' available.

b. Safety and proper use

(1) Never use a center punch to drive pins.

(2) The top of the pin should be beveled.

(3) A pin punch should be the largest possible that will fit the hole.

(4) Always strike a pin punch a sharp, solid blow rather than a series of light blows.

(5) A clearance hole slightly larger than the driver bolt must be drilled for the chassis punch.

7. Wrenches

a. Six different types at site.

(1) Open End.

(2) Adjustable.

(3) Box End.

(4) Socket.

(5) Nut Driver.

(6) Hex and Flute.

b. Safety and proper use

(1) Pull on wrench whenever possible. If you have to push it, use the palm of your hand.

(2) Never use a wrench that is too large for a nut.

(3) Adjustable wrenches are not designed for heavy work.

(4) The fixed jaw of the adjustable wrench should be on the opposite side of the nut from the direction the wrench is being pulled.

(5) Box end wrenches should be used to break loose difficult nuts.

8. Pliers

a. Ten types at the site:

(1) Taper pin

(2) Duck bill

(3) Long nose

(4) Needle nose

(5) Diagonal cutters

(6) Truarc

(7) Gas

(8) Vise Grip

(9) Cam Lock

(10) Contact Staking

b. Safety and proper use.

(1) Taper pin pliers are used to insert and remove taper pins. No other pliers should be used for this job.

(2) Duck Bill, Long Nose, and Needle Nose are used for general electrical work and are not to be used for heavy gripping.

(3) Diagonal cutters should not be used to cut nails or similar objects.

(4) Diagonal cutters should be used to cut wires as near to the pivot as possible.

(5) Always turn the cutting jaws away from you when cutting wire.

(6) Truarc pliers are used to spread snap rings.

(7) Camlock pliers are used to insert and remove camlock fasteners.

(8) Contact staking pliers are used for making repairs to PU connectors.

9. Hacksaws

a. Two types at site.

(1) Large adjustable.

(2) Small non-adjustable.

b. Safety and proper use

(1) Large saw should be used for heavy work.

(2) Small saw should be used in areas that will not permit the use of the large saw or if a narrow cut is to be made.

(3) A minimum of two teeth should always touch the metal on the cutting stroke.

(4) The blade should be inserted into the sawframe with the teeth facing away from the handle.

(5) Pressure should not be applied on the back stroke.

(6) A groove should be made with a file before starting a cut.

(7) A blade should be tight enough to prevent buckling but not tight enough to snap if it is accidently hit.

(8) Relieve blade tension when the saw is not in use.

(9) Insure work is secure before cutting.

(10) Wipe the blade with a cloth dampened with light-weight oil before returning it to the stockroom.

10. Miscellaneous Common Tools.

a. Machinists Vises.

(1) Never hammer on a vise handle to close it tighter.

(2) The jaws should be covered before using the vise to hold soft metal or delicate instruments.

b. Retriever - Used to pick up small objects in inaccessible places.

c. Scriber - Used for marking metal.

d. Inspection Mirror - Used to check work that is hidden from view.

e. Tweezers - Used to pick up small parts.

f. Burnishing blade - Used to smooth relay contacts.

g. Fuse Pullers - Used to remove fuses.

11. Special Tools.

a. Wire Stripper - three types at site.

(1) Miller

(2) Semi-automatic

(3) Coaxial

(4) Wire size should never be larger than stripper slot.

b. Crimping tools - 20 different types at site.

(1) Color coded to match lug to be used and size of wire.

c. Rules and Gauges

(1) Various types are available to cover all applications.

NOTE: Refer to "Use of Hand Tools" for detailed information.

d. Screw Extractor - Used to remove screw or bolts that have been broken or damaged so that they cannot be removed with a wrench or screwdriver.

e. Relay Puller - This tool should be used any time a wire contact relay is removed or replaced.

f. Tube Pullers

(1) Protects the user from the heat of the tube.

(2) Allows a good grip on the tube.

g. Lamp Extractor - Used as an aid in removing 48v indicator lamps.

h. Extensions - Used to get a part into a position so that it is easily checked while it is still in the circuit.

i. Lubricating Tools - Used in maintenance of moving parts throughout the AN/FSQ-7.

j. Alignment tool - Used to make adjustments that are affected by metal screwdrivers.

k. Voltage Detection Probe - Used to check for the presence of -48v DC only.

l. Display Alignment Tool - The out sleeve is used to loosen a lock nut. The inner shaft is a screwdriver.

m. Punch and Anvil Assembly - Used for inserting panel jacks on Unit 28.

n. Drum Hoist - Used for lifting drum assembly from unit.

o. Bearing Thermometer - Used to determine temperature of drum bearings.

p. Grinder and Oil Stones - Used to shape and sharpen tools.

q. P.U. Holding Tool - Used to hold P.U.'s while they are being repaired.

r. Tube Pin Straightener.

s. Lead Winder - Used to make loops of the proper size to be used in Memory.

t. Crochet Needle - Used as a soldering aid and for lacing cables.

u. Spring Hook - Used for insertion and removal of springs.

v. Magnifiers - Used for close inspection.

CHAPTER 3

PLUGGABLE UNIT REPAIR

1. Installation of service terminals. Used when mounting large lead components. (Figure 3-1.)

a. Remove failed component by clipping leads 3/16 $\pm$ 1/32 from the top of the tapered component termination. (1)

b. Clean lead to assure a good solder connection. (2)

c. Slide terminal, P/N 3212547, over clipped lead and crimp its entire length. The service terminal should not be off the tapered termination a distance of greater than 1/32". (3)

d. Insert the new component in the service terminal and crimp the service terminal around it. The component lead should not extend beyond the service terminal a distance of greater than 1/32". (4)

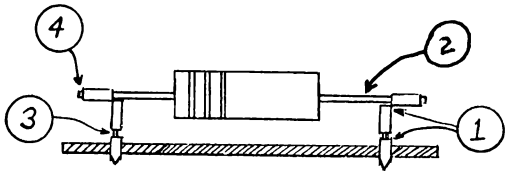


Figure 3-1

e. Solder the service terminal to the component lead and to the old lead remaining in the card.

> NOTE: If the component is a diode or a precision resistor, use a heat shunt between the service terminal and the component body while soldering. (Figure 3-3.)

f. To re-attach a component that has been clipped on only one end, the service terminal should be rotated 180 degrees as shown in the figure below.

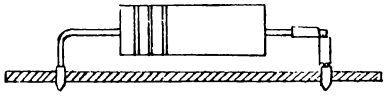
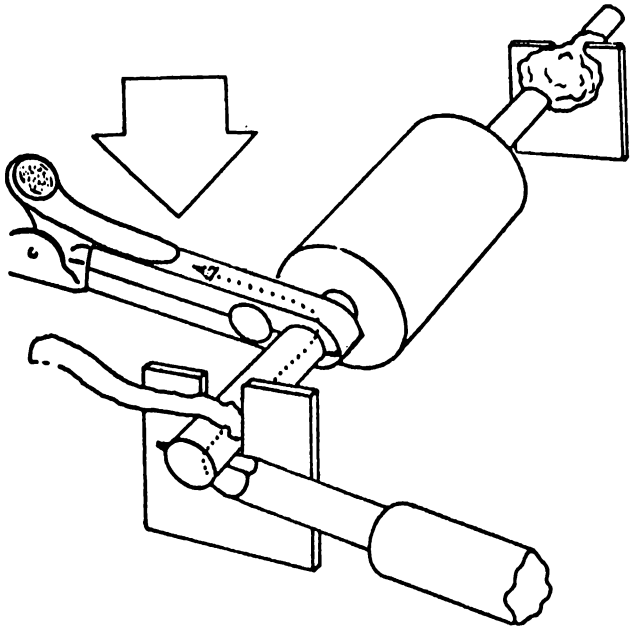


Figure 3-2

Heat Shunt

Heat is absorbed here



Electrical components that may be adversely affected by excessive heat should be protected by a heat shunt.

Figure 3-3

2. Alternate Method of Mounting Large Lead Components

   a. Use replacement procedure for small lead components as outlined below.

3. Component Mounting of Small Lead Components

   a. Diodes and neons with small leads should be mounted as follows:

      NOTE: Should be used only with prior Quality Control approval when service terminals are not available.

      (1) Procedure One

(a) Remove the faulty component by cutting the leads approximately 1/8 of an inch from the component body. (a, Figure 3-4.)

(b) Straighten the leads remaining on the card.

(c) Center the new component on the old leads using a mechanical wrap to secure the component while soldering (b, Figure 3-5.)

(d) Solder the new component and trim the excess wire.

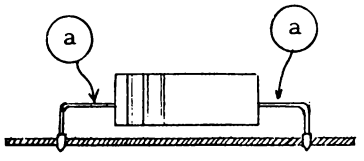


Figure 3-4

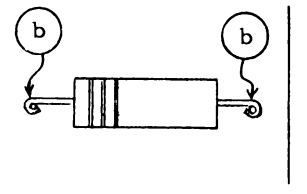


Figure 3-5

(2) Procedure Two

(a) Remove the faulty component by cutting the leads approximately 1/8 of an inch from the component body. (a, Figure 3-4.)

(b) Bend the leads remaining on the card in accordance with illustration. (b, Figure 3-6.)

(c) Place the card in a vertical position and center the new component across the bent leads.

(d) Solder the new component to the old leads and trim the excess wire. (C&D, Figure 3-6.)

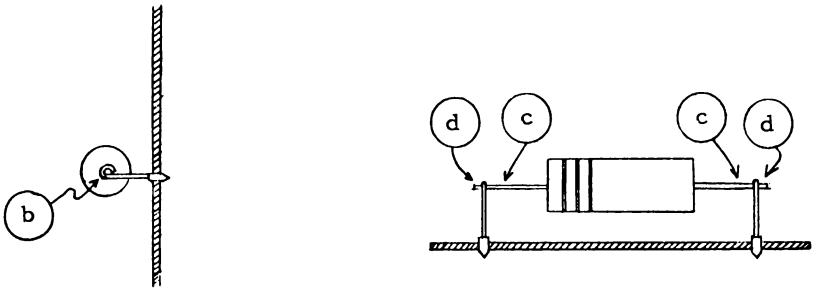


Figure 3-6

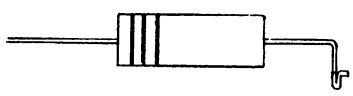
4. Method of replacing a component when the tapered terminal comes loose from the card or a component is inserted into a new hole location.

a. Be sure the lands are not pulled away from the card assembly.

b. Bend the component lead as illustrated in Figure 3-7.

c. Insert the lead through the card assembly.

d. Solder both top and bottom lands to the component lead.



End of leads should be long enough to be visible after insertion.

Figure 3-7

5. Alternate method of mounting a component when the tapered terminal comes out or mounting components in new mounting holes.

a. Be sure the lands are not pulled away from the card assembly.

b. Insert the component through the printed card.

c. The component should be 1/16'' to 1/4'' from the card assembly.

d. Be sure the component leads have a relief bend, then bend the end of the leads flat against the lands. Bent leads should not be greater than 1/8'' $\pm$ 1/32''. (See Figure 3-8.)

e. Solder the lead, using extreme care not to raise a land from the card.

NOTE: This mounting is to be used in diode can assemblies.

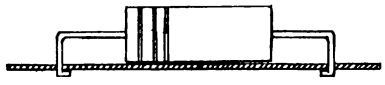


Figure 3-8

f. When using the above method of mounting, be sure to solder both top and bottom land if it is a double land type card.

6. Method of Installing Transistors on a Printed Card.

a. Cut defective transistor leads 3/8'' above printed card.

b. Bend the transistor leads and leads remaining on the card as shown in Figure 3-9.

c. Connect new transistor leads to remaining leads.

d. Crimp and solder. Use heat shunt to avoid damage to the transistor.

e. The distance between the bottom of the transistor and the card surface will be 5/16'' $\pm$ 1/16''.

NOTE: Transistor leads will have to be shortened before mounting.

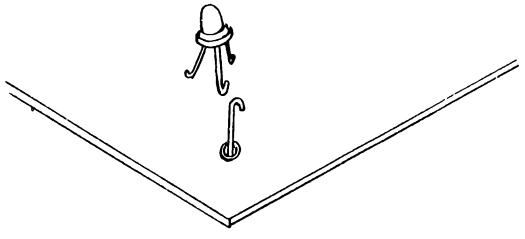


Figure 3-9

7. Method of installing large diameter components and extra long components.

   a. Install service terminal per paragraph 1, a, b, and c above.

   b. Bend component leads and mount per Figure 3-10.

   c. Crimp entire length of service terminal.

   d. Solder service terminal to new and old component lead.

   NOTE: Example of mounting transformers, large length resistors and capacitors.

Figure 3-10

8. Method of replacing potted assemblies to a printed card.

   a. Clip leads as shown in 1, Figure 3-11.

   b. Heat and remove old leads.

   c. Insert new potted assembly through card. New assembly should be within 1/16" $\pm$ 1/32" from the card. (2, Figure 3-11.)

   d. Bend leads back against card along the conductor which terminates at that mounting hold and clip excess off (all over 1/8"). Solder the termination. Use extreme care when soldering so the card laminations will not be lifted off the card assembly. (3, Figure 3-11.)

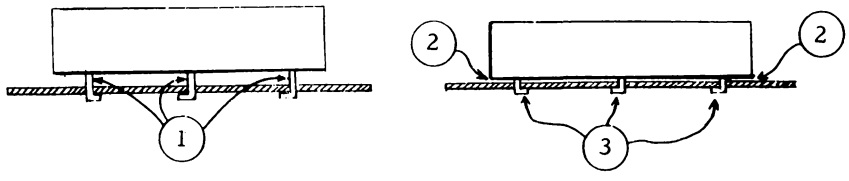


Figure 3-11

9. Resistor mounting on a tube socket base.

a. When connected between tube sockets and cards, the body of the resistors shall be between 1/4'' and 1/2'' from the tube socket pins.

b. When it is necessary to increase the resistor lead length on the card side, a splice may be made. This splice shall be made using uninsulated solid wire (3005352) and a butt connector (3003820). It shall be insulated with plastic tubing (3002614) and (3002914), leaving no exposed metal. This ''jumper'' shall be as short as possible while maintaining satisfactory routing.

10. Special Component Mounting

a. When diode 3212261 is mounted between pluggable unit connector pins, tubing #3208139 must be placed over the diode body.

11. Wiring within a Pluggable Unit (Figures 3-11 and 3-13).

a. All stranded wires should be stripped and tinned before wrapping.

b. All wraps should be from 270° to 360°.

c. All wraps shall be tight and fully closed against the terminal.

d. There shall be no loose strands projecting from the solder joint.

e. There shall be no fanning of wire strands after wrapping.

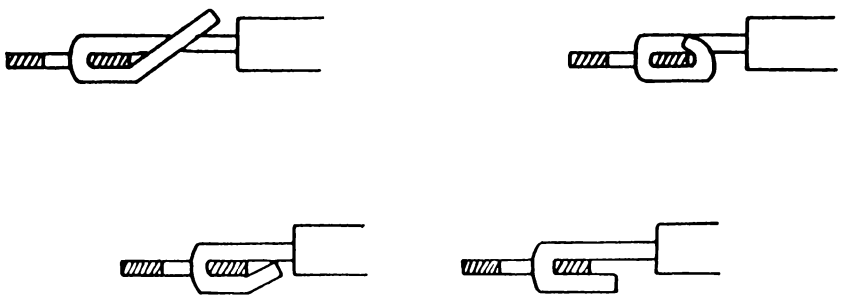
f. All wire wraps on a terminal will be in the same direction.

g. All wires will be installed so that any one wire can be removed without disturbing the other wires.

h. There shall be no nicked or broken strands on any wires.

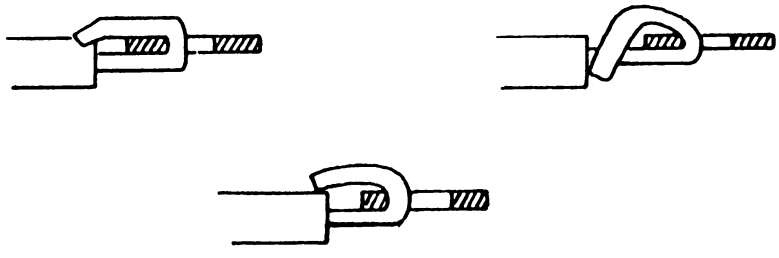
i. Insulation will be stripped 1/16'' $\pm$ 1/32'' from the terminal.

j. Wires wrapped on P.U. base pins will be wrapped on the end of the pins, if possible.



Satisfactory Mechanical Wraps on Eyelet Type Terminals

Figure 3-12



Unsatisfactory Mechanical Wraps on Eyelet Type Terminals

Figure 3-13

k. New wires being installed will have enough length to reterminate the lead one additional time.

l. Wiring within a P.U. shall be done in a squared off fashion. Wiring between cards should be secured in slots in cards.

m. The distance between wires wrapped on adjacent terminals will be no less than 1/16''.

n. Filament wires should have a minimum of six (6) turns per foot.

12. Repair of Conductors on Printed Circuit Card Assembly.

NOTE: Require prior Quality Control approval.

a. General

(1) Repair jumpers may be run from land to land, lug to lug, component lead to component lead or any combination thereof.

(2) All repair jumpers, replacing open circuitry, shall be made with #20 bus wire and sleeving, P/N 3061949, cut to length.

(3) All repair jumpers will be on the front side of the card (under the components, if possible) and shall be mounted off the card.

b. Procedure

(1) Land terminations will be made by using a berg wrap terminal, P/N 3096029, or approved equivalent, crimped to the jumper. The terminal will be soldered in place using a suitable, well-tinned iron and 60-40 non-activated flux core solder.

(2) Lug and component lead connections must be clean and mechanically tight before soldering. One completely closed wrap is necessary. See Figure 3-14.

(3) All repair jumpers must be inspected for good mechanical and soldered connections.

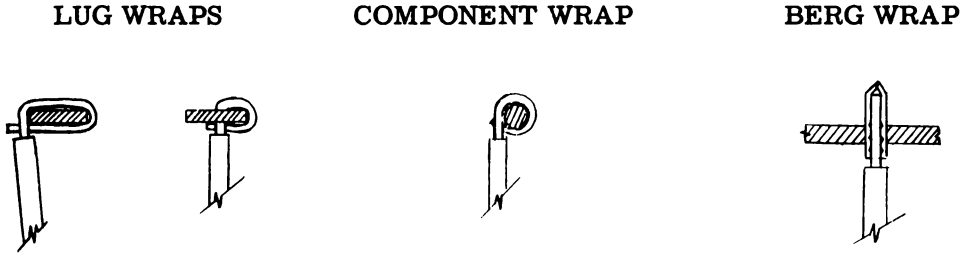


Figure 3-14

13. Repair of Cracks in Card Assemblies.

NOTE: Requires prior Quality Control approval.

a. Cracks and crazes (surface separations which do not extend completely through the body of the card) will be considered for repair only if all the following conditions can be met:

(1) The crack must not run under, or appear to run under a conductor, on either side of the card. A crack cannot run through a land pattern, or under a land pattern, in a location which may affect continuity to a conductor.

(2) No single crack can be more than 5/8" in length.

(3) There will be no more than two repairable cracks on a card, and no more than two additional acceptable damaged areas in the phenolic.

(4) No cracks may originate at either of the mounting edges of the card or from the other edges of the card to within 1'' of either mounting edge.

(5) No cracks may extend in a line parallel to the mounting edge of the card.

b. Procedure

(1) Secure the card by means of a vise or other fixture such that the longer sides receive the gripping action. Caution must be taken to prevent damage to the edges.

(2) Drill hole (holes) at the crack and completely through the card with proper bit, located as follows: (Minimum diameter 1/32'' maximum diameter 1/16'').

(a) Crack connecting two lands - drill one hole mid-way between the lands.

(b) Crack extending from a land and terminating in the open card - drill one hole at the very end of the crack in the open card.

(c) Crack extending from edge of card to a land - drill one hole within 1/16'' of the land.

(d) Crack extending from edge of card and not connecting a land - drill one hole at end of crack within the card.

(e) Crack originating and ending in the open card - drill two holes, one at each end of crack.

c. Clean particles of phenolic from the card with a small brush or cloth. The edges of the drilled hole (holes) must be clean, smooth and free of chipping.

14. Special Information on Diode Cans.

a. Ring tongue terminal grounds must be tight. (1, Figure 3-15.)

b. Female base pin should exhibit sufficient pressure on a male base pin to provide a good ground.

c. Insulators are required between diode cards and between the card assemblies and the diode can cover.

d. Diode card assemblies that have lands on both sides of the card must be soldered to the component lead on both sides.

e. Component mounting will be handled as outlined in P.U. repair information, Item E.

f. Cover screw holes should be checked for correct alignment prior to installing screws to present stripping.

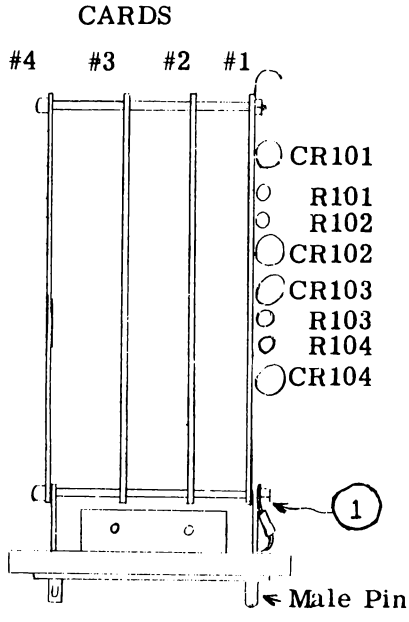


Figure 3-15

15. IMPORTANT ITEMS TO REMEMBER

a. Service terminals should be mounted off the tapered terminal not more than 1/32".

b. The printed cards that have lands on both sides of the card must be soldered on both sides.

c. All leads require mechanical security before soldering.

d. Wires with broken or nicked strands must be reterminated.

e. All leads or terminals which come within .045" of another lead or unequal potential surface must be sleeved.

f. Only one end of a component can be clipped for test purposes, if both ends are clipped, the component must be replaced.

g. Base connectors which are broken or cracked will be replaced.

h. There should be no missing or loose hardware on any P.U.

i. No bend in the component lead shall have a radius which is less than the lead diameter.

j. All wires and component leads will have a relief bend or visible slack.

k. All card assemblies must be in their correct slot.

INFORMATION CONCERNING BACK PANEL WORK

1. Back Panel Wiring

a. All filament and power wires must be No. 18 stranded. larger

b. All signal wire shall be No. 22 stranded. smaller

c. Wire color code table is as follows:

Table 3-1

COLOR	VOLTAGE AND USE
Black	Ground
Brown	Heater at -70v (standard) bias
Red	+150
Orange	+250
Yellow	Signal
Green	-150
Blue	-30
Violet	-300
Grey	+90
White	-15
White with Black Tr.	+10
White with Brown Tr.	Heater voltage at other than -70v bias
White with Red Tr.	+150 Margin Check
White with Orange Tr.	+250 Margin Check
White with Yellow Tr.	-150 Reset
White with Green Tr.	-150 Margin Check

White with Blue Tr.	+150 Relay
White with Violet Tr.	-300 Margin Check
White with Grey Tr.	+90 Margin Check
White with Red and Black Tr.	-15 Decoupled
White with Orange and Green Tr.	-48
Twisted and (Yellow)	Signal
Shielded Pr. (Yellow and Black)	Return
White with Grey and Yellow Tr.	+115 AC Decaying Volt
White with Violet and Brown Tr.	+600 DC Driver Situation Display Console
White with Blue and Green Tr.	+208 AC Regulated

d. All wires terminating at a soldered connection of a soldered terminal will be stripped and tinned before wrapping or inserting into terminal. Wires terminating in a solderless connector will be stripped only.

e. Before soldering to any terminal, all wire must pass through the eye of the terminal and be mechanically secured with a 270° minimum bend around the right side of the pin. 1/16" $\pm$ 1/32" of exposed wire shall show between a soldered connection and the end of the wire insulation where insulated wire is used.

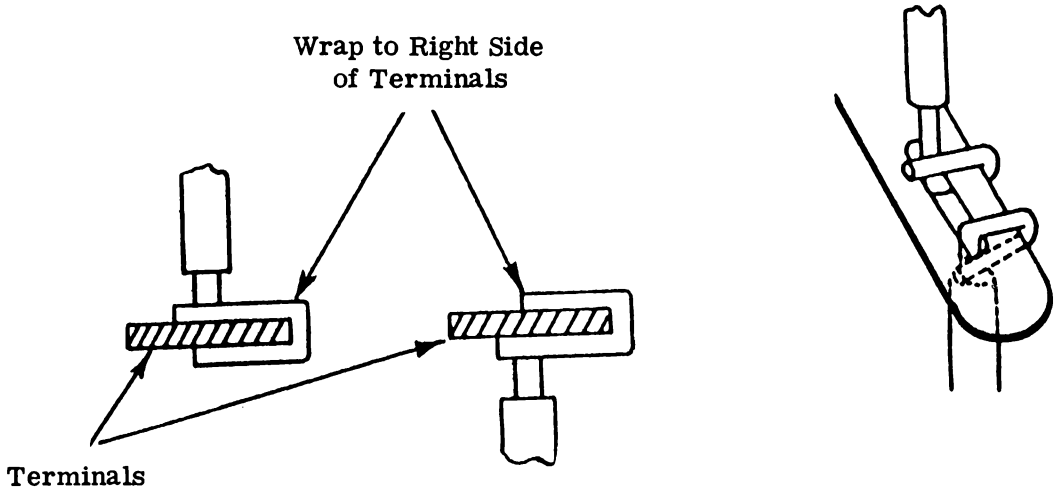


Figure 3-16

f. Ring type crimp-on terminal lugs will be used on all wires connecting to the Jones strip.

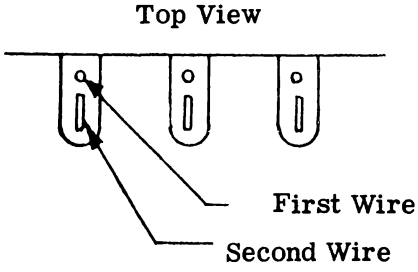


Figure 3-17

g. Inter-Module Coax Assembly will have its vertical travel in Cable Straps provided for them at the right hand side of each Module. (1, Figure 3-18.) Use shortest available coax assembly leads (yellow and black) to allow shortest path to termination with sufficient amount of slack to maintain flexibility in positioning wires. This practice is commensurate with good wiring standards. This vertical travel will take place on the right hand side of that module which is the left hand termination point of the Coax Assembly. Inter-module coax signal wire leads crossing the frame break will be labeled with a piece of sleeving 5/8" in length or easy marker which has been stamped to designate the row and edge connector termination. The sleeving will be slipped over the yellow lead of the coax. The black lead will not be labeled.

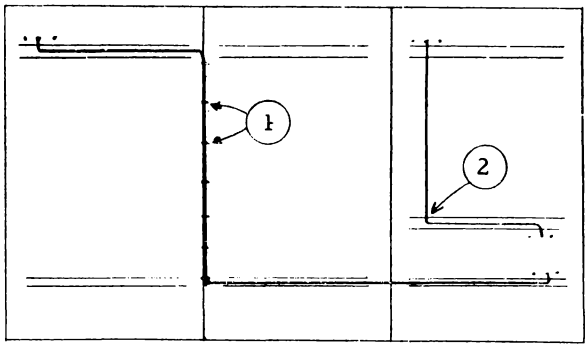


Figure 3-18

h. Intra-module Coax Assembly traveling vertically passes through spring clips at the base of resistor boards. When arriving at the resistor board nearest to its terminating point, it will enter the board via the spring clip, pass horizontally to the rectangular opening nearest its terminating point where the coax leads will then pass through. (2, Figure 3-18.) The terminating leads of the Coax Assembly will be considered as back panel wire and will adhere to paragraphs governing back panel wire.

i. Back panel wires, with the exception of Coax Assembly, will follow the shortest vertical and/or horizontal path possible between connections allowing for a sufficient amount of slack to maintain flexibility in positioning wires. No diagonal wires are permitted. This practice is commensurate with good wiring standards.

j. Resistor board jumpers and leads to the resistor board will be wrapped and soldered to the inner ring of the CTC terminals. When no component is mounted on a CTC terminal, and the inner ring is filled, the outer ring may be used for additional leads. Be sure there is sufficient relief bends.

k. Resistor board jumper leads exceeding 3/4'' in length must be insulated with approved sleeving. This allows the use of uninsulated jumper wires between adjacent CTC lugs on resistor board assemblies.

l. Any loose resistor board terminal board in use on the solder bus should be bussed to a tight terminal using #20 AWG or larger wire.

2. Component mounting on back panel resistor boards.

a. The color coding on components mounted on resistor boards will be left to right, front to back. (The side of the resistor board furthest from the metal fish plates is considered the front side.) (1, Figure 3-19.)

b. All components should have a relief bend. (2, Figure 3-19.)

c. Components should be mounted to the right of the CTC terminals, provided this is the prevailing direction of all rework in that area. (3, Figure 3-19.)

d. Components mounted parallel to the resistor boards length should be mounted on the inside of the CTC terminals, provided they will not interfere with other components. (4, Figure 3-19.)

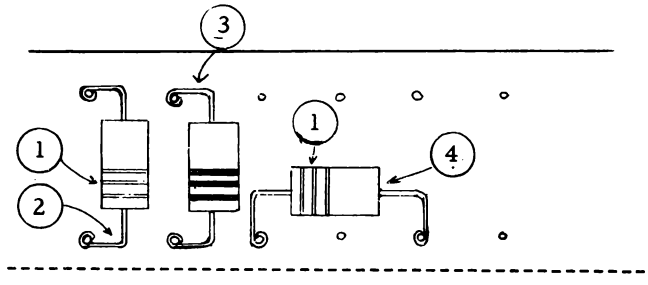


Figure 3-19

e. Where components are mounted across the board and a component is to be mounted with the length of the resistor board, mount the resistor outside the CTC terminals. (1, Figure 3-20.)

f. Components mounted ouside the CTC terminals should not extend beyond the resistor board. (2, Figure 3-20.)

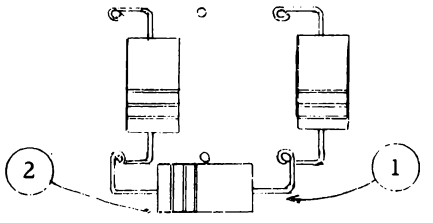


Figure 3-20

g. Where possible, resistors mounted on the resistor board shall not lie across the mounting flanges of the delay line. If a resistor is to be located over the mounting flanges, it will be positioned as to make the screw accessible. Resistors will not be mounted across both flanges of a delay line.

h. Neon assemblies mounted on resistor boards shall have their leads insulated with approved sleeving.

i. Resistors, capacitors and other components will be wrapped and soldered to the outer ring of the resistor board CTC terminals.

3. Check over all rework areas for the following:

a. Each unit shall be visually checked after assembly against the wiring charts for errors.

b. Each solder joint made during assembly or after rework shall be individually inspected.

c. A careful inspection of all wire and resistor leads must be made to determine that the respective leads do not touch against an adjacent uninsulated wire or terminals to cause a short circuit.

d. Be sure the resistor board clips are not on too tight. Place them between the resistor board CTC lugs, so there will be no possible way of shorting to a CTC lug. For ease in detecting missing clips, use four clips on a 9-tube module and three on a 6-tube module.

e. Safety shields should be returned to their proper home location when work is completed in that general area.

MISCELLANEOUS INFORMATION

1. Soldering

a. Completed solder joints shall exhibit the following characteristics:

(1) All wraps shall be fully loosed and have mechanical security.

(2) Good filleting, Figure 3-21.

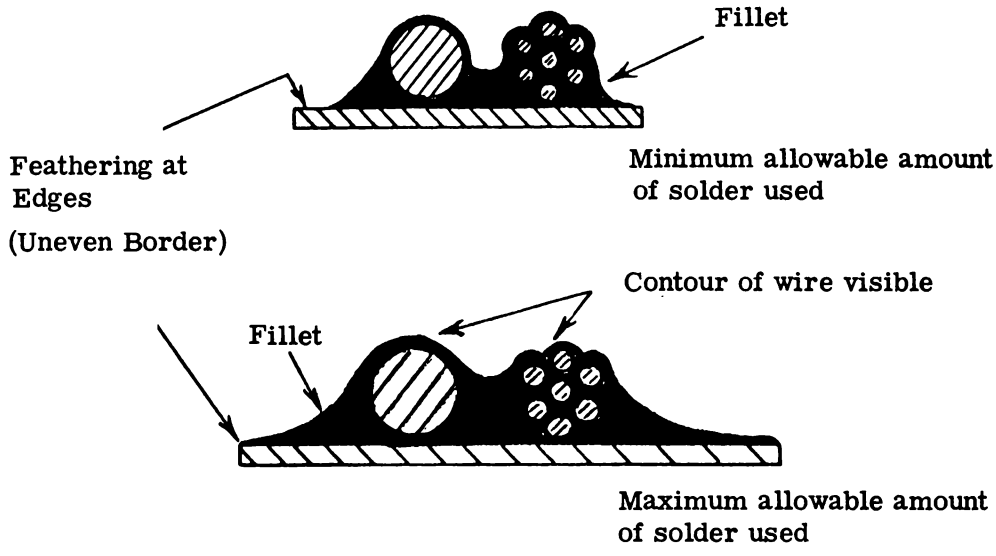


Figure 3-21

(3) Feathering at the edge of each joint.

(4) Sufficient contour of the wire shall be visible to assure that the solder bond is adequate.

(5) Wire insulation shall be kept within 1/16'' ± 1/32'' of the solder joint. In no case shall the insulation be in the solder. (See Figure 3-22.)

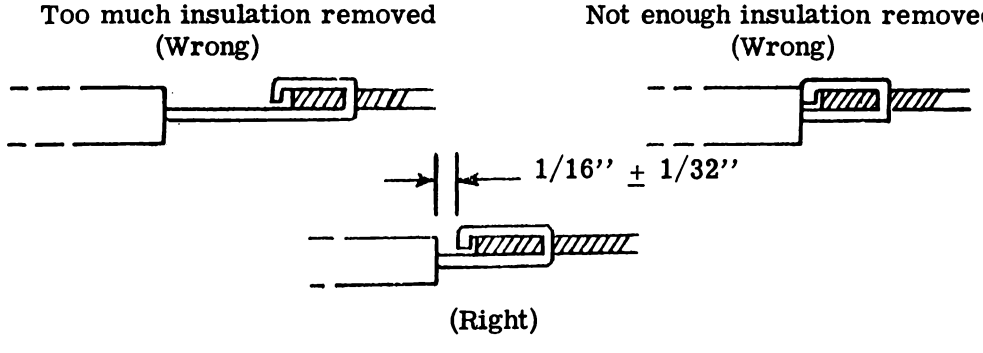
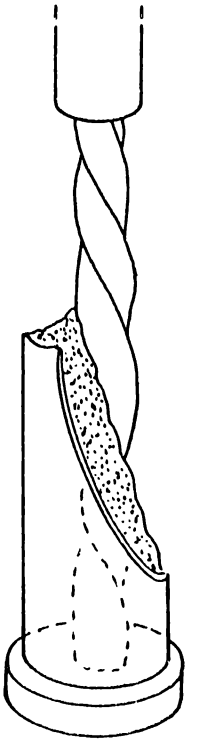


Figure 3-22

(6) There shall be no sharp points, corners, bulges or projecting wire strands.

(7) No wire or lead stress may occur, all shall have a relief bend or visible slack.

(8) Wires terminating in hollow, cylindrical, solder type terminals shall bottom in the cup before solder is applied. (Figure 3-23.)



Hollow Terminal

Figure 3-23

A wire being soldered to a turret-type lug shall make at least one, and not more than two, complete turns around the lug. (Figure 3-24.)

(9) Soldering with a Console Power Supply or High Voltage Unit is very critical. All joints should contain enough solder so that a smooth surface is formed by the solder joint. This will reduce corona effect. If there are any sharp points on the termination, or in the general area of the termination, arcing may exist.

(10) Soldering on the ceramic terminal blocks within Tektronix test equipment will be done with silver solder, P/N 3034899.

(11) Soldering on commercial test equipment printed cards, such as the multimeter selector switch board, should be done with the printed circuit soldering iron, P/N 3064606.

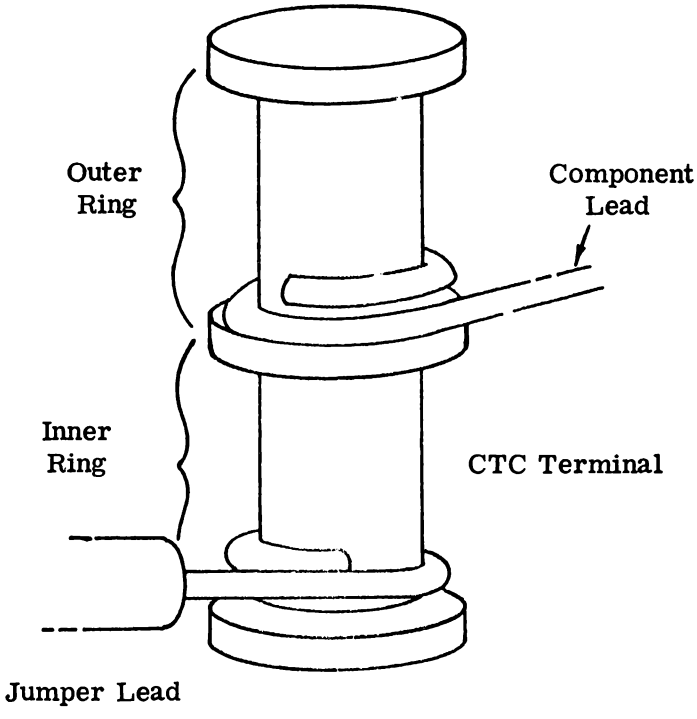


Figure 3-24

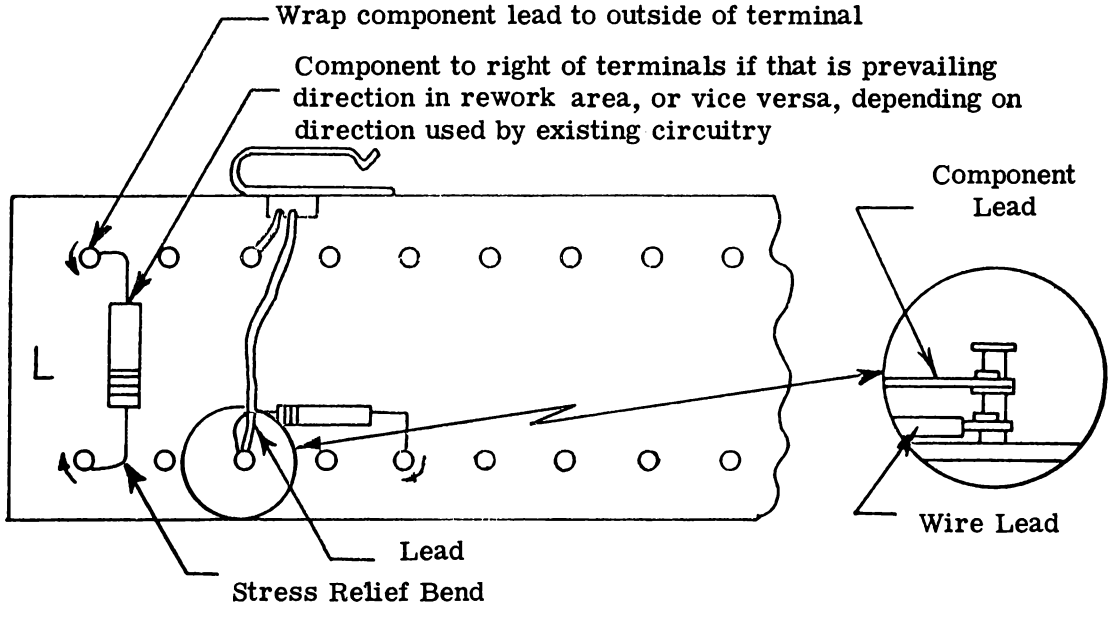


Figure 3-25

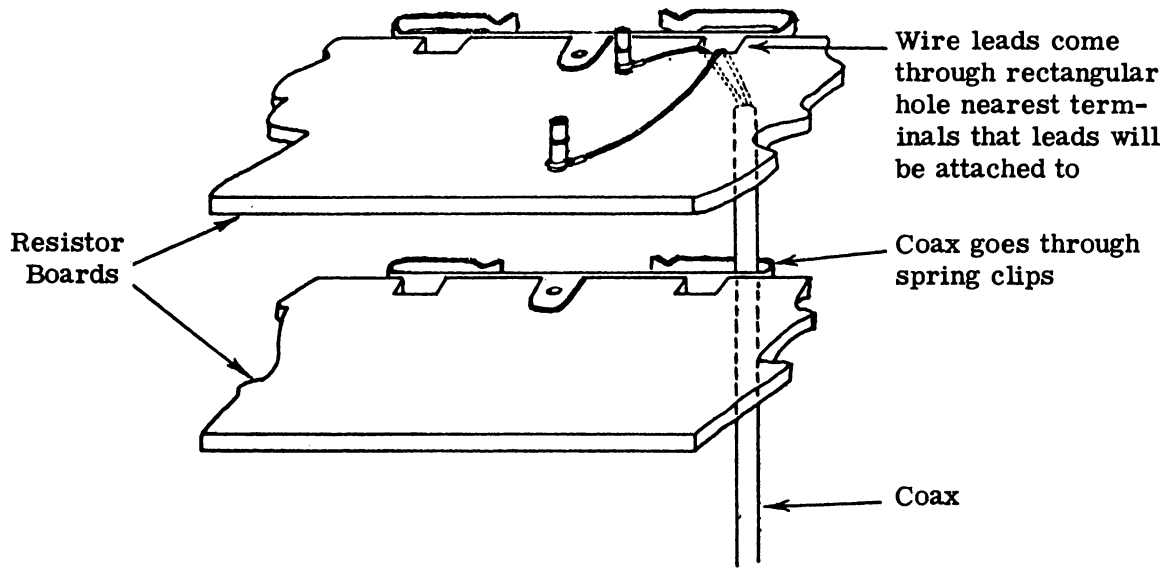


Figure 3-26

(12) To clean solder from terminals use braided shield previously dipped in Liquid Flux P/N 3501128.

2. Grounding

a. Surface contact grounding

(1) The following operations will give a good electrical contact surface where an area is required to be tinned.

(a) Clean to base metal by using 3034928, 3034929, 3034930 or 3034906 sandpaper.

(b) Blow clean or wash with 3034626 (do not touch with your hands).

(c) Allow soldering iron 10 to 15 minutes to warm up.

(d) Heat surface with soldering iron and apply solder to surface, rubbing iron tip on surface to speed tinning.

(e) Clean with 3034626 solvent to remove flux residue (after cooling).

(f) Mask off tinned area to size called for (ref: 3/4'' square unless otherwise specified).

(g) Spray exposed area with zinc chromate primer, 3034741, gray primer, 3034742, and other finish if required. Blend paint into existing paint.

(h) After paint is removed, remove masking tape and clean tinned area with 3034626 solvent.

(i) Assemble joint.

(j) For a permanent ground connection, the joint should be sprayed with one coat of a finish matching the surrounding area (this may be the second coat of gray primer to seal air from the joint).

> NOTE: All areas not to be painted shall be protected from overspray, especially electrical and glass parts before painting is started.

b. Point Contact Grounding

(1) Bond between painted parts may be accomplished by the following:

(a) External tooth lockwashers (star washer) and sem screws can be used to obtain an electrical bond between two painted parts. In this manner, a painted panel can be grounded by being bonded to a frame which is at ground potential. When assembling the connection, the lock washer should grind into the painted surface.

(b) All the connections shall be checked (see c) to assure that the lock washer has broken through the painted surface. Since it is possible for corrosion to appear where the painted surface was marred by the tooth type washer, all these connections will be painted to assure of no corrosion.

(c) The maximum resistance between two metal parts shall be one ohm. This test should be verified with an ohm meter.

c. Table of lock washers that can be used for grounding.

Table 3-2

Screw Size	Manufacturer Part No.	IBM Part No.
#4	AN936-B4	3000845
#6	AN936-B6	3000846
#8	AN936-B8	3000847
#10	AN936-B10	3000848
1/4	AN936-B416	3003874
5/16	AN936-B516	3003963
3/8	AN936-B616	3003851
1/2	AN936-B816	3004139

3. Special Termination

a. All solderless connector terminations should exhibit the following characteristics:

(1) All strands of a stranded conductor are to be clamped within the connector.

(2) The wire leads should not be tinned.

(3) Terminal barrels shall exhibit no evidence of fracturing or spalling as a result of crimping.

(4) Each terminal must be crimped with the tool recommended by the manufacturer of the terminals. (See "Use of Hand Tools" Book Tables.)

(5) Insulation grips shall be closed on the wire insulation.

(6) The electrical continuity between the wire and the solderless connector shall be "0" ohms.

(7) Wire sizes No. 10 AWG and smaller which are to be inserted in an insulation gripping terminal shall be stripped back a minimum length equal to that portion of the terminal which grips the wire with a tolerance of +1/32 -0 inches.

RING TONGUE TERMINAL

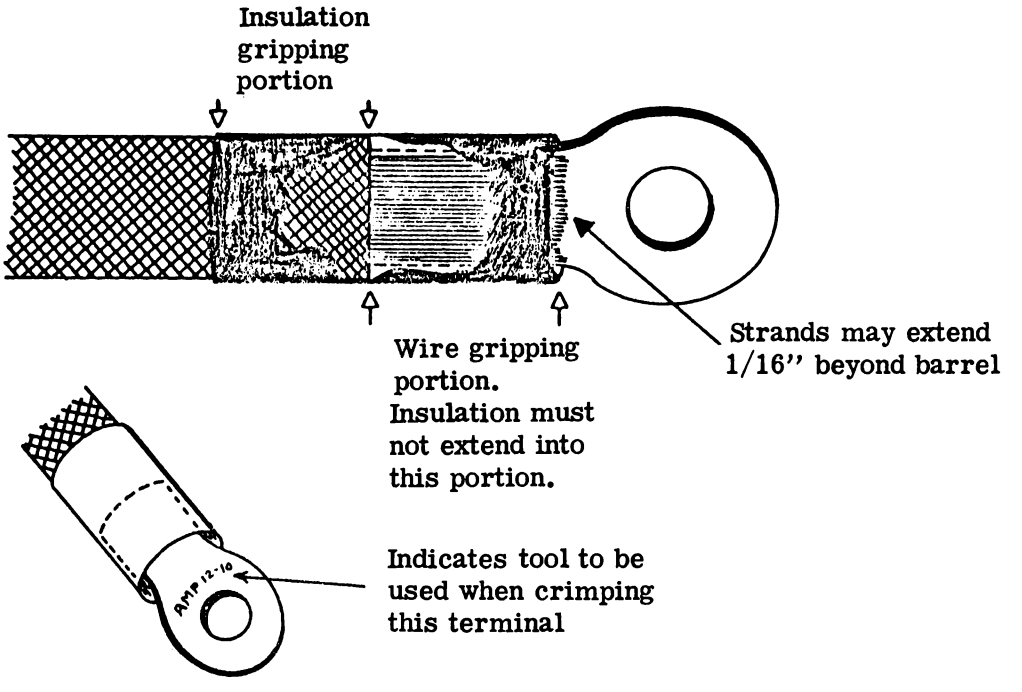


Figure 3-27

(8) The wire shall be inserted in the barrel of the connector so that the area of contact after crimping is equal to or greater than the cross section area of the wire.

(9) All leads terminating in solderless connectors must be securely crimped on both the wire and insulation.

b. Ring Tongue Terminal Installation

(1) There are two major types of ring tongue terminals:

(a) Insulated shall be used on all current carrying wires. Wire of #10 AWG and smaller must have the insulation crimped within the ring tongue terminal.

(b) Uninsulated shall be used on wires larger than #10 AWG. This type terminal can also be used on components where there is no insulation on the component lead and where spacing of components permits the use of uninsulated leads.

(2) Correct method of mounting ring tongue terminals:

(a) Wire insulation to be stripped back a sufficient amount to allow the wire strands to extend through the end of the ring tongue terminal for a length of up to 1/16".

(b) Be sure enough wire insulation is inserted into the ring tongue terminal barrel for a tight crimp.

(c) Crimp with the proper hand crimper. This information is available in Table 16 of the "Use of Hand Tools" manual. Use AMP tools on AMP lugs and Burndy tools on Burndy lugs.

(d) AMP and Burndy lugs are carried under the same part number. Be sure the correct tool is used for whatever type terminal is received from stock. If the wrong tool is used, the crimp will not be good and may be rejected by Q.C.

(3) Method of determining manufacturer of ring tongue terminals:

(a) Burndy lugs

1. Wire size and symbol will be present on the metal terminal throat.

2. The plastic insulation extends beyond the terminal barrel (both ends).

(b) Amphenol lugs

1. Wire size and "AMP" will be present on the metal terminal throat.

2. The plastic insulation is flush with the terminal barrel on the lug end of the terminal.

(4) Correct use of hand crimper:

(a) Hand crimpers which have adjustable jaws should be adjusted to the correct wire size before making the crimp.

(b) Place the side of the crimpers with the narrowest jaw opening nearest the lug end of the ring tongue terminal.

(c) Apply sufficient pressure to insure a good crimp.

(d) Be sure the insulation has been crimped securely.

c. Taper Pin Termination

(1) As seen in the inspection window (a, Figure 3-28) nearer to the tip of the taper pin, bare wire must be flush with or extend past the wire crimp. Insulation (b, Figure 3-28), as seen in the other inspection window, must be flush with or extend past the insulation crimp.

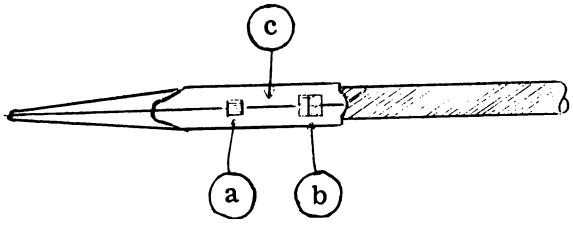


Figure 3-28

(2) Be sure to use the right tool on the taper pin. (See Hand Tool Book Tables.)

(3) The tightest crimp on the taper pin will be on the wire strands. (c, Figure 3-28.)

d. Coax Cable Termination

(1) The use of two-way or butt connectors shall require that the outer connector be stripped back 11/16" from the cable end. The center conductor insulation shall be stripped back to leave 3/16" of insulation showing beyond the end of the braided conductor.

(2) When the coaxial cable or shielded conductor has an outer insulation, this insulation shall be stripped back 5/16" from the end of the braided conductor, as shown in Figure 3-29.

(3) Install inner ferrule between the center conductor insulation and the braided shield.

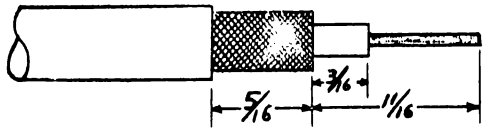


Figure 3-29

(4) The termination of the outer conductor shall be accomplished by pushing the outer ferrule over the braided conductor. It should be placed at least 1'' from the end of the outer conductor.

(5) If a lead or pigtail will be connected to the outer conductor, the lead insulation shall be skinned so that no less than 1/4'' of the lead is in contact with the outer conductor. The outer ferrule shall now be pulled into position over both the outer conductor and the lead until it is directly over the inner ferrule. The ferrule assembly shall now be crimped with the appropriate crimping tool.

NOTE: See Table 16 in ''Use of Hand Tool Manual'' for listing of ferrules for the coax cables and the hand tool listing.

(6) The center conductor shall be solder coated over its entire exposed length. When the size of the conductor is #24 AWG or less, the conductor shall be folded back upon itself approximately 13/64 before solder coating. The two-way connector shall now be slipped onto the center conductor to a full depth of the conductor barrel. The connector insulation must extend over the center conductor insulation. The lead to be joined with the center conductor by means of the connector shall now be stripped 1/4'' and inserted full depth in the other end of the connector barrel.

(7) The assembled connector shall now be crimped with the appropriate tool.

(8) A piece of vinyl plastic tubing which has been previously dilated in a mixture of three parts Methylene Chloride (3034905) and seven parts TecSolv-928 (3034868) shall now be slipped over the assembly so that both the outer ferrule and the two-way connector are fully insulated. The length of time needed to dilate the tubing will depend on the size of the tubing and the amount of swelling desired. The tubing should be left in the mixture only long enough to achieve the desired results, maximum of 15 minutes. Excessive exposure to this mixture will cause the tubing to become hard and brittle. The assembly shall appear as shown in the figure below in which the plastic tubing is shown cut away to demonstrate the centering of the tubing over the connection.

(9) A good coax termination will withstand a pull of nine pounds with no physical derangement of the termination.

(10) Step by step illustration of assembling the inner and outer ferrule can be found in FTI 493.

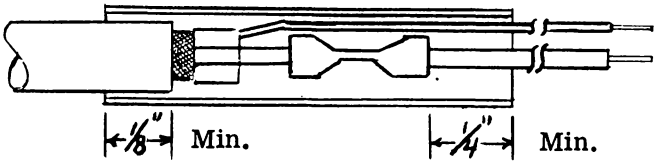


Figure 3-30

4. Butt Connectors

a. Use on wire sizes #10-22

(1) The insulation must enter the connector far enough so it can be gripped by that portion of the connector intended to grip the insulation. The bare wire should extend beyond that portion of the connector intended to grip the bare wire, a distance of 1/16" + 1/32 - 0. No part of the wire's insulation will be gripped by that portion of the connector intended to grip the bare wire. The bare wire should be seen in the inspection window.

b. Use on wire sizes #24-26

(1) The conductor shall be folded back upon itself a distance of approximately 13/64 and solder coated. Then proceed as in 1, above.

c. Use on Coax

(1) See Miscellaneous Information, Special Terminations, Coax.

5. Cable Modification

a. To extract a conductor from a cable.

(1) Cut the conductor back to the lacing or taping at both ends of the cable.

(2) No taping will be required provided the conductor is cut close to the cable.

b. To remove a conductor.

(1) Disconnect the wire from its termination point.

(2) Tape the wire end 3" back with plastic tape.

(3) Fold the wire back and spot tie it to the cable trunk.

c. To modify a cable by using a spare lead.

(1) Remove the spare lead from the spare group. This lead will have to be taken completely out of the spare group (all the way to where the spare group leaves the main cable trunk).

(2) When using a single spare lead, spot tie the lead along the main cable trunk, following the branch closest to your desired termination point.

(3) When using more than one spare lead, the leads must first be laced together, then proceed as for a single spare.

(4) The last tie before a breakout should be doubled.

d. To modify a cable by adding a conductor.

(1) Route the conductor along the main cable trunk.

(2) Spot tie along the cable trunk every 6''.

(3) If more than one conductor is added, they must first be laced together, then spot tied to the main cable trunk.

CHAPTER 4

CABLING PROCEDURES

Many wires are used to convey power and signals to and from equipment on a site. These wires would present an almost insurmountable control problem were it not for the fact that the bulk of the wires are cabled.

1. DEFINITION

a. By definition, a cable is a transmission line or group of transmission lines mechanically assembled in compact, flexible form. As such, cables have definite advantages in both troubleshooting and in machine-wiring on the assembly floor. One decided advantage is the pre-installation of the various terminal fittings, eliminating the necessity for costly hand-stripping and terminating by the assembly wireman. Another advantage is in the control over part numbers. A cable can have 200 leads and but one part number. If individual wires were used, there would have to be a part number for each color, gauge difference in insulation, and wire length. Each bill of material would have to carry a part number for each wire to be installed if proper production control were to be realized.

2. QUALITY CONTROL

From the viewpoint of quality control, the many advantages would be:

a. Uniform strips and crimps on terminals.

b. When cables are pre-stripped in a cable-finishing area, they arrive at the assembly department ready for use, thereby eliminating the possibility of fracturing or cutting out of conductors through the use of hand strippers. This is important to the assembly departments, as each fractured strand is a major reject.

c. If for no other reason than that of neatness and appearance, good cabling would be a necessity. A cable is much neater than 200 wires hanging individually from inside a frame or machine. Our customers (whether commercial or government) are interested in the compactness and neatness of the machine.

3. ASSEMBLY TECHNIQUES

a. Number 10 AWG and smaller wire sizes which are to be inserted in an insulation-gripping terminal shall be stripped back a minimum length equal to that portion of the terminal which grips the wire with a tolerance of +1/32 -0 inch. (See Figure 4-1B.)

b. The wire shall be fully inserted in the barrel of the connector so that the area of contact after crimping is equal to or greater than the cross-section area of the wire.

c. When a wire terminates in a tapered pin, all strands of the wire shall be visible in inspection window No. 1, nearest the tapered end. The end of the insulation must be

visible in inspection window No. 2. Both the wire and insulation shall be crimped while the conductor maintains this position. (See Figure 4-1A.)

d. The conductivity of the completed connection shall be no less than the conductivity of the wire used.

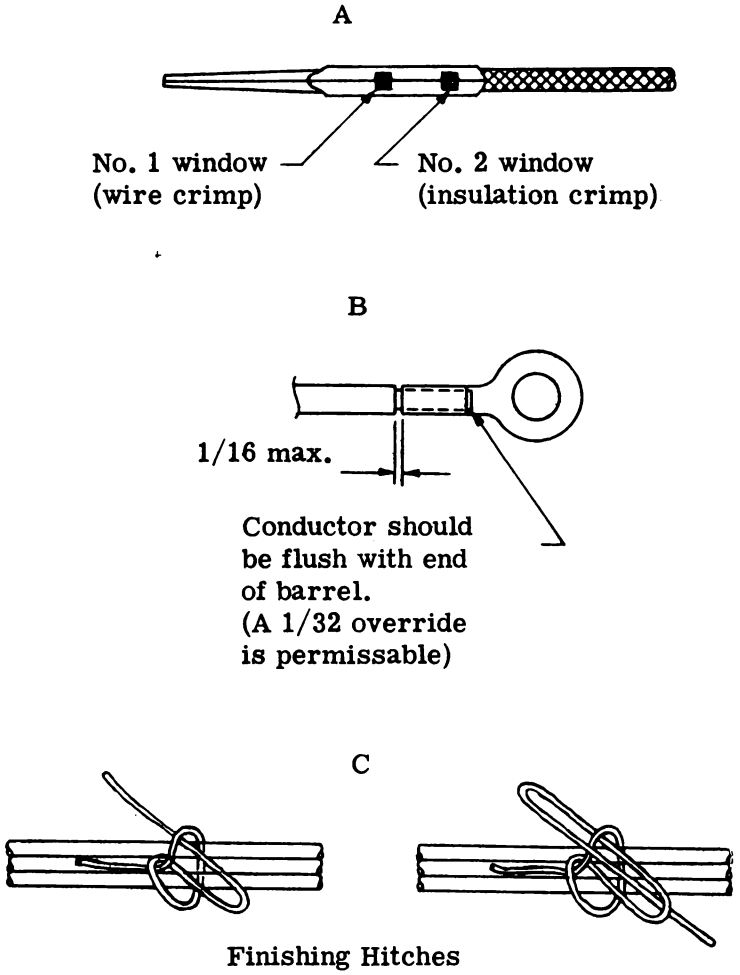


Figure 4-1. Cabling Crimps and Hitches

4. FABRICATION OF CABLES AND HARNESSES

a. Lacing: Whenever portions of the cable or harness are represented on the drawings by two parallel lines 1/8 inch apart, such portions shall be bound and securely laced, using nylon lacing tape (IBM Dwg. No. 3061002). Lacing shall be applied in such a manner as to ensure a circular section. Lacing shall not be used for any section of cable where tape or sleeving is specified on the drawing. This shall include all external cables and harnesses.

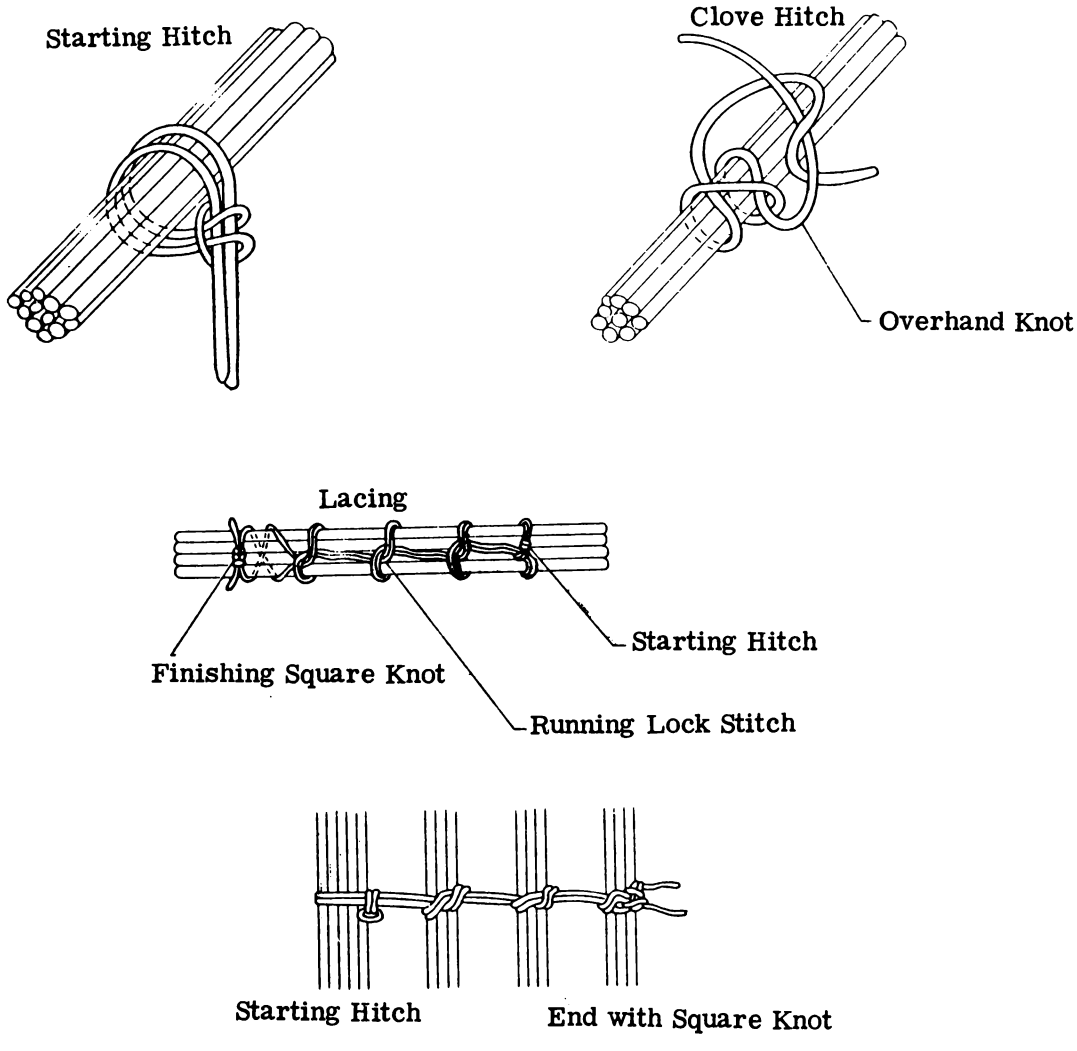


Figure 4-2. Lacing Stitches and Knots

b. Spot Ties: Spot ties shall employ a clove hitch with an overhand knot, as illustrated in Figure 4-2.

c. Procedure for Lacing: Cables 1/2 inch and smaller shall use a single cord single-running lock stitch. These cables shall use a starting hitch, as shown in Figure 4-2 and a finishing hitch, as shown in Figure 4-1C.

d. Cables: Cables over 1/2 inch shall use a double cord, single-running lock stitch. These cables shall have a starting and a finishing hitch, as shown in Figure 4-2.

e. Spacing: Spacing between stitches shall be approximately 1 inch on cables under 1/2 inch in diameter and approximately 1-1/2 inches on cables over 1/2 inch diameter. A stitch shall be made wherever a breakout occurs.

5. LACING OF SPARE GROUP AND FABRICATION

a. Spare Group: Spare group breakouts shall be laced separately from the cable body. Lacing shall be modified to three times the normal distance between stitches and drawn just tight enough to take up slack in the lacing. (See Figure 4-3.)

b. Cable Drawings: On cable drawings No. 3, 501,000 or less, the spare group shall be tied to the longest cable branch at maximum intervals of 6 inches except where the drawing specifies that spares be folded and laced to cable trunk. The ends of spares will be bundled and covered to a minimum distance of 3 inches with black plastic tape No. 3061004. On cable drawings No. 3, 501,000 or more, the coaxial spare group shall be folded back into the cable body and spot-tied to cable body. (See Figure 4-3.)

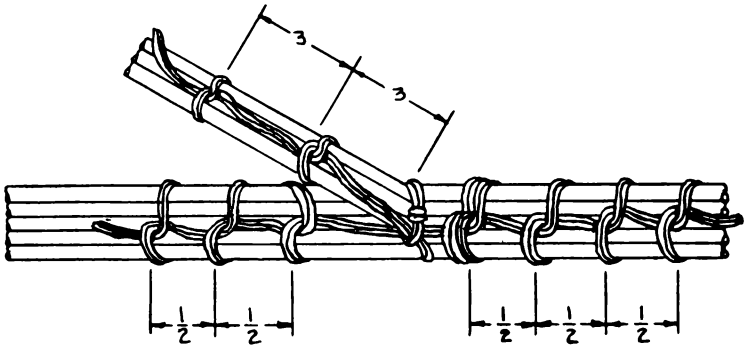
c. Fan Tie: Tie points of the stitching knot for fan-ties shall be approximately 1/2 inch from the body of the cable harness unless otherwise indicated on the applicable drawing. (Figure 4-4.)

d. Broom Stitch: A minimum breakout length of 1 inch shall be maintained. Lead lengths shall vary 1/8 inch unless otherwise indicated on applicable drawing. (See Figure 4-4.)

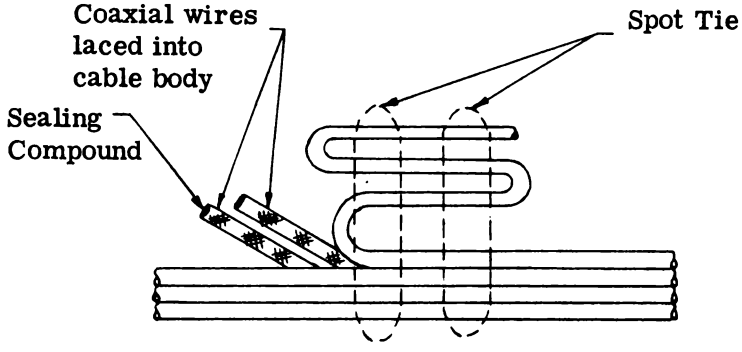
e. Twisting: Two conductor cables, when applicable, shall be twisted with approximately 10 turns per foot.

f. Looping of short leads: Conductors which enter and leave the cable body within a short distance must have at least 2 inches of length laced within the body, even though the conductor must be looped down into the cable and back 2 inches, then securely tied, to obtain this minimum anchorage.

g. Taping: Taping shall be applied with care to insure a smooth surface and a circular cable cross-section. Tapes up to 2 inches in width may be used on cable runs. Junctions shall be taped with tape not over 1-1/2 inches wide on all members extending out 2 inches from the junction center. On all applications each succeeding layer of tape shall overlap the preceding layer by 1/2 the width of the tape. (See Figure 4-5.)

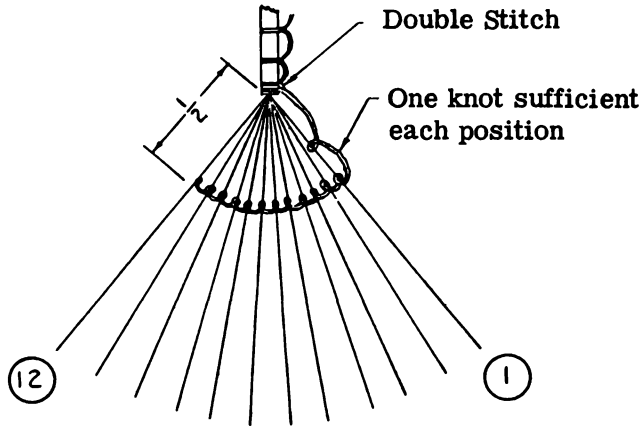


Lacing of Spare Group



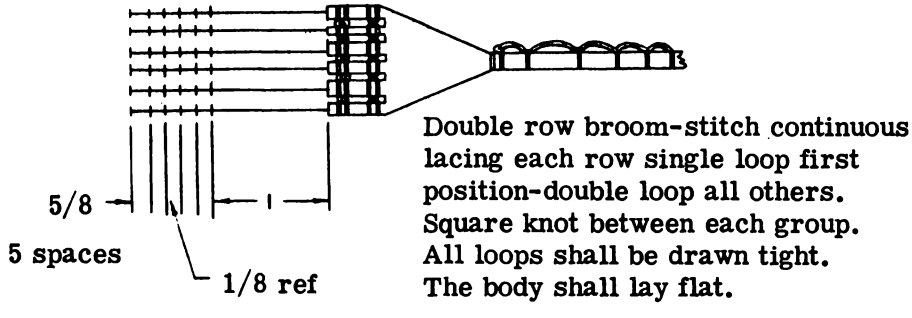
Spot Tie Spare Group to Cable Body

Figure 4-3. Spare Group Lacing



Fan Tie

Body Double Stitch Lacing



Broom Stitch

Figure 4-4. Stitch Lacing

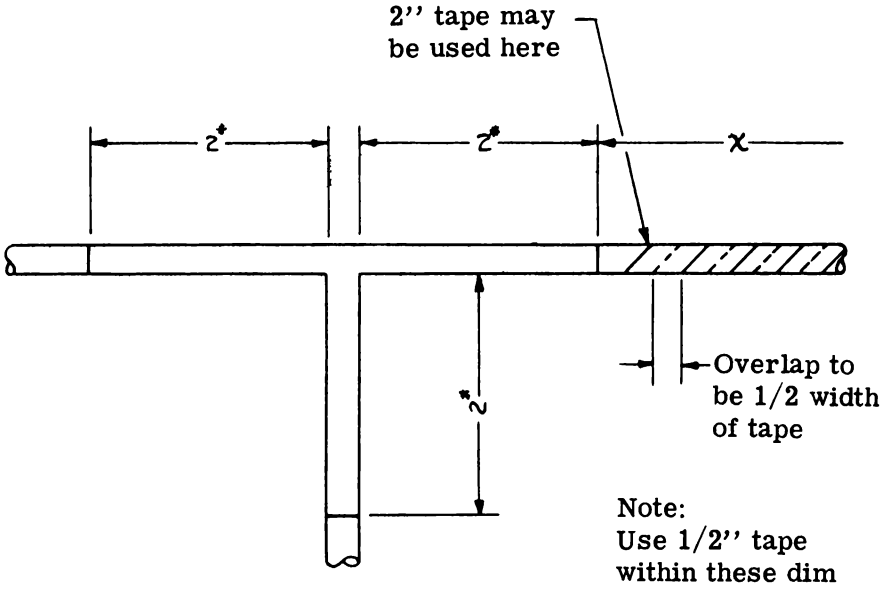


Figure 4-5. Taping

h. Sleeving: Sleeving shall be in accordance with MIL-I-631C. Where sectioned breaks occur in sleeving used over bundled wires, an overlap of a 12 inch minimum is required. The overlap shall be securely bound and sealed with black plastic tape No. 3061004.

i. Fabrications: Where a powder lubrication is used to aid in the installation of sleeving over bundled wires, all excess powder shall be blown out of the sleeve before and after installation. The sleeve ends shall then be split back 3 to 4 inches and tightly bound to the cable body with black plastic tape No. 3061004.

j. Markers and Identification: The identification (does not apply to jumpers) to be stamped on wire markers for all cable drawing numbers less than No. 3, 501,000 shall be the terminal identification found on the drawings adjacent to the cable trunk from which the terminal lead extends. (See Figure 4-6, examples A, B, and C.) The identification on cables and harnesses whose drawing numbers are 3, 501,000 or over shall be the proper circuit point.

k. Coaxial Cable: Wherever coaxial cable shall be used alone or in a harness, the cable shall not be bent shorter than a radius of five times its outside diameter. The force applied to the cable shall be the minimum force required to position it. All preformed bends shall be laced or taped in such a manner as to maintain a smooth curve and prevent the development of kinks through normal handling.

6. COAXIAL CABLE TERMINATION

Figure 4-7 illustrates the four procedural steps involved in terminating a coaxial cable. Proceed as follows:

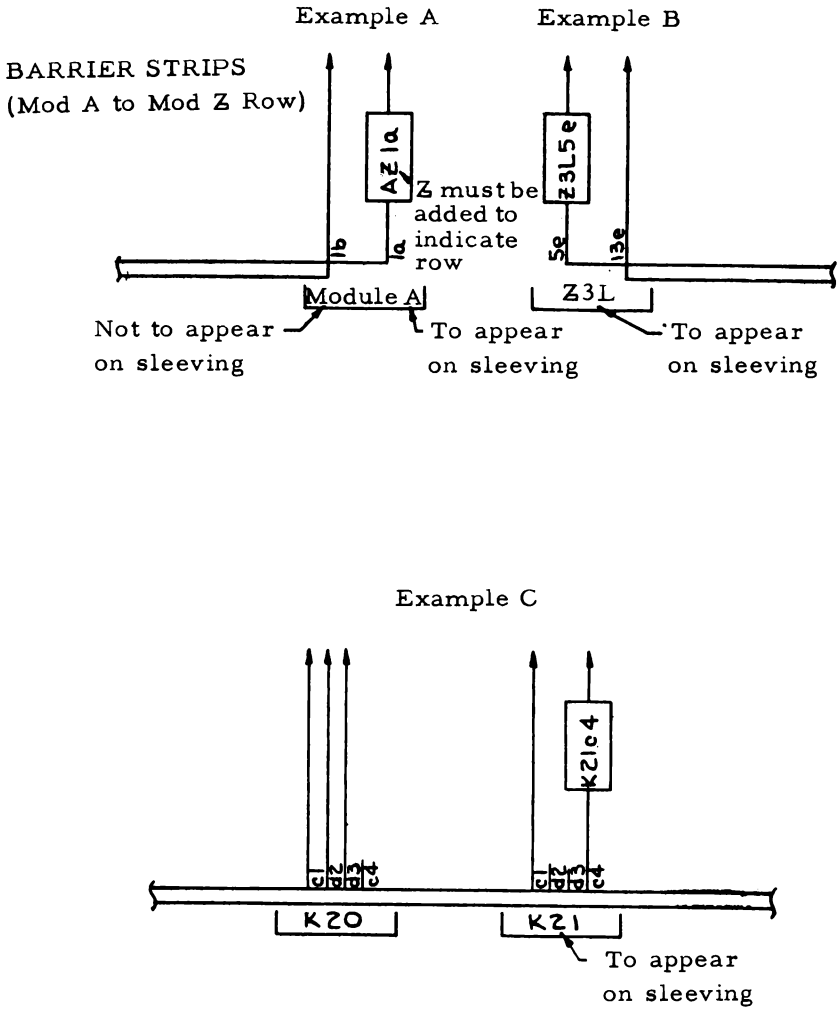


Figure 4-6. Wire Marker Identification

a. Strip the coaxial braid back 11/16 inch from the center conductor insulation. Then, strip the insulation of the center conductor from its wire lead, leaving only 3/16 inch of insulating material showing beyond the braid. If the coaxial braid is insulated, cut back this insulation so the shield protrudes 5/16 inch, as shown in A.

b. Push the outer sheath connector over the braid within 1/4 inch from the braid end. Then insert the inner sheath connector over the center conductor insulation and under the braid. (See B, Figure 4-7.) This inner sheath connector must not extend more than 1/16 inch beyond the coaxial shield. If required, place the shield lead wire against the braid. This wire must contact the braid for 1/4 inch of its surface, as shown in B. Now pull back the outer sheath over the shield lead wire so it is positioned directly over the inner sheath connector. At this stage, this outer sheath must be crimped with the appropriate tool. (See Figure 4-7C.)

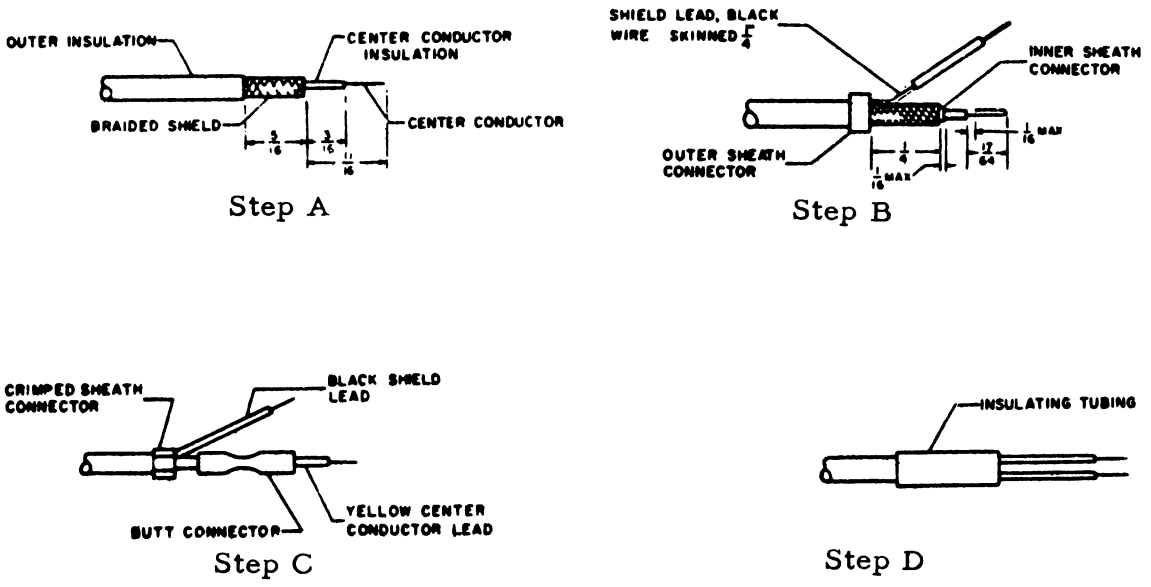


Figure 4-7

c. Before the butt connector is assembled to the coax lead, fold back the coax center conductor on itself approximately 13/64 inch (See Figure 4-7B.) The center conductor must now be solder-coated over its entire exposed length. The butt connector should then be slipped onto the center conductor so that the connector outer plastic tube covers the center conductor insulation and the coax wire is fully inserted in the connector barrel. The yellow center conductor lead (C) must now be stripped 1/4 inch. The stripped end must be placed in the remaining open end of the butt connector so it is fully seated in the metal barrel. The butt connector must now be crimped with the appropriate tool to form the assembly shown in Figure 4-7C.

d. Slip a piece of vinyl plastic tubing, which has been previously dilated in toluene for 10 or 15 minutes, over the assembly so that the sheath and butt connectors are fully covered by the tubing length, as shown in Figure 4-7D.

7. CABLE ID BANDS

a. When assembling identification plate to cable body, insert tongue through slot and secure tightly, fold tongue back on itself, and cut off tongue approximately 1/4 inch from slot.

b. Metal identification plate to be covered by clear plastic tape, P/N 3212814. Sides of metal tag to be covered to a minimum of 1/16 inch.

c. Two bands should be on each cable, one on each end.

8. EASY MARKER

a. Nomenclature must be typed on the sleeving, to prevent smearing spray with Krylon.

b. Wherever EZ type markers are used to mark any portion of a cable, they shall be applied to completely encircle that part of the cable, and shall overlap and adhere upon themselves not less than 3/8 inch. Blank markers may be used to extend the length to encircle large cable bodies.

9. RELAY ADJUSTMENT PROCEDURE

a. The small relays within a relay box, P/N 3034748, should be adjusted according to the following procedure:

(1) Adjust the armature backstop so that a .020 shim can be placed between the armature and the relay core.

(2) Adjust the relay transfer contacts so the push rods rest on the armature arms. A check of the normally closed contacts should be made before any adjustment on the transfer contacts is made. If the normally closed contact is out of adjustment, it will prevent the push rods from going back all the way.

(3) Adjust the N/C contacts to make with a .012 shim at (1) (see Figure 4-8) and break with a .010 shim at (1).

(4) Adjust the N/O contacts to make with a .010 shim at (1) and break with a .012 shim at (1).

NOTE: If the adjustment of the relay is correct, all N/O contacts will begin their transfer at exactly the same time.

(5) When the above procedure is followed, all relay contacts will have a good wiping action, which will keep the contact surface clean.

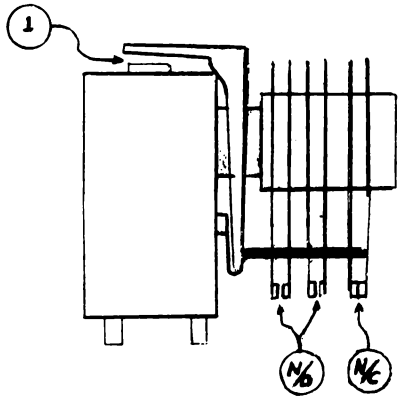


Figure 4-8

10. WIRE AND CABLE REPAIR

a. Splicing Power Cables

(1) Splicing of power cables shall be done only on cables which have already been fabricated. It may be done only in an emergency. The following procedure may be used to rework the cable rather than run a new wire. It is very important that the proper size butt connector be used in conjunction with the proper hand tool. It is also equally important that the splice be made in or as near the main cable body as possible so as to give it support; only one splice shall be made per cable lead. The following steps should be followed in the order they appear.

(a) Strip off the required amount of insulation on the wire, being careful not to nick the strands. The wire being added must be the same size as the wire to which it is being spliced.

(b) Insert the wire into the copper sleeve of the butt connector until the insulation rests against the inside shoulder of the connector and the end of the wire is visible in the center of the window.

(c) Crimp the connection with the approved hand tool, being careful to hold the hand tool in such a manner so that the heavier indentor crimps the insulation. After this has been done on both wires, check to see that both the wire and insulation have a tight connection.

(2) The following table calls out the butt connector and hand tool which must be used for a specific wire. The length of the insulation strip is also listed. (Table is shown below.)

(3) Additional information relative to the lugs and hand tools available is contained in the Appendix of the "Use of Hand Tools" manual.

Table 4-1

IBM P/N	3002913	3099830	3097800	3097801
Vendor	AMP	AMP	AMP	AMP
Vendor P/N	321029	320559	320562	320570
Wire Size	26-22	22-16	16-14	12-10
Strip Length	3/16	1/4	1/4	5/16
Tool Number	48518	49556	48431	59062
Color Code	Yellow	Red	Blue	Yellow
IBM Tool P/N	3033463	3033461	3033464	3033467

b. WIRE LEADS

(1) Wire with split or burned insulation must be replaced. If the wire is not extending from a cable assembly, the complete wire must be replaced. If the wire is extending from a cable assembly, the wire should be cut close to the last cable lacing (at both ends of termination) and a spare lead used. If the spare lead is not available, a new wire should be run, according to normal cable modification methods. In only extreme cases will the use of a butt connector be allowed, such as when a lead leaving armored cable is split.

c. REPAIR OF INSULATION ON SHIELDED WIRE

(1) Coaxial cable that has been burned to the extent that the metallic braid is exposed must be scrapped.

(2) Cuts or tears in the outer covering of coaxial cable may be repaired by wrapping the damaged portion with insulating teflon tape P/N 3514806. The tape must completely cover the damaged portion and must adhere to itself securely by wrapping more than three times around the cable with enough overlap to seal the metallic portions.

(3) This repair is designed to facilitate repair on cables that have not been heated to the point that electrical characteristics may have been altered.

d. REPAIR OF BROKEN SHIELDED WIRE GROUND LEADS

(1) The information contained herein is to clarify acceptable repair on subject wire damaged in assembly processes.

(a) Cut the vinyl plastic tubing the full length of the sleeve and remove it from the connection.

(b) Inspect to see the outer ferrule is properly secured to the wire shield and inner ferrule.

(c) Take a piece of ground wire (No. 22 Teflon insulated) P/N 3003542 which has been previously stripped and tinned and solder it lengthwise over the entire length of the outer ferrule. The outer ferrule is made of copper and tinned, making this very adaptable to soldering.

(d) The solder joint after cooling must have a positive, bright, finish and all excess flux must be removed.

(e) Place a new piece of vinyl plastic tubing, which has been previously dilated in a mixture of three parts Methylene Chloride (3034905) and seven parts Tec-Solv-928 (3034868) (see FTI 555) for fifteen minutes, over the entire connection.

NOTE: This instruction applies only to shielded wire whose inner conductor is protected by Teflon or some other heat resistant insulation.

12. VARIATION REPORTS

a. A Variation Report will be required when any deviation from blueprint configuration is made. Circumstances requiring a VR are listed below:

(1) Parts and components used deviate from drawings or other specifications.

(2) A temporary or non-blueprint repair is made.

(3) Modifications to the equipment are made without Kingston Engineering authorization.

(4) A temporary "FIX" is installed and when an engineering investigation requires rewiring or component changes.

b. The VR should be initiated prior to or concurrent with the deviation from blueprint configuration, if practicable. In all cases, it should be completed within 48 hours of the deviation.

c. A deviation must be concurred upon by the Technical Assistant and the Quality Control Field Engineer and approved by the Sector Manager. The Group Manager or Group Supervisor on duty and the alternate Q.C. Field Engineer will concur upon the change in the absence of the T.A. or Q.C.F.E.

d. An incident card is not authorization for non-blueprint repairs. However, if an incident requires a non-blueprint repair to keep the computer operating, a VR will be originated. The incident can then be closed, referencing the VR.

e. The original copy of the VR will be retained on file by the Q.C. Field Engineer and a copy forwarded to the Group Managers.

f. Rework will be required when the disposition states "Return to blueprint configuration when correct parts are received," or "Return to blueprint configuration when investigation is completed." The Group Manager's copy of the VR will be returned to the Q.C.F.E. when the necessary rework has been accomplished.

g. In instances when the disposition states, "Use as is, no rework will be required."

13. CHECKING WIRE SIZE OF STRANDED WIRE

a. An accurate method is to measure the diameter of an individual strand with a micrometer and determine wire size from the table below.

Table 4-2

No.	No. of Strands	Strand Dia. (Inches)	No.	Type	Insulation O.D. (Inches) Min.	Max.
22	7	.010	22	PVC	.063	.075
	19	.0063		Teflon	.046	.054
20	7	.0126	20	PVC	.071	.084
	19	.0080		Teflon	.053	.062
18	7	.0159	18	PVC	.082	.095
	19	.010	18-	Teflon	.064	.074
16			16	PVC	.091	.105
	19	.0113		Teflon	.073	.087
14			14	PVC	.106	.120
	19	.0142		Teflon	.098	.114
12			12	PVC	.127	.142
	19	.0179		Teflon	.113	.132
10			10	PVC	.147	.167
	37			Teflon	.135	.151

SAVE A LIFE

If you observe an accident involving electrical shock,
DON'T JUST STAND THERE - DO SOMETHING!

RESCUE OF SHOCK VICTIM

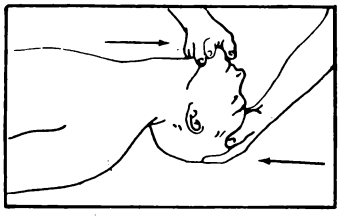
The victim of electrical shock is dependent upon you to give him prompt first aid. Observe these precautions:

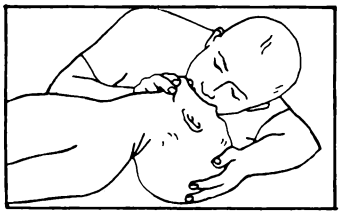
1. Shut off the high voltage.
2. If the high voltage cannot be turned off without delay, free the victim from the live conductor. REMEMBER:
   a. Protect yourself with dry insulating material.
   b. Use a dry board, your belt, dry clothing, or other non-conducting material to free the victim. When possible PUSH - DO NOT PULL the victim free of the high voltage source.
   c. DO NOT touch the victim with your bare hands until the high voltage circuit is broken.

FIRST AID

The two most likely results of electrical shock are: bodily injury from falling, and cessation of breathing. While doctors and pulmotors are being sent for, DO THESE THINGS:

1. Control bleeding by use of pressure or a tourniquet.
2. Begin IMMEDIATELY to use artificial respiration if the victim is not breathing or is breathing poorly:
   a. Turn the victim on his back.
   b. Clean the mouth, nose, and throat. (If they appear clean, start artificial respiration immediately. If foreign matter is present, wipe it away quickly with a cloth or your fingers).





   c. Place the victim's head in the "sword-swallowing" position. (Place the head as far back as possible so that the front of the neck is stretched).
   d. Hold the lower jaw up. (Insert your thumb between the victim's teeth at the midline - pull the lower jaw forcefully outward so that the lower teeth are further forward than the upper teeth. Hold the jaw in this position as long as the victim is unconscious).
   e. Close the victim's nose. (Compress the nose between your thumb and forefinger).
   f. Blow air into the victim's lungs. (Take a deep breath and cover the victim's open mouth with your open mouth, making the contact air-tight. Blow until the chest rises. If the chest does not rise when you blow, improve the position of the victim's air passageway, and blow more forcefully. Blow <u>forcefully</u> into <u>adults</u>, and <u>gently</u> into <u>children</u>.
   g. Let air out of the victim's lungs. (After the chest rises, quickly separate lip contact with the victim allowing him to exhale).
   h. Repeat steps f. and g. at the rate of 12 to 20 times per minute. Continue rhythmically without interruption until the victim starts breathing or is pronounced dead. (A smooth rhythm is desirable, but split-second timing is not essential).

DON'T JUST STAND THERE - DO SOMETHING!