CONNECTING AND SOLDERING INDIVIDUAL CONDUCTORS
WIRING AND CABLING
GENERAL EQUIPMENT REQUIREMENTS

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1. GENERAL

1.01 This practice covers general requirements for the connecting and soldering of cross-connections and individual conductors of equipment and apparatus wiring using 16-gauge and smaller diameter wire. For connections using 14-gauge and larger diameter wire, see AT&T Practice 802-005-180.

1.02 This practice is reissued to make the changes listed under **REASONS FOR REISSUE** at the end of this practice.

1.03 ***A soldered plier connection*** is a soldered connection made in the hole, hook, or notch of a terminal in conformance with the requirements covered in **2. REQUIREMENTS FOR CONNECTING.**

1.04 ***A soldered-wrapped connection*** is a soldered connection made with a wire-wrapping tool or with pliers in conformance with the requirements covered in **2. REQUIREMENTS FOR CONNECTING.**

1.05 ***A solderless-wrapped connection*** is a connection made with an approved power-driven or hand-grip wire-wrapping tool in conformance with the requirements covered in **3. REQUIREMENTS FOR SOLDERLESS-WRAPPED CONNECTIONS.**

1.06 ***A quick-connect connection*** is a connection made in a slotted-beam terminal with an approved-type tool in conformance with the requirements covered in **4. REQUIREMENTS FOR MAKING CONNECTIONS TO QUICK-CONNECT TYPE TERMINALS.**

1.07 Types of terminals used principally on apparatus are shown in Fig 1, 9, 10, 11, 13, 25, 29, 32, and 34.

1.08 ***Whiskers or Filamentary Metallic Growth:*** In applications where current-carrying parts are in close proximity, careful consideration should be given to the finish on the parts. Some finishes containing tin, zinc, or cadmium, such as 562 tin plate finish, have a tendency to promote whiskers or filamentary metallic growths that are accelerated if the finished surfaces are under external stresses. Whiskers or filamentary growths can result in low electrical impedance paths or short circuits. Short circuits may be intermittent if the whiskers are destroyed by the short circuited current. Before specifying apparatus parts that have been finished with such finishes, the design engineer should discuss the condition with the inorganic finishes consultant responsible for metallic growths and whiskers in AT&T Bell Laboratories Department 11534.

1.09 The requirements covered in this practice should be followed except as modified by applicable specifications and drawings.

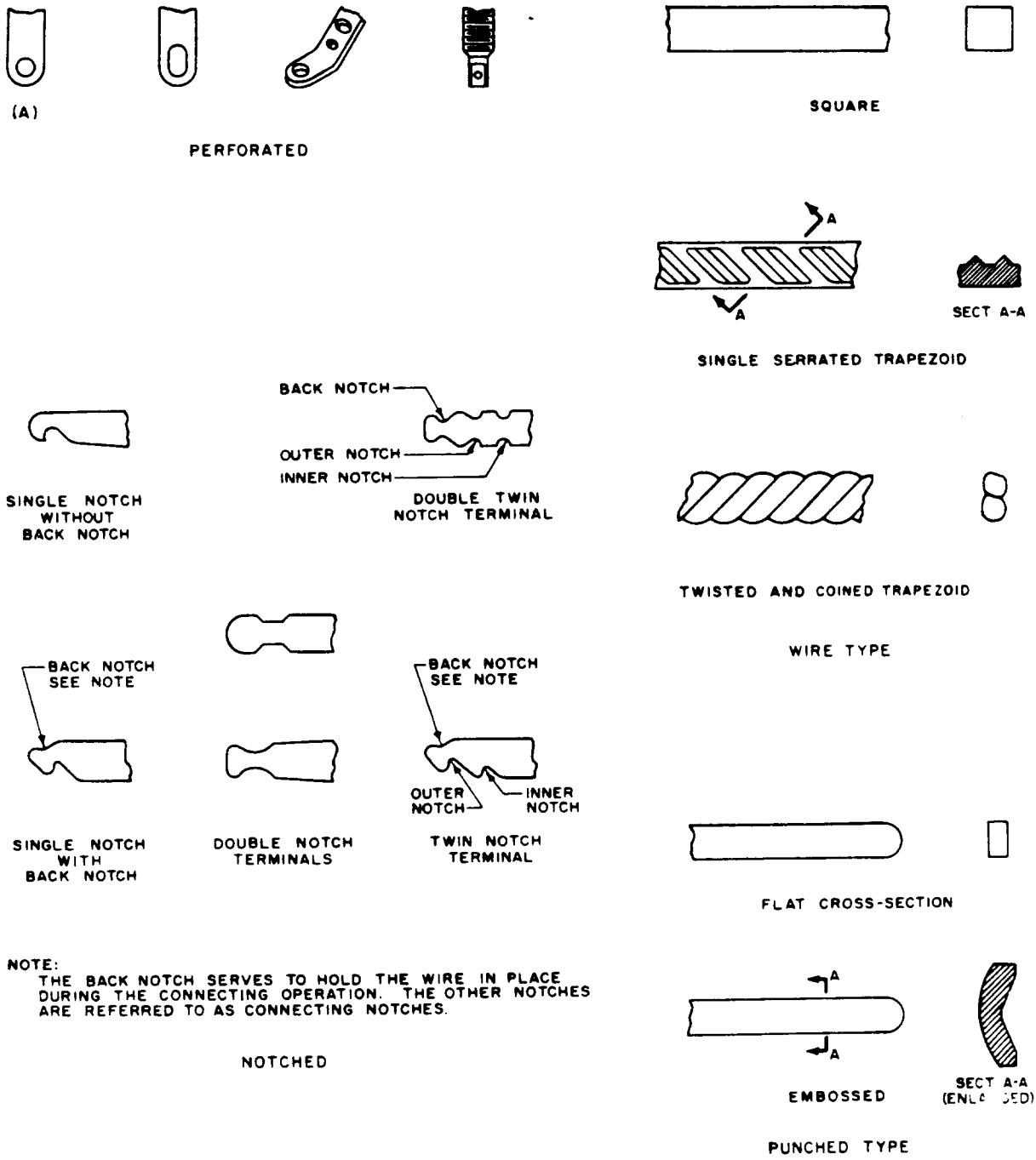


Fig 1—Types of Apparatus Terminals

1.10 The AT&T Practices and drawings listed below contain supplementary wiring and cabling requirements and, where applicable, are referred to in other parts of this practice.

005-150-101—Wiring Symbols, Wiring Abbreviations and Definitions
800-610-152—Gauge and Insulation of Wire
800-612-150—Specific Requirements for Electronic-Type Equipment
800-612-151—Design of Cable Forms
800-612-153—Stripping and Butting Cables
800-612-156—Placing, Securing and Supporting Cable Forms
800-612-157—Protection of Cable Forms and Skinners
800-612-158—Splicing Switchboard and Lead-Covered Cables, Local Cables and Individual Conductors
800-612-160—Dressing of Skinners
800-612-161—Color Combinations and Uses
800-612-162—Selection of Standard Copper and Lightguide Central Office Cables
800-612-163—Specific Requirements for Crossbar-Type Equipment
800-612-164—Forming, Grounding, Splicing and Terminating Shielded Wiring
800-612-165—Dressing of Skinners - Power Plant Apparatus
800-614-152—Switchboard, Power and Local Power Cables
802-005-180—Assembly and Installation of Power Plant Bus Bar and Wiring
X-17151—Solderless Wire Wrap Terminal - Design Information
X-18957—Requirements for Crimped Electrical Connections
ED-94818-01—Apparatus Approved for Solderless Wrapped Connections
ED-94909-01—Components (Pigtail) Approved for Solderless Wrapping
ED-94996-01—Qualified Crimped Connection Requirements

2. REQUIREMENTS FOR CONNECTING

COMMON REQUIREMENTS

A. Position of Wire on Terminals

2.01 ***Plier connections*** through holes in perforated terminals and in the notches of notched terminals should be connected so that the bare portion of the wire will have as large a contact surface with the soldering surface of the terminal as practicable. Wires should also be connected in such a manner as to provide the best maintenance conditions, usually with a clockwise wrap on the terminal and with top or right-hand soldering for the craftsperson, except where a lead approaches a terminal in such a manner as to make this impracticable. Top or right hand shall be interpreted as being taken facing the terminal side of the apparatus with the frame or unit in an upright position.

(a) Clockwise wrapping and top or right-hand soldering may be disregarded on self-contained equipment units, such as box-type test sets or plug-in units which are removed from the frame for maintenance and bench-wired subassemblies (where such subassemblies are relocated in the above assemblies).

(b) Where factory soldering is done with the frame placed on its side, some of the connections will be for left-hand or bottom soldering when the frame is righted. Such connections should be limited to as few cases as practicable. Connections to cross-connection terminal strips on the front or apparatus side of the frame shall be made so as to provide top or right-hand soldering when the frame is righted.

(c) Connect installer wiring in the standard manner; that is, for top or right-hand soldering, except where it is necessary to double up on terminals where the shop has soldered left or bottom. In such cases, connect the wires to conform with those connected by the shop.

2.02 ***Soldered-wrapped connections on flat-type terminals (such as perforated terminals)*** are connections where the wire is not connected in the hole in the terminal but wrapped around the terminal. Unless otherwise specified, the wire may be wrapped either over or in back of the hole. Soldered-wrapped connections may be either plier- or machine-wrapped. In either case, the wire should be wrapped around the terminal as shown in Fig 2. A minimum of one and one-quarter turns of bare wire should be maintained. While it is desirable to have the wire end terminate on the same side of the terminal as soldered, it may terminate on the opposite side of the terminal. While it is not a requirement that the wire end lie flat against the terminal, it should in no case project to an extent that the required clearance, specified in paragraph 5.13, between wire and adjacent terminal cannot be maintained, and in no case shall it project

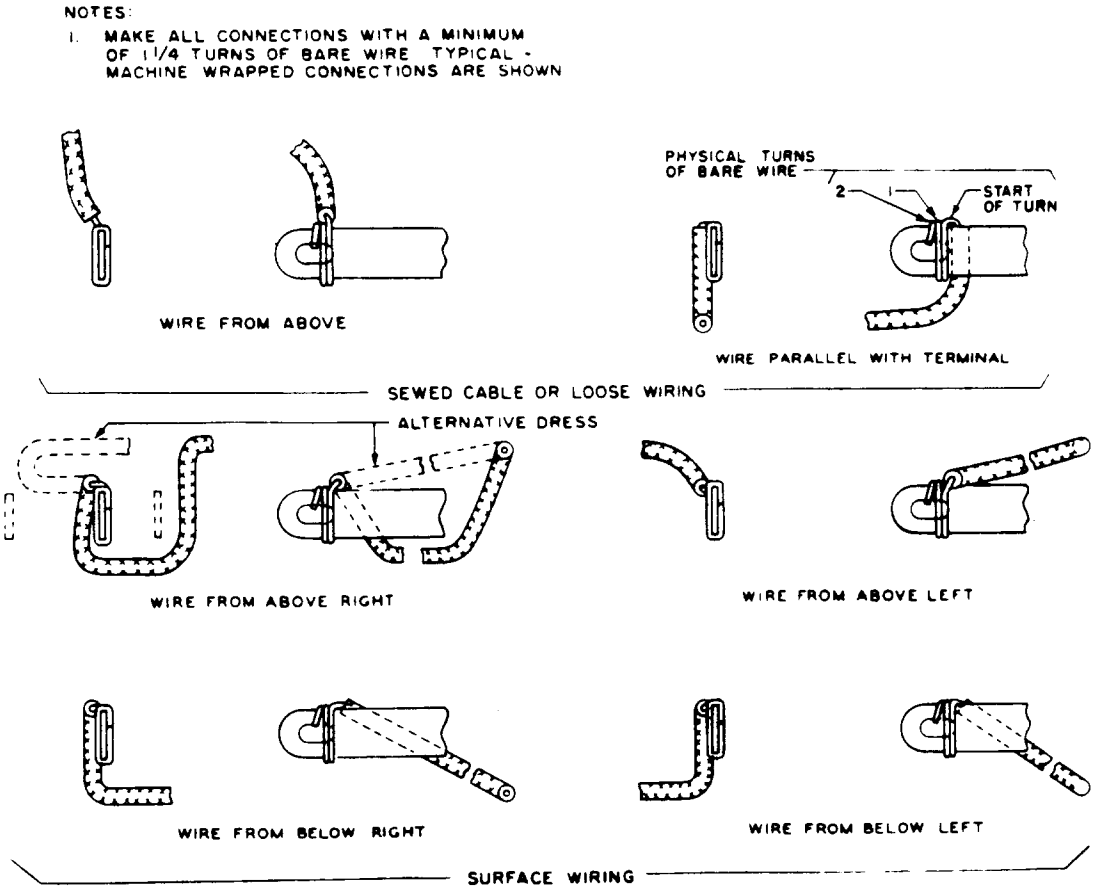


Fig 2—Soldered-Wrapped Connections - Perforated Terminals (Solder Not Shown)

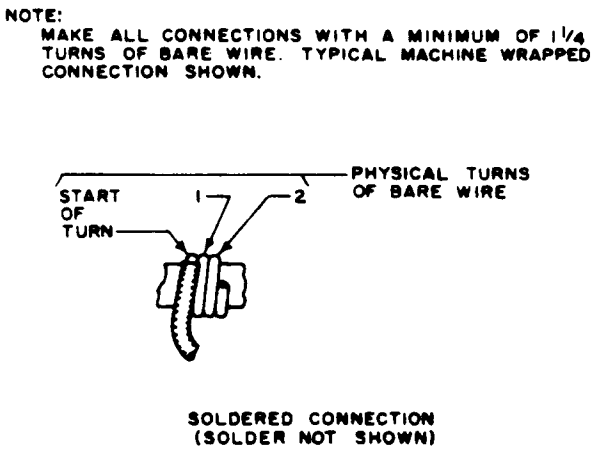


Fig 3—Soldered-Wrapped Connection - Wire-Type or Punched-Type Terminal

more than 1/8 inch maximum from the terminal. Terminals which will be inaccessible after being installed, such as jack and lamp strips in switchboards, shall be connected by a simple hook connection as specified in paragraph 2.16.

2.03 ***Solder-wrapped connections on wire-type or punched-type terminals*** that have neither notches nor perforations should be connected by wrapping the wire around the terminal as shown in Fig 3. The wire should be wrapped in the same manner as covered in paragraph 2.02 for solder-wrapped connections on flat-type terminals. Connections using No. 28 and No. 30 gauge wire should have a minimum of three-quarters of a turn of insulation wrapped around the terminal (modified wrap).

(a) Connections that are made directly to the lead-in wires on pigtail apparatus mounted in plastic strips should be made as outlined in Fig 3 for wire terminals. Care should be exercised to avoid excessive heating, and heat sinks should be used where necessary. The plastic strips can be damaged or apparatus can become loose if the soldering copper or other heat source is applied too closely to the plastic strip for too long a time.

2.04 ***Shank connections*** should be made where the hole, hook, or notch of a terminal will not accommodate all of the wires that must be connected or any individual wire because of its size. Shank connections are also made where the hole, hook, or notch of a terminal must be kept free for subsequent wiring operations. The connections are made in the manner described for soldered-wrapped connections on flat-type terminals in paragraph 2.02 and shown in Fig 2.

(a) When shank connections are made for the purpose of providing for future wiring, the holes or notches in the terminal should be kept open. In the case of terminals that have neither notches nor holes, space shall be provided for the future wiring.

(b) Shank connections are not required at the ends of shop-placed straps where the subsequent wiring to be placed at the terminal consists only of straps.

(c) On terminal strips, such as 227-type (with terminals similar to double twin notch terminals of Fig 1), having terminals too short to connect the wire in back of the notch, connect the wire in the inner notch of the terminal.

2.05 ***Surface wiring,*** such as SW1 and D3, shall be connected to perforated terminals as specified in paragraph 2.17(f).

2.06 ***D-type wiring*** shall be connected to perforated terminals in the same manner as specified for surface wiring in paragraph 2.17(f).

2.07 ***Strapping:*** Straps shall be connected to terminals in accordance with the requirements covered in AT&T Practice 800-612-159.

2.08 ***Position of Insulation***

General

(a) The bare portion of a wire between the point of connection to a terminal and the insulation of the wire should be less than half the distance between adjacent terminals at that point and in no case longer than 1/8 inch.

(b) Wires shall not be taut around terminals to which they are not connected. This is necessary to prevent insulation breakdown and to minimize strain on the terminal.

(c) The position of insulation of strapping shall be in accordance with AT&T Practice 800-612-159.

Perforated and Notched Terminals

(d) Textile insulation of wires should:

(1) Extend close to the point of soldering but should be excluded, as far as practicable, from the holes and notches of the terminals

(2) Where the wires are wrapped around the terminal, the insulation may overlap the terminal but should not exceed one-half the width of the terminal on the soldered side.

(e) Plastic and rubber insulation of wires, without textile covering, should not overlap the terminal but should be kept slightly away from the terminal to avoid damage to the insulation when soldering the connection.

Wire or Punched-Type Terminals 0.062 by 0.062 Inch or Less (Soldered-Wrapped Connections)

(f) The insulation of wires (with or without textile covering) may overlap the terminal, provided the soldering is performed on the turns of wire away from the insulation and care is exercised so as not to damage the insulation by heat during the soldering operation.

2.09 ***Fraying of the insulation*** of wires during connecting, disconnecting, and soldering operations should be kept to a minimum. However, the so-called insulation flags are not considered objectionable, provided they do not prevent a good soldered connection.

2.10 ***Number of Wires at One Terminal (Except Power-Type Lugs or Punchings):*** Not more than three No. 22 gauge or smaller wires shall be connected at the same hole or notch of a terminal. Where more than three No. 22 gauge or smaller wires terminate at a single terminal, wrap the additional wire or wires around the terminal at a point as close as practicable to the edge of the hole or notch nearest the apparatus. Press the wires firmly against the terminal. Where practicable, not more than two No. 20 gauge or larger wires should be connected at the same hole or notch of a terminal, although three such wires are permitted when necessary. Where more than two No. 20 gauge or larger wires terminate at a single terminal, wrap the additional wire or wires as indicated above for No. 22 gauge. When connecting more than three No. 22 gauge or more than two No. 20 gauge wires to a terminal, special consideration must be given to the rigidity of the terminal.

(a) ***Number of Soldered-Wrapped Connections at One Terminal:*** It is desirable that the number of soldered-wrapped connections be limited to three.

2.11 ***Sleeving Apparatus Terminals:*** Where it is necessary to prevent short circuiting of apparatus terminals, the terminal, including the soldered connection, shall be sleeved. See AT&T Practice 800-612-157 covering protection requirements.

2.12 ***Individual ground leads at frames and racks,*** where specified, should be connected and soldered to the No. 6 common frame ground lead by wrapping the individual ground lead around the common frame ground lead with a minimum of two or three complete closely wound turns.

2.13 ***Power Equipment:*** Connections to power equipment shall be in accordance with AT&T Practice 802-005-180 covering power plant wiring.

2.14 Make all connections to threaded switch studs, NEC fuse studs, circuit breaker studs, shunt studs, etc, by clamping the terminals between nuts on the studs. Where stud length permits, space should be left between the nuts clamping the terminal and the nut securing the stud to the panel to permit tightening the latter nut.

2.15 ***Radio Equipment:*** In general, D-type wiring is employed and connections to apparatus terminals are made in the usual manner for D-type wiring. However, in some cases, adjacent pieces of apparatus are connected directly to each other by butting or overlapping the terminals, for example, adjacent KS-9943 (button-type) capacitors. In such cases, the terminals should be held in contact with each other by a turn of No. 24 gauge tinned wire before soldering. The wire may be either wrapped around the terminals or through the holes in the terminals, as is most practicable. When the butted or overlapped terminals can be bent to make contact and there is no strain on the terminals, it will not be necessary to bond the terminals together with wire.

B. Connections to Various Types of Terminals

2.16 ***General:*** No. 20 gauge or larger wire cannot always be connected to thin flexible terminals in the standard manner because of the stiffness of the wire with respect to the stiffness of the terminal. Also, due to the size and/or inaccessibility of certain apparatus terminals (such as encountered in small compact components in radio equipment, video equipment, plug-in units, and small portable test sets) or where stranded wire is specified, it may not always be practicable to make the connection in the standard manner. In such cases, the connection may be made by either a simple hook connection similar to that used for making local cable connections, as shown in Fig 4, or by wrapping the wire around the terminal just sufficiently to anchor it before soldering. This applies to surface wiring, D-type wiring, local cable wiring, and the pigtail leads, of pigtail apparatus.

2.17 *Perforated Terminals*

Cable Wiring or Loose Wiring

(a) ***When plier-connected,*** bring the wires through the hole in the terminal from below or from the left, where possible, and bend against the terminal and away from the apparatus, as shown in Fig 4. Where the hole is not large enough to accommodate all the wires, the extra wire or wires should be wrapped around the terminal as described under shank connections in paragraph 2.04. Locate as close as practicable to the edge of the hole nearest the apparatus.

(b) ***Where the lead to be connected is too large for the hole*** in the terminal, it should be connected in the manner described in paragraph 2.02 for soldered-wrapped connections. [See (d) and paragraph 2.16.]

(c) ***When wrapped-connected (either plier or machine),*** wrap the wire around the terminal in the manner described in paragraph 2.02 for soldered-wrapped connections.

(1) Where the wires approach the terminals from above (see Fig 2) as in the case of cable connections to the lower terminals on U- and Y-type relays, the connection should form a natural dress from the stem of the breakout, downward towards the right-hand side of the terminal. This will avoid a reverse bend in the wire at the point of connection during the dressing operation and will reduce wire breakage.

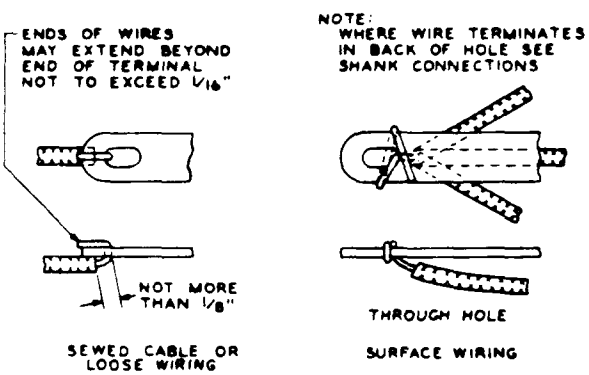


Fig 4—Plier Connection Through the Hole in Perforated Terminals (Solder Not Shown)

(d) ***The terminals of commercial apparatus,*** such as KS-7862 and KS-8132 electron tube sockets and Amphenol connectors [with terminals similar to Fig 1(a)], frequently have the perforations for wire connections so close to the ends that the connection shown in Fig 4 for sewed cable and loose wiring at perforated terminals is not satisfactory. In such cases, in order to obtain sufficient contact between the wire and the terminal before soldering, the connection should be made in the manner shown in Fig 4 for surface wiring or by wrapping the wire either through or back of the hole in the terminal.

(e) Where a sewed cable is dressed back against the mounting plate or panel and the wires approach the terminals from the base of the terminals, make the connections to perforated terminals as shown in Fig 4 for surface wiring.

Surface Wiring

(f) ***Surface wiring*** is connected to perforated terminals either at the hole in the terminal or by means of shank connections, depending on circumstances as outlined below.

(1) Where only surface wiring leads are to be connected and it is not necessary to keep the hole in the terminal open for future connections (wiring which may be from sewed cable or surface wiring), the leads should be connected at the outer end of the terminal. If plier connections are used, the wires should be passed through the hole in the terminal and then anchored by wrapping approximately one and one-quarter turns, as shown in Fig 4. It may not always be practicable to use the standrd surface wiring connections on terminals of certain jacks and keys due to the difficulty in meeting the clearance requirement between the solder and the adjacent terminal. In this case, it will be satisfactory to use either a simple hook connection similar to that used for making local cable connections, as shown in Fig 4, or to wrap the wire around the terminal just sufficiently to anchor it before soldering. Machine-wrapped connections are made in the same manner as are soldered-wrapped connections. (See paragraph 2.02).

(2) Where wiring is to be connected subsequent to the surface wiring, the surface wiring leads should be connected with

the shank connection described in paragraph 2.04. Either plier-wrapped or machine-wrapped connections may be used.

(3) On terminal strips where the terminals are provided with both notches and holes, the surface wiring leads may be terminated in the notches.

2.18 ***Notched Terminals:*** Connections (other than cross-connection wire) should be made as follows:

Note: Generally, the excess wire is cut off after soldering. However, where the connection consists of one No. 22 gauge or smaller wire, the wire end may be broken off at the back edge or top of the terminal as the connection is completed, provided the rigidity of the terminal used permits breaking off.

(a) ***On single-notch terminals*** (either with or without back notch for breaking off wires), draw the wires up into the connecting notch and bend over flat against the upper or right-hand side of the terminal, as shown in Fig 5.

(1) On the 700A-type terminal strip (with terminals similar to the single notch without back notch terminal of Fig 1), it will be permissible to wrap the wire with one to one and one half turns around the terminal.

(b) ***On double-notch terminals,*** connect the wires as shown in Fig 5, using one complete turn of bare wire where the wire approaches from the botton or parallel to the terminal. Where the wire approaches from the top of the terminal, wrap the bare wire one and one-half turns. When connections to these terminals are made with the

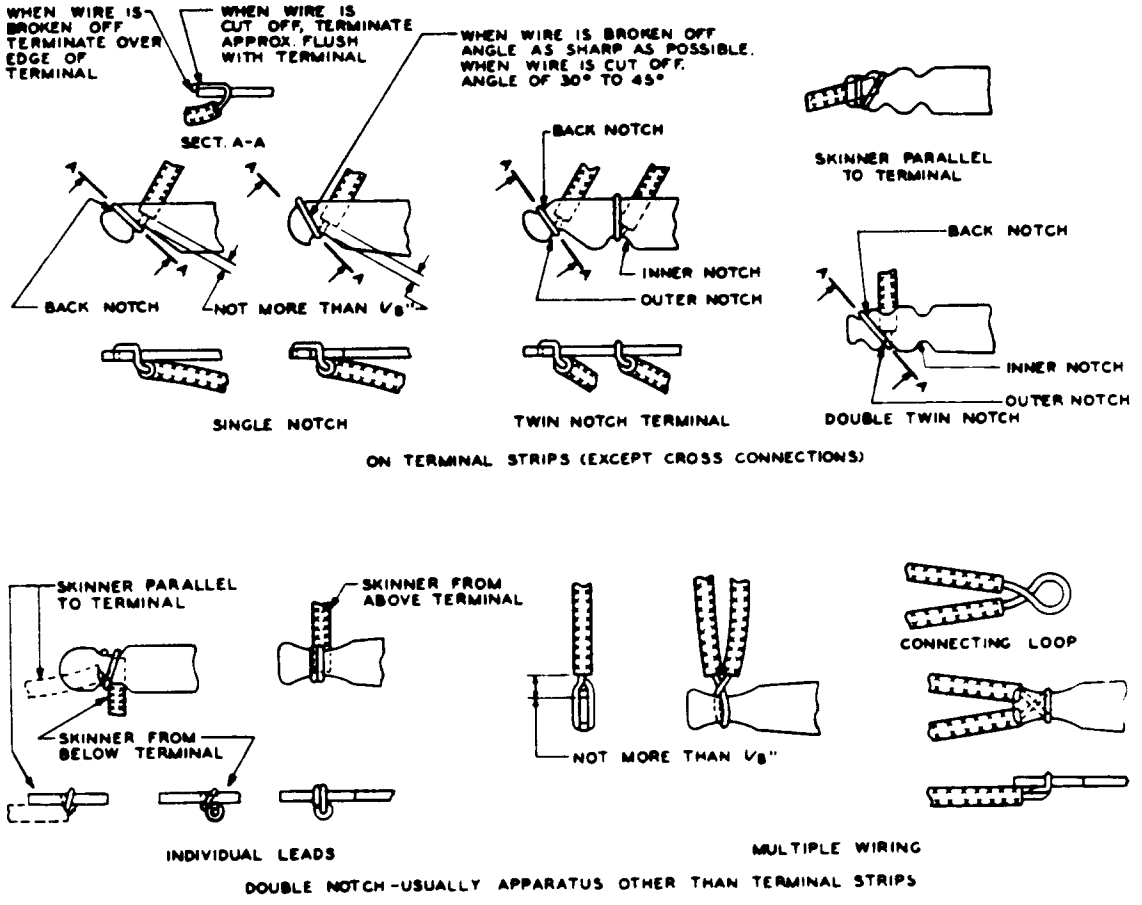


Fig 5 —Plier Connections to Notched Terminals (Solder Not Shown)

wrapping tool, the connection may be made in the notch, in back of the notch, or both, in the same manner as used in flat-type terminals. (See paragraph 2.02.)

(1) At switch jacks of universal step-by-step shelves, the switchboard wire is considered as approaching parallel to the terminal.

(c) ***On twin-notch terminals,*** also shown in Fig 5, connections should be made in the outer notch except when supplementary information specifies that these notches are to be reserved for strapping or cross connections subject to change in service or when some other specific arrangement of leads is covered in the supplementary information.

(d) ***On double-twin-notch terminals,*** connection should be made to the outer notch unless otherwise specified in the supplementary information. Draw the wire into the notch on the opposite side of the terminal from which the wire approaches and bend over diagonally, flat against the upper or right-hand side of the back notch, as shown in Fig 5. Where the wire approaches parallel to the terminal or where a more secure connection is desired to prevent the wire from loosening before it is soldered, it will be satisfactory to wrap the wire with one to one and one-half turns, as shown in Fig 5. Wires connected to the inner notch should be treated in the same manner as at the inner notch of twin-notch terminals.

2.19 ***Hook-Type Terminals:*** Where the lead approaches from a cable form directly opposite the end of the terminal and is plier-wrapped, draw the wire up into the connecting notch as for notched terminals and bend over flat against the right-hand side into the concave end, as shown in Fig 6. Where such leads are machine wrapped, they should be shank connected. Where the lead approaches from the appratus mounting plate or panel, as in the case of surface wiring, it should be connected at the rear of the notch, as shown in Fig 6.

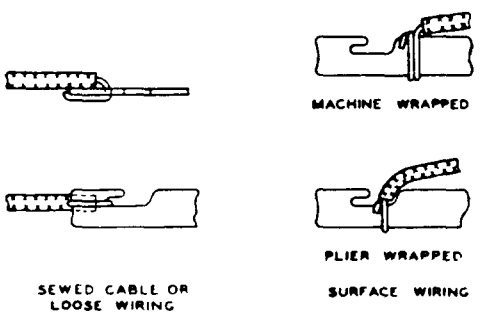


Fig 6—Connection to Hook-Type Terminals (Solder Not Shown)

2.20 ***Spun-In Terminals:*** These terminals are frequently used for mounting pigtail apparatus. The pigtail lead length and bend requirements covered in paragraph 2.51 shall apply to the pigtail leads. The connections shall be made as follows. (See Fig 7.)

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

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

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

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

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

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

2.21 ***Stand-Off and Grooved-Type Terminals:*** Connect wires as shown in Fig 8, using one full turn of wire. Special care should be exercised to avoid overheating stand-off terminals, such as the 202 type, during the soldering operation. (See paragraph 5.07.)

2.22 ***Tubular Terminals:*** Except as otherwise specified herein for spun-in and electron-tube terminals, wires may be connected as follows.

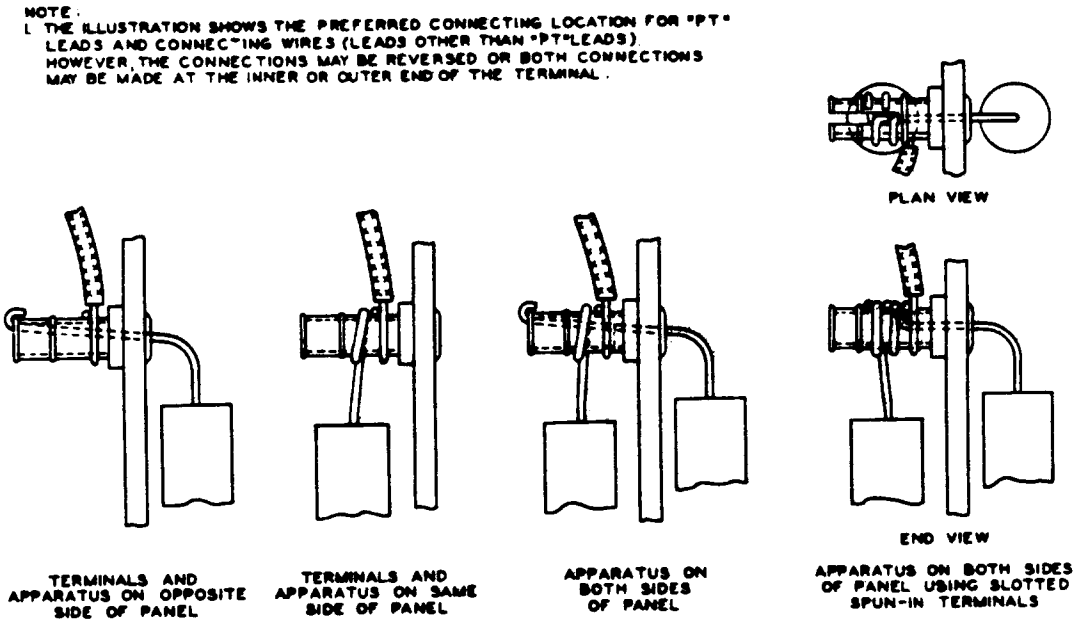


Fig 7—Plier Connection to Spun-In Terminals (Solder Not Shown)

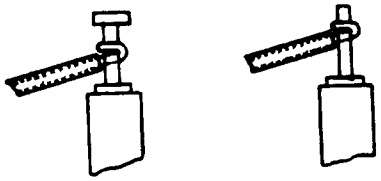


Fig 8—Stand-Off and Grooved-Type Terminals (Solder Not Shown)

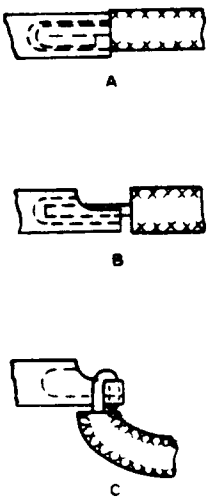


Fig 9—Connection to Tubular Terminals (Solder Not Shown)

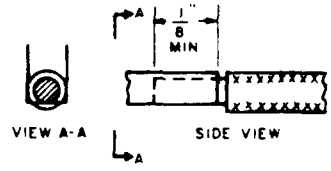


Fig 10—Connection to Trough-Shaped Terminal (Solder Not Shown)

(a) ***Skinned End of Wire Folded Back:*** Fold the skinned end of the wire back before inserting into terminal so that the spring effect of the folded wire will hold it in place prior to soldering, as shown in Fig 9A. The length of bare wire from skinning point to fold should be slightly less than the depth of terminal. This permits insulation to be brought up close to the terminal. Where the hole in the terminal is not large enough to accommodate all the wires, the extra wire or wires should be wrapped one full turn around the terminal at a point close to the end of the terminal.

(b) ***Skinned End Inserted Without Fold:*** Insert the wire into the tubular portion of the terminal, as shown in Fig 9B.

(c) ***Wire Wrapped Around Terminal:*** Wrap the wire around the terminal using one full turn of wire, as shown in Fig 9C.

(d) Refer to paragraph 5.08 for soldering requirements.

2.23 ***Trough-Shaped Terminals (such as on the KS-16671 plugs):*** On trough-shaped terminals, the wire shall be laid in flat and make contact with the terminal for a minimum distance of 1/8 inch before soldering. (See Fig 10.)

2.24 ***Wire-loop terminals*** (such as encounterd on 330-type capacitors) should be connected as shown in Fig 11.

2.25 ***Commercial Solder-Type Terminals—Zierick and Similar Types:*** Connect wires to these terminals as shown in Fig 11. If the terminal has a hole through which the wire runs, the hole should be filled with solder, within the limitations of paragraph 5.03. It is not objectionable in such cases if some of the solder flows to the other side of the terminal.

2.26 ***Crimp-Type (Barrel) Terminals, Lugs, and Connectors:*** Connections to these terminals, lugs, and connectors shall be crimped and the crimp system "qualified" in accordance with X-18957, ***Requirements for Crimped Electrical Connections*** and listed on ED-94996-01.

(a) Where the crimp connection is ***not*** in accordance with the qualification requirements or test requirements of X-18957, the crimp connection shall be soldered in accordance with item (C) or reterminated using a connection system that meets the requirements.

(b) A terminal shall be crimped only once in any given length of barrel; that is, double crimping is not acceptable.

(c) The following conditions apply to preinsulated/uninsulated crimp components:

(1) Where crimping has been done and the conductor is stranded or solid wire, it may be soldered for repair purposes or if not qualified. The soldering process must not damage insulation on preinsulated barrels or extend beyond the crimp zone to the extent that it would interfere with subsequent assembly or connecting operations. Consequently, it is not recommended that preinsulated crimp components be soldered as a standard practice.

(2) Where crimping has not occurred, the assembly is required to be held such that no movement takes place between the conductors and the component during the soldering process. Frictional forces between the conductor and the component may be sufficient to meet this requirement without using any fixturing.

(3) After soldering, the wire end or outline thereof shall be visible for open ended barrel components. Soldering of closed barrel components is not recommended.

2.27 ***Crimped Connection Systems:*** Crimped connection systems that have been tested and "qualified" and the product requirements for these connections are listed on ED-94996-01.

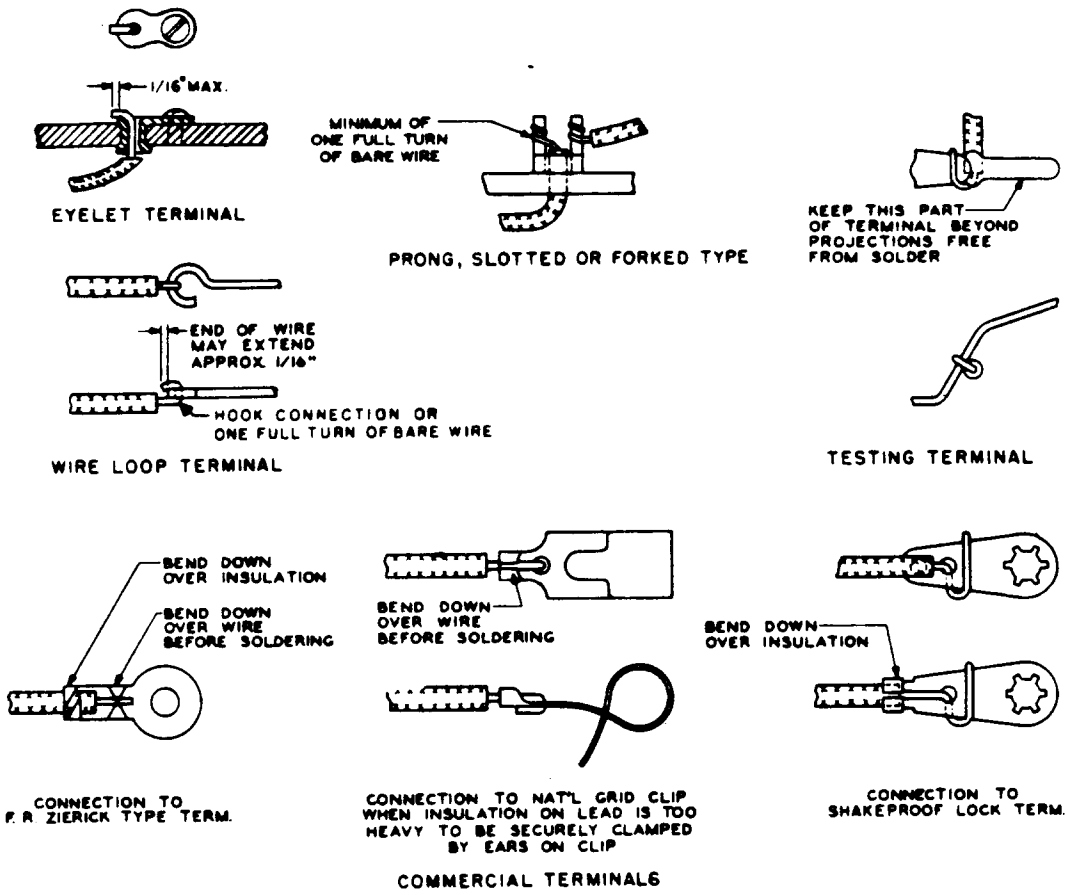


Fig 11—Connections to Miscellaneous Terminals (Solder Not Shown)

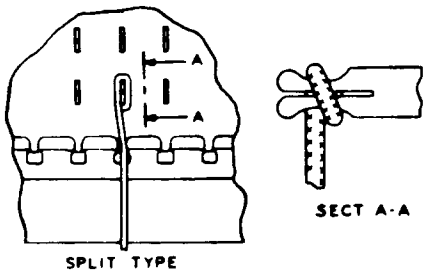


Fig 12—Solderless Connections of Solid Wire at Split-Type Terminals

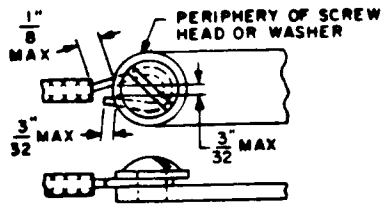


Fig 13—Solderless Connection of Solid Wire at Screw-Type Terminals

2.28 ***Terminals With Testing Lugs:*** Connect wires, as shown in Fig 11, to keep the testing lug free of solder.

2.29 ***Eyelet Terminals:*** Connections to this type of terminal are made by threading the wire through the eyelet and bending over the top surface, as shown in Fig 11. When solder is applied, care shall be taken to prevent the wire from moving while the solder is solidifying. Unless otherwise specified, a soldered joint without filling the hole is permissible.

(a) In cases where a combination eyelet and screw-type terminal is encountered, care shall be taken to avoid building up the solder on the eyelet portion to a point where it will interfere with proper seating of spade clip under the screwhead.

2.30 ***Prong-, Slotted-, or Forked-Type Terminals:*** Connect wires to these terminals as shown in Fig 11. Clearance between shop connected wire (including solder) and other prong should be a minimum of 1/32 inch to provide sufficient space to connect a wire to the other prong.

(a) When miniature slotted-type (or forked-type) terminals with insufficient strength for wrapping are used, or where the slots are too small for wrapping, it will be satisfactory to lay the wire in the slot (or fork) and solder.

C. Unsoldered Hand-Wrapped Terminals

2.31 ***Split-Type Terminals:*** Solderless connections (solid wire only) at split-type terminals shall be made by removing the insulation to approximately 1/8 inch from the wire end and pushing this portion of the wire to approximately half the depth of the slot in the terminal, with the insulation drawn up to the terminal. The insulated portion of the wire is then given a full wrap (counterclockwise for upper connection and clockwise for lower connection) around the terminal in front of the bare wire protruding through the slot, as shown in Fig 12.

2.32 ***Screw-Type Terminals:*** Connect the wire with one turn, without overlapping, around the screw in a clockwise direction, as shown in Fig 13. The wire end may project a maximum of 3/32 inch beyond screwhead, or washer if a washer is provided. Where two wires (maximum) are to be connected, twist the bare portion together before placing around the screw. This applies to wire gauges smaller than No. 18 gauge. If more than one No. 18 gauge or larger wire is to be connected, terminate one lead under the head of the screw with the additional leads wrapped around the first lead and soldered to it.

(a) When connecting No. 24 gauge or smaller diameter wire to screw terminals, the wire has a tendency to break off when the screw is tightened, due to the small diameter of the wire. In order to prevent this wire breakage, supplementary terminals shall be attached to the wire, or washers shall be placed under the screwheads.

(b) All stranded wires terminated by mechanical fasteners, ie, screws, nuts, etc, must be equipped with terminal lugs except for receptacles or plugs equipped with an approved clamp plate. The use of lugs has been shown to eliminate the incidence of unreliable connections when stranded wire is used. In those cases where a lug cannot be used, solid wire should be used. Components with an approved clamp plate that terminates stranded wire provide clamping so that the wire is not terminated directly under the screwhead or nut. For this case, the wire should not be tinned.

2.33 For unsoldered hand-wrapped connections on notched-type terminals in cross-connecting fields, see paragraph 2.40(b)(2).

D. Common Requirements for Connecting Local Cable and Switchboard Cable Leads

2.34 ***Location of Cable Forms:*** After the wires are connected and dressed, the location of the cable form should not exceed the nominal more than 1/4 inch.

(a) When two or more cable forms are connected to the same apparatus, such as the straight and slanting forms of short multiple cable, the group of forms should be considered as one form.

2.35 ***Paired wires*** (local cable form) should be untwisted the entire skinner length before connecting to apparatus terminals except for electronic type equipment (see AT&T Practice 800-612-150).

(a) When the apparatus is equipped with a fanning strip, the paired wires should be untwisted from the terminals to a point a short distance behind the rear terminal.

(b) The skinners of paired wires terminating at the front end (apparatus side) of 224-type (cable well) terminal strips should be untwisted for a distance approximately equal to the depth of the well.

(c) The skinners of paired wires terminating at the front end (apparatus side) of D-type terminal strips should be untwisted to a point approximately where the wires leave the wiring throat at the front of the terminal strip.

(d) On step-by-step shelves when fanning wires to switch jacks through insulated fanning rings, paired wires should be left twisted to a point as near to the terminals as possible. This will tend to keep the wires in the fanning rings and will also result in smaller forms.

(e) The conductors of a cross-connection at distributing frames should be untwisted so that none of the twist remains within the fanning strip after the wires are terminated. However, the cross-connection should not be untwisted more than one regular twist back of the fanning strip, or the regular twist disturbed back of that point.

2.36 ***Partial Equipment and Optional Features:*** Connect and solder wiring to such apparatus as is furnished in the unequipped circuits or circuit features, for example, terminal strips, jacks, lamp sockets, etc.

(a) Where universal local cables terminate at 203-type, 224-type, and similar small terminal strips, the leads for unused optional features are not connected initially unless there are enough terminals provided to connect all used and unused feature leads on separate terminals.

2.37 ***Current supply leads for unequipped circuits or circuit features,*** such as battery and ringing leads, should be connected at the fuse panel end providing dummy fuses are installed and wires on the unequipped end are individually sleeved.

2.38 ***When circuits or circuit features initially equipped are removed from service,*** and apparatus that is part of the circuit is removed, the connecting and soldering requirements covered in paragraphs 2.36 and 2.37 for unequipped wiring should be followed.

(a) Where circuits or circuit features are wired and equipped but not put in service initially or are removed from service at some later date while the wiring and apparatus remain intact, the wiring at the fuses shall not be disconnected and the associated fuses should not be removed unless specifically authorized by the telephone company. When so authorized, they shall be replaced by dummy fuses.

2.39 ***Switchboard Short-Multiple Cable Forms:*** Connect and secure as shown in Fig 14. Bring the straight or short forms in from the right, facing the rear of the switchboard, and in front of the slanting or long forms.

(a) ***Connect the multiple so that the skinners will be below*** all cables and other forms in front and in the same layer for all new and additional multiples (complete layers) on multiple shelves and on pins when arranged for future multiple shelf support.

(b) ***Connect the multiple so that the skinners will be above*** all cables and other forms in front and in the same layer for all new and additional multiples (complete layers) on cable pins or brackets, except multiples on pins arranged for future multiple shelf support.

(c) ***Connect the multiple to conform to the skinner arrangement*** of the existing multiple for all additional multiples (incomplete layers) and extensions.

(d) ***The short or straight skinner form*** should be securely tied to the skinners of the long or slanting skinner form, a tie being placed at each end and in the middle of the forms, as shown in Fig 14.

(e) ***Separate the individual conductors*** of the forms between the point of connection and the forms so that the skinners associated with any one jack will not be crossed more than one-half turn. This requirement shall be

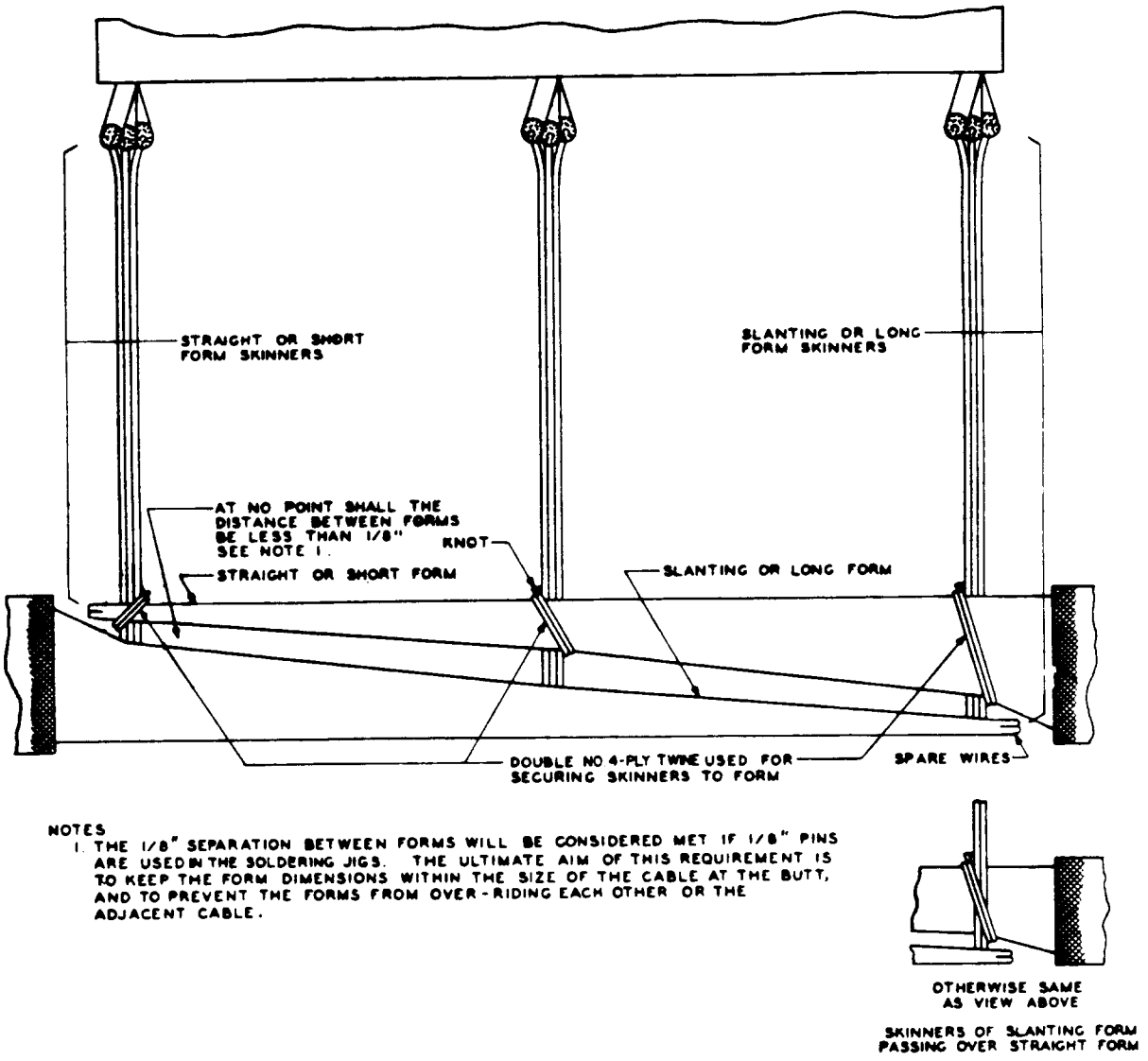


Fig 14—Short Multiple Cable Forms in Switchboards—Placing, Securing, and Connecting Forms

considered as being met if the forms and skinners can be separated to within 1-1/2 inch of the ends of the jack terminals.

(f) ***When two leads of each circuit connect to lamp sockets,*** the colored wires should be connected to the top or battery terminals and the green, white, or mated leads of the pair to the bottom or ground terminals.

E. Common Requirements for Connecting Cross-Connection Wire

2.40 ***Cross-Connection Wire (DP-Type Cross-Connection Wire):*** Cross-connection wire connections at notched terminals on terminal strips differ from the connections used for other wire only in that the end of the cross-connection wire is always brought around the back edge of the terminal, as shown in Fig 15. Usually the wire is broken off over the edge indicated in preference to cutting. This method of breaking the wire is sometimes used for other wire connections where the rigidity of the terminal used or the number and gauge of wires permits breaking off. In general, only one cross-connection wire per terminal is used.

(a) Connections to protectors with notched terminals should be made as shown in Fig 16. Both single- and back-notch terminals are encountered. On standard B-type main frames, the protectors are mounted so that the notch is at the bottom. When mounted on the older A-type frames, protector mountings are reversed, resulting in the terminal notches being on top. Both conditions are shown in Fig 16.

(1) Where the notch appears on the underside of the terminal, as shown in Fig 16, bring the wire under the terminal, up through the notch along the front of the terminal, over the top edge, or through the back notch where provided, and down the rear side, making one complete turn of bare wire around the terminal in a clockwise direction.

(2) Where the notch appears on the upper side of the terminal, as also shown in Fig 16, bring the wire through the notch, down the front side, up the rear side, making one complete turn of bare wire around the terminal in a counterclockwise direction.

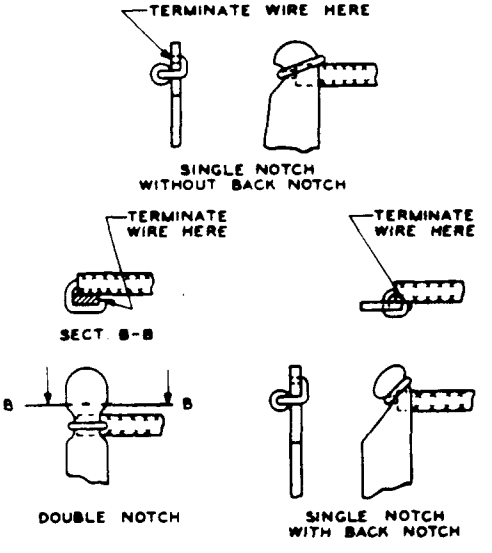


Fig 15—Connecting and Soldering Cross-Connection Wire to Notched Terminals (Solder Not Shown)

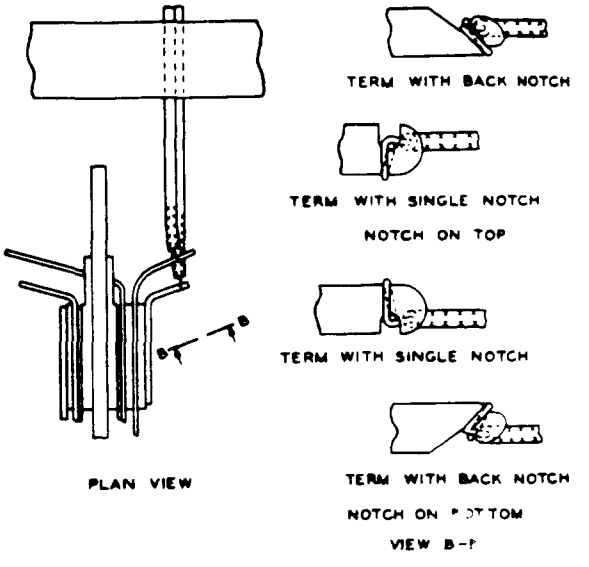


Fig 16—Connecting and Soldering Cross-Connection Wire to Protector and Line Jack Terminals (Solder Not Shown)

(b) ***In cross-connecting fields,*** such as on the block relay frame in No. 1 crossbar and the number group frame in No. 5 crossbar, the cross-connections from the common cross-connecting fields to the terminal strips located immediately above and below the common field should be connected as follows, depending upon requirements furnished by the telephone company.

(1) ***Soldered Connections:*** The end of the cross-connection wire that is connected first shall be connected with one full turn of bare wire around the terminal, regardless of the type of terminal. This connection is similar to that shown in Fig 5 for wires approaching at right angles to double-notched terminals. The other end shall be connected with one-half turn of bare wire, regardless of the type of terminal. This connection is the same as that shown in Fig 15 for cross-connection wire.

(2) ***Unsoldered Hand-Wrapped Connections:*** The termination of unsoldered hand-wrapped connections should be made by a manual wrap of two turns of bare wire clockwise on the top terminal, and two turns counterclockwise on the bottom terminal. Wrap turns in the terminal notch so that the turns are parallel to each other, maintaining a steady tension on the wire while wrapping the wire around the terminal in order to insure a good contact between the edge of the terminal and the wire. When two or more wires are connected to the same terminal, wrap and solder the connections in the same manner as specified for soldered connection.

Note: Do not attempt to make the wrapping tighter by squeezing the wire against the side of the terminal with pliers, as this procedure tends to release the grip of the wire in the notch.

SPECIFIC REQUIREMENTS

2.41 ***Banks—26, 27, and Similar Types:*** Connect bank multiple wiring by looping the wires around the terminals, as shown for double-notched terminals in Fig 5.

2.42 ***Mechanized Banks—42 and Similar Types:*** Mechanized banks, that is, machine-made banks, are of two types, the solder type and solderless (clinch) type. Connections to the mechanized solder-type and mechanized solderless-type banks are made as follows:

(a) On 42D- and similar-type banks (solder type), the bank multiple wiring should be connected in the same manner as described above for 26-, 27-, and similar-type banks.

(b) On 42E- and similar-type banks (solderless), the bank multiple wiring is furnished with the bank. At the end bank, the incoming leads should be connected as shown in Fig 17.

2.43 ***Cable—coaxial and twin-conductor shielded office cable and shielded wiring*** shall be connected in accordance with the requirements covered in AT&T Practice 800-612-164.

2.44 ***Cable — 754, 760, 761, and 762 Types:*** On 754-, 760-, 761-, and 762-type cable, the blue lead of the pair shall be considered ring and the white lead tip unless otherwise specified.

2.45 ***Cords:*** Flexible cords shall be connected to devices and to fittings so that tension will not be transmitted to joints or terminal screws. This shall be accomplished by a knot in the cord, winding with tape, a special fitting designed for that purpose, or other equivalent means.

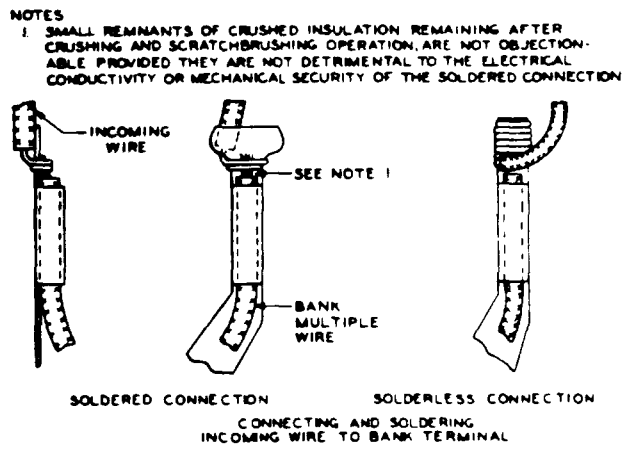


Fig 17—42 and Similar Mechanized Solderless Clinch-Type Banks

2.46 *Capacitors*

(a) Capacitors equipped with wire terminals (pigtails) should be connected and mounted by means of their pigtail leads in the manner described in paragraph 2.51 for pigtail apparatus.

(b) ***KS-14355 and Similar-Type (Electrolytic) Capacitors:*** The pigtail lead is considered to be only the wire welded to the tantalum leadout wire. In order to avoid rupturing the weld, the start of the bend in this pigtail lead shall not be closer to the weld than 1/16 inch.

(1) Special care should be exercised to avoid overheating these capacitors during soldering, as excessive heat will generate a gas which may destroy the capacitor seal.

(c) When wiring KS-13998 variable air capacitors and similar types which have a terminal as an integral part of the spring furnishing the rotor-retarding torque, the terminal shall neither be bent nor clipped, since this may destroy the retarding torque.

(1) Care must be taken when making soldered connections, as heat applied too long may result in loose stator posts and plates.

(d) When connecting wires to the wire terminals of button-mica capacitors, such as the KS-13482, and feed-through-type capacitors, such as the KS-14066, special care should be exercised to avoid putting any strain on the terminal during the wiring operation. This necessities preforming of pigtail leads or conductors prior to application of the leads to the terminal.

2.47 *Electron Tubes Equipped With Wire Terminals (Pigtails):* The bending, splicing, and protection requirements covered in paragraph 2.51 shall apply to the pigtail leads.

2.48 *Electron-Tube Base Terminals or Terminals of Plugs Designed To Fit Electron-Tube Sockets, Such as the KS-13915 (Tubular-Type Terminals) Plug Terminals:* Wires that extend into the pins shall be connected and soldered in accordance with Note 2 on A-553097. After connecting wires, solder shall not extend more than 1/8 inch from the tips of the pins. Note 2 on A-553097 reads as follows:

Note: Remove insulation from portion of leads that extend into pins, thread leads through pins, and cut off at end of pins. Dip the pin ends in No. S2 Flux (Specification 50016) and immediately place the base so that tips of the pins just touch the surface of a bath of molten solder maintained at a temperature of 290°C to 315°C. Clean and round off any excess solder at tip of pins. Solder on cylindrical surface of the tips of the pins shall not cause the diameter of the pins to be greater than 0.097 inch. Essentially, there shall be no solder on the remaining cylindrical surface of the pins.

2.49 *Electron-Tube and Sockets—KS-13225, KS-14314, and Similar Types:* When required, connect wires to the center tubular terminal of these sockets either by wrapping the wire around the terminal with a minimum of one full turn in a manner similar to that used for connecting wires to spun-in terminals, as shown in Fig 7, or by passing the wire through one of the side holes in the terminal making a simple hook connection. Care should be taken that the solder does not flow into the tubular terminal.

2.50 *Jacks—410 and Similar Types:* When soldering connections to the contact terminals which are made up of two metal contacts and are not electrically insulated from each other, it is necessary that the two contacts be soldered together. This requirement shall be considered met when solder is applied on at least one edge of the two contacts in addition to the usual top or right-side method of making the soldered connection. The hole in the terminal nearest the insulation of the wire need not be filled with solder if the edges are soldered in accordance with the above method.

2.51 *Pigtail Apparatus*

General

(a) The following requirements apply to those types of pigtail apparatus that are mounted by means of their wire terminals (pigtails). (See Notes 1 and 2.) In general, apparatus of this type can be damaged by excessive heating during the soldering operation, heat being transferred to the apparatus body by conduction through the pigtail. In locating a piece of apparatus in close proximity to other apparatus, several considerations become important and, in some instances, controlling. The electrical characteristics of some components

may be changed temporarily or permanently when mounted in higher ambient temperatures than those for which they are designed, or when subjected to the heat of the soldering operation. Special care in the soldering operation should be given to such components as electrolytic capacitors, carbon and composition resistors, transistors, thermistors, and varistors. Grouping that results in temperatures approaching the kindling point of the materials involved should be especially avoided. Where the placement of pigtail apparatus bodies and arrangement of wiring is critical, it is the responsibility of the AT&T Bell Laboratories engineer to cover this information with equipment requirements.

Note 1: For those types of pigtail apparatus that are not mounted by their pigtail leads, follow the requirements given for specific types of apparatus in other paragraphs and/or in other equipment information. Examples of such types are some capacitors, transformers, networks, and coils, which may be mounted to the panel by studs, clips, etc.

Note 2: For requirements for pigtail apparatus in Miniplas assemblies, see AT&T Practice 800-610-154.

Note 3: For requirements for pigtail apparatus mounted on printed wiring boards, see X-20062.

Note 4: For requirements for pigtail apparatus mounted on amplas assemblies, see AT&T Practice 800-610-161.

Connecting

(b) The following ***pigtail lead length*** (distance between the apparatus body and the point of soldering) requirements shall apply.

General

(1) ***The nominal length*** of a pigtail lead shall be approximately 1/2 inch.

(2) ***The minimum length*** of a pigtail lead shall be 3/8 inch in order to minimize the possibility of damage to the electrical characteristics of the pigtail apparatus, unless otherwise specified in the equipment information.

(3) ***The maximum length*** of a pigtail lead shall be 1 inch, except where size and/or positioning of apparatus and spacing between connecting points require that the pigtail lead length be greater than 1 inch. In these cases, the pigtail leads shall be run as short as practicable.

Specific

(4) On carrier telephone, carrier telegraph, radio, television, and data systems, the ***maximum length*** of a pigtail lead shall be 5/8 inch, except where size and/or positioning of apparatus and spacing between connecting points require that the pigtail lead length be greater than 5/8 inch. In these cases, the pigtail leads shall be run as short as possible.

(5) When connected to the terminals of apparatus mounted on strip mounting plates, the maximum length requirement of the pigtail lead will be met if the center line of the pigtail apparatus body is not capable of being displaced more than 1 inch, as gauged by eye, beyond the ends of the terminals to which it is connected.

(c) When a pigtail component having a lead length of 1/2 inch or more is connected between two rigid terminals, the pigtail leads shall not be taut but shall have a visible bow, unless otherwise specified.

(d) In some cases, pigtail leads are so critical that they require special treatment regarding length and/or path. Such leads shall be designated "a" on the schematic and "PTa" on the wiring information drawings. The schematic and/or wiring information drawings shall specify the special treatment required. Where two or more special treatments are required on the same drawing, the second, third, etc, may be identified by "a1," "a2," etc, on the schematic and by "PTa1," "PTa2," etc, on wiring information drawings.

(e) In soldering pigtail leads, precautions against heat damage (affecting electrical characteristics) to the body of the apparatus should be exercised. When soldering leads closer than 1/2 inch from the body, a heat conducting device is recommended to restrict the heat flow into the pigtail apparatus.

(f) ***Pigtail Lead Bend Requirements (Except for Stranded or Braided Insulated Pigtail Leads):*** In order to avoid impairment of the seal in sealed components and to avoid breakage of pigtail leads it is ***recommended*** that the pigtail leads be as straight as practicable without bends for a distance of 1/16 inch from the body of the apparatus. In the following cases it is a ***requirement*** that the pigtail lead bend shall not start closer than 1/16 inch from the point of attachment to the apparatus.

(1) Pigtail lead emerges from sealed glass bodies.

(2) Pigtail lead is soldered or welded to any tubulation, such as in the case of the 426-type diode. No part of the tubulation extending from the glass end of the case may be bent or stressed.

(3) Pigtail lead is soldered or welded to the apparatus leadout wire, such as in the case of KS-14337 capacitor.

(g) When connected to terminals of other apparatus, the pigtail leads should be connected as follows.

(1) ***Perforated- and Notched-Type Terminals:*** Connect in hole or notch with either a simple hook connection or a wrapped connection using one full turn of wire. This applies to either local cable or surface-wired equipment.

(2) ***Wire- or Punched-Type Terminals (Without Holes or Notches):*** Make the connection by wrapping the pigtail lead around the terminal with a minimum of one full turn of wire.

(3) When it is specified to provide for a future connection on terminals without holes or notches, place the pigtail lead connection far enough in on the terminal to provide for the future connection. On perforated and notched terminals, the hole or notch should be kept open for the future connection.

(4) Pigtail apparatus having heavy gauge wire cannot always be connected to thin flexible terminals (flimsy terminals, as on certain relays and commercial electron-tube sockets) with at least one full turn of wire where shank connections are involved, because of the stiffness of the wire with respect to the stiffness of the terminal. Also, due to the size and/or inaccessibility to certain apparatus terminals, such as encountered in small compact components in TD-radio equipment, video equipment, N and O carrier plug-in units, and small portable test sets, it may not always be practicable to make the connection in the standard manner. In such cases, it will be satisfactory to wrap the pigtail lead around the terminal just sufficiently to anchor the pigtail apparatus before soldering. This method of connecting may also apply to pigtail leads (No. 22 gauge or larger) connected to wire terminals (No. 18 gauge or smaller).

(h) When miniature slotted- or forked-type terminals with insufficient strength for wrapping are used, it will be satisfactory to place the pigtail lead in the slot and solder.

(i) When pigtail apparatus is connected to spun-in terminals, the pigtail leads shall be connected as covered in paragraph 2.20 and Fig 7, unless otherwise specified.

(j) Pigtail apparatus is sometimes mounted by embedding the pigtail leads in plastic strips (Miniplas assemblies). In such cases, the connections are made directly to the pigtail leads as outlined in paragraph 2.03.

Pigtail Lead Splices

(k) When two or more pieces of pigtail apparatus are to be connected to one terminal, the connections shall be made as follows. Connect as many pigtail leads to the terminal as practicable. The remaining pigtail leads shall be wrapped with at least one full turn around one or more of the connected pigtail leads and soldered. These connections (or solder thereon) shall not be made closer to the body than 3/8 inch, unless otherwise specified.

(l) Where the spacing between connecting points requires that the pigtail lead be spliced to increase its length, make the connections by means of a straight or end splice. Short or broken pigtail leads should be spliced to a wire (insulated or bare) of the same gauge to

increase the length of the lead. Where the pigtail leads or conductors (insulated or bare) are of a different gauge, it is permissible to twist two full turns of the smaller gauge conductor around the larger gauge conductor and solder. In either case, the splices shall not be made closer to the body than 3/8 inch, unless otherwise specified. It is recommended that a terminal punching (or unused relay terminals) be specified to eliminate a splice wherever it is practical to do so.

Pigtail Lead Protection

(m) Bare pigtail leads shall be protected with sleeving per KS-7851, or equivalent, wherever there is less than 1/16 inch clearance between:

- the pigtail lead and metal surfaces (panel, framework, covers, cans, etc)
- the pigtail lead and any terminal to which it does not connect
- the pigtail lead and any other bare pigtail lead or bare wire connecting to a different terminal
- the pigtail lead and enameled wire of inductors, etc.

(n) Sleeving is also requires whenever a pigtail lead can be shorted by coming in contact with metal surfaces or terminals to which it does not connect when the pigtail apparatus is pushed to one side, as is possible during handling or maintenance operations. This possibility of shorting is most likely to occur when the apparatus has No. 24 gauge or smaller pigtail leads of such length as to permit the body to be readily displaced. An example is the KS-16048 wafer capacitor. Each piece of apparatus should not actually be pushed aside to determine the possibility of shorting. Therefore, when sleeving is considered necessary, as can best be determined by examination of a development or sample review model, it is recommended that the manufacturing drawings specify such sleeving for specific leads.

(o) On some transistors, the collector, base, and emitter leads are spaced approximately 3/64 inch apart at the plane of the base. In such cases, where the spacing between the pigtail leads is an integral part of the design of the component, the 1/16-inch clearance requirement, specified in (m), is waived for the spacing between the pigtail leads emerging from the base. However, the requirements covered in (m) and (n) shall apply to the remaining portion of these pigtail leads.

Mounting

(p) Unless otherwise specified by note or by dimensions on drawing information, the location or position of the body of pigtail apparatus shall be in accordance with the following requirements.

(1) The mounting arrangement shall be consistent with the pigtail lead requirements outlined in (b), (d), and (f).

(2) The body of the apparatus shall be clear of all terminals.

(3) The uninsulated metallic cases or exposed enameled wire of apparatus bodies shall have 1/8-inch clearance from all terminals, from metalwork, bare wire, or bare straps.

(4) It is desirable to keep the body of the apparatus clear of wiring whenever practicable.

(5) On vitreous enamel-type resistors, such as KS-14603, the body of the resistor shall be clear of all wiring, adjacent components, and mounting surfaces by a minimum of 1/8 inch. On film-type resistors, such as KS-20289, the body of the resistor shall be clear of all wiring, adjacent components, and mounting surfaces by a minimum of 1/16 inch.

(6) The clearance between temperature-sensitive type insulation, such as used on BU-type wire, and all resistors up to 2 watts, shall be a minimum of 1/32 inch. For resistors larger than 2 watts, the clearance shall be a minimum of 1/8 inch.

(7) The mounting arrangements for 185-, 186-, and similar-type networks are covered in AT&T Practice 800-612-160.

(q) Where the location of the pigtail apparatus body is a requirement, this shall be so stated on the drawing information. If the position in a third dimension is not specifically indicated by dimensions, supplementary view, or other means, it is not a requirement. Unless specifically located by dimensions and tolerances, the body shall be positioned within 1/4 inch of the location shown, as gauged by eye. The exceptions are as follows.

(1) Where the drawing shows or specifies that the body must be kept away from metal surfaces (panel, framework, covers, cans, etc), the minimum clearance from the metal surface shall be 1/8 inch.

(2) When lead length and/or path requirements (specified on the drawing) prevent application of the 1/4-inch positioning tolerance.

(3) When the lead length would become less than 3/8 inch or other minimum length specified on the drawing.

(r) Code and electrical value markings need not all be oriented in the same direction. It is preferable, although not a requirement, for these markings to be visible.

(s) When heating or other circuit conditions permit, as judged by the design engineer, two or more pigtail components may be tied together as shown in Fig 18. This should be done only after consideration is given to the conditions outlined in (a). For example, resistors not having an insulating finish, such as the 111 type, should not be grouped together in this manner.

(t) When sheet-fiber details with terminals of the type shown in Fig 18 are used for mounting pigtail apparatus, connect the pigtail leads by passing them through the eyelet portion of the terminals and wrapping around the terminals as shown in Fig 18. The mounting arrangement shall be consistent with the pigtail lead requirements outlined in (b), (d), and (f).

(1) When apparatus mounted on both sides of sheet-fiber detail is to be connected to the same terminals and the pigtail leads are too large for both to pass through the eyelet, one pair of pigtail leads (preferably from the apparatus on the side opposite the terminal) shall be wrapped around the terminal without passing through the eyelet. All soldering shall be on the same side of the sheet-fiber detail.

(u) Where pigtail resistors, such as KS-8441 and similar types, are specified to be mounted on fuse posts, they should be soldered to the fuse posts and supported by fiber-resistance shield, P-419378 (804193787). The pigtail lead length (distance between apparatus body and the point of soldering) shall be approximately 1/2 inch, gauged by eye. Where the fuse posts are on panels served by sewed forms, the skinner should be the same length as those to fuse posts without resistor and the slack disposed of, as indicated in Fig 19.

2.52 ***Resistors*** equipped with wire terminals (pigtails) should be connected and mounted by means of their pigtail leads in the manner described in paragraph 2.51 for pigtail apparatus.

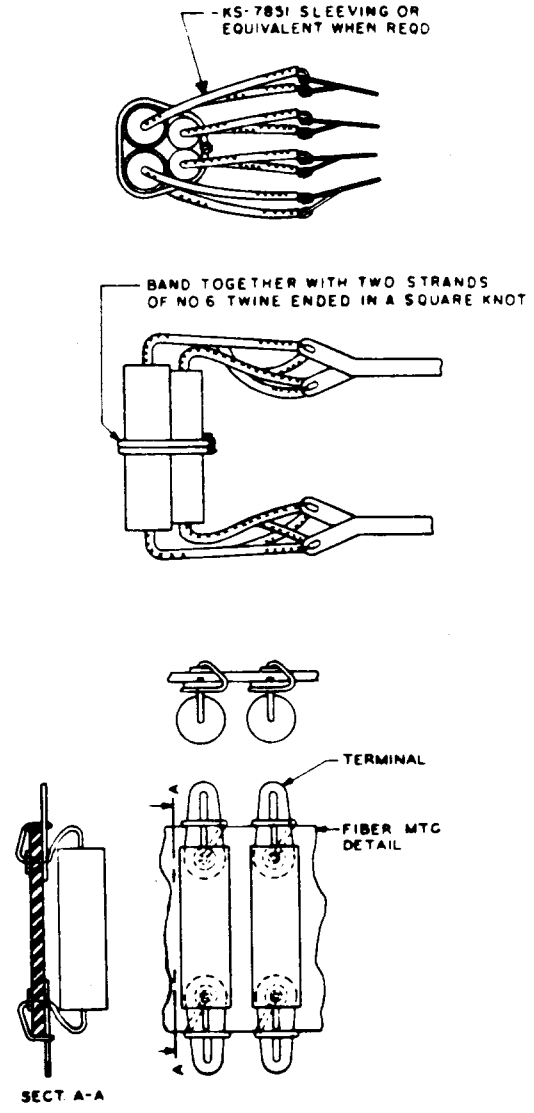


Fig 18—Pigtail Apparatus—Connections to Other Apparatus Terminals (Solder Not Shown)

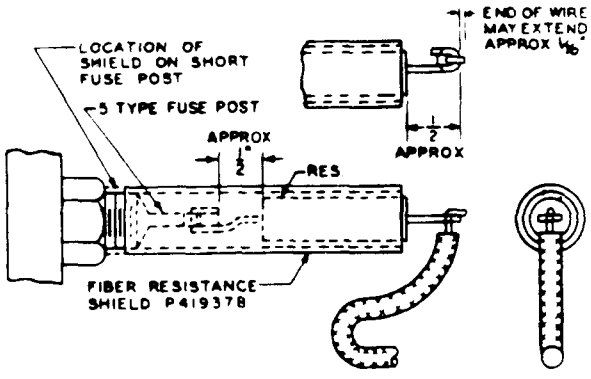


Fig 19—KS-8441 and Similar-Type Resistors Mounted on Terminals of Fuse Posts (Solder Not Shown)

(a) ***The 18-, 19-, and Similar-Type Resistors:*** Plate-mounted 18-type resistors should be wired, if practicable, with battery or other potential on the terminals away from an adjacent common can cover through which it would be possible to ground the resistor. If the resistors are isolated or the chances of grounding above or below are equal, wire them with battery or other potential on the lower terminal. The 19-type resistors are wired as circuit and mounting conditions require.

2.53 ***Sequence switches*** mounted in a sequence switch bay should have the battery lead connected to the outer magnet terminal of sequence switches in the first, third, fifth, etc, sequence switch positions from the bottom of the bay to the inner magnet terminal of the sequence switches to the second, fourth, sixth, etc, sequence switch positions from the bottom of the bay.

2.54 ***Terminal Strips:*** Connect the tip wire to the outer row of terminals, the ring wire to the second row, and so on to the inner row of terminals adjacent to the fanning strip.

(a) Cables connected to 65-, 182-, and similar-type terminal strips at the MDF should be connected to the inner lugs of each pair of terminals and should have the tip wire on the left and ring wire on the right of each pair, facing the front of the terminal strip in position on the frame.

(b) At 216- and similar-type terminal strips, connect switchboard cable to the lower terminal and the local cable to the top terminal.

(c) When both switchboard and local cable leads are connected to the same side of terminal strips having terminal pile-ups (with or without fanning strips), the point of connection on the terminals for each will depend upon the method of forming specified for the switchboard and local cables.

(1) When switchboard cable leads are brought through fanning strips and local cable leads are run directly to the terminals, connect the switchboard cable leads in the notch in back of the holes (or inner notch in the case of twin-notch terminals) in the terminals, and the local cable leads in the hole or outer notch of the terminal.

(2) When both the switchboard and local cable leads are run directly to the terminals, connect the switchboard cable leads in the holes (or outer notch in the case of twin-notch terminals) in the terminal and the local cable leads in the inner notch of the terminal.

(3) When both switchboard and local cable leads are brought through fanning strips, connect the switchboard cable leads in the holes (or outer notch in the case of twin-notch terminals) in the terminal and the local cable in the inner notch of the terminal.

(d) On terminal strips equipped with thermoplastic faceplates, extra care should be taken to avoid contact between the soldering copper and the faceplate.

2.55 ***Thermistors*** equipped with wire terminals (pigtails) should be connected and mounted by means of their pigtail leads in the manner described in paragraph 2.51 for pigtail apparatus.

(a) 1A- and similar-type thermistors should be connected as shown in Fig 20.

(b) In order to avoid damage to the nylon casing of 8A, 8B, and 8C thermistors, special care is required to avoid contact between the soldering copper or other heat source and the nylon casing.

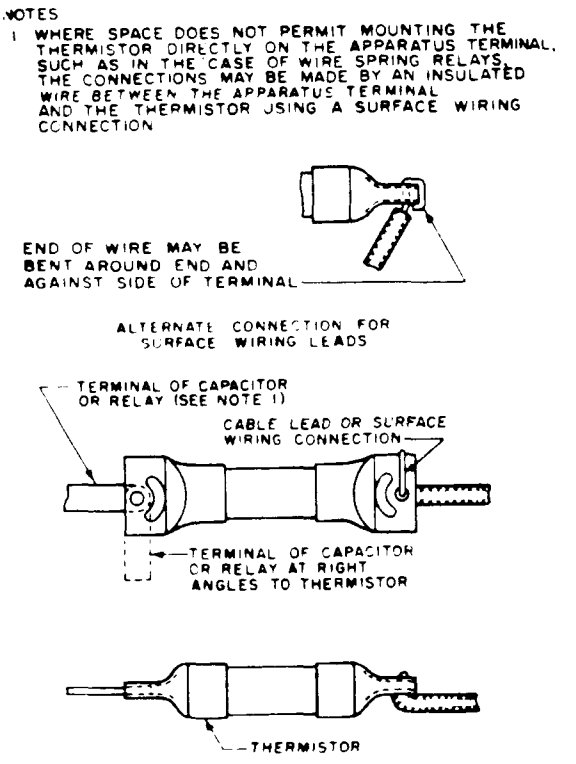


Fig 20—Connecting and Soldering No. 1A and Similar-Type Thermistors (Solder Not Shown)

(c) ***21A Thermistor and Similar-Type Pigtail Apparatus With Sealed Glass Bodies:*** The body of this apparatus is usually mounted using a plastic clip or other supporting means. The bending, splicing, and protection requirements covered in paragraph 2.51 shall apply to the pigtail leads. When mounted by pigtail leads (not recommended), the requirements covered in paragraph 2.51 shall be met.

2.56 ***Transistors Equipped With Wire Terminals (Pigtails):*** Except for 51- and 66-type transistors, the start of the bend in the pigtail lead shall be no closer than 1/16 inch from the point of attachment to the apparatus body. When bending or cutting pigtail leads greater than 0.020 inch in diameter, it is important to grip the leads securely between the transistor and the point of bending or cutting. When soldering any size lead, it is important to give consideration to placing some heat-dissipating device between the connection and the transistor.

(a) When connecting wires (conductors) to the wire terminals (pigtails), special care should be exercised to avoid putting any strain on the wire terminals during the wiring operation. This necessitates wrapping the wire (conductor) around the wire terminal (pigtail) just sufficiently to anchor the wire to the wire terminal before soldering.

2.57 ***Varistors and diodes*** equipped with wire terminals (pigtails) should be connected and mounted by means of their pigtail leads as described in paragraph 2.51 for pigtail apparatus.

(a) ***426- and Glass Enclosed-Type Diodes:*** The bend in the pigtail lead shall not start closer than 1/16 inch from the varistor or tubulation. No part of the tubulation extending from the glass end of the case may be bent or stressed. When bending or cutting leads greater than 0.020 inch in diameter, it is important to grip the leads securely between the varistor and the point of bending or cutting. When soldering any size lead, it is important to give consideration to placing some heat-dissipating device between the connection and the diode.

(1) When connecting wires (conductors) to the wire terminals (pigtails), special care should be exercised to avoid putting any strain on the wire terminals during the wiring operation. This necessitates wrapping the wire (conductor) around the wire terminal (pigtail) just sufficiently to anchor the wire to the wire terminal before soldering.

(b) ***400-Type Diodes:*** The minimum bend requirements specified in paragraph 2.51 may be waived provided that when the bend starts immediately adjacent to the weld, the inside radius of the bend shall not be less than 1/16 inch.

3. REQUIREMENTS FOR SOLDERLESS-WRAPPED CONNECTIONS

GENERAL

3.01 The successful use of solderless-wrapped connections depends, in part, upon the design of terminal to which they are applied. Approved terminal designs have been established and are classified as punched type and wire type. Punched

types are characterized by their cross sections, that is, flat punched and punched embossed. Wire types are similarly characterized as square, flattened and serrated, and twin wires twisted together and coined to a trapezoidal cross section. See Fig 1.

3.02 The parameters affecting the design of the terminals are described extensively in specification X-17151. These parameters must be met if the terminals of an apparatus item are to be approved for solderless wrapping.

3.03 Apparatus having terminals approved for solderless wrapping are listed on ED-94818-01.

3.04 Pigtail apparatus approved for solderless wrapping and the terminals to which they may connect are specified in ED-94909-01. Where this pigtail apparatus is specified and the terminals are approved for solderless-wrapped connections, the pigtail connections to this apparatus should be made by the solderless-wrap technique provided the end requirements can be met.

3.05 For field use, connections to General Trade apparatus or equipment may be made by the solderless wrap technique provided the General Trade apparatus terminal design meets the requirements of Development Letter Apparatus 2320.

3.06 All connections not specifically approved per ED-94818-01 or ED-94909-01 shall be soldered.

3.07 Apparatus terminal ends having color dye markings, usually red, do not meet requirements for solderless wrapping and all connections to such terminals shall be soldered. These markings usually indicate repaired apparatus, but may appear on nonconforming terminals of new apparatus.

3.08 Where apparatus terminals are designed, approved, and authorized for solderless-wrapped connections, the connections to these terminals shall be made by the solderless-wrap technique. Repair of defective solderless-wrap connections by soldering does not normally meet design intent.

3.09 Since solderless-wrapped connections made over solder tend to loosen in service, it shall not be permissible to solderless wrap any portion of a terminal on which solder or solder splashes are present. If one connection on a terminal is soldered, all connections on that terminal shall be soldered except as follows.

(a) Where a strap is soldered beyond the working length of the terminal (straight portion), a solderless-wrapped connection may be placed on the working length of the terminal provided that the strap is soldered first. In this case, there shall be no solder or solder splashes on the portion of the terminal designed to accommodate the solderless-wrapped connection. Thin, smooth films of rosin or slight discoloration due to rosin along the solderless-wrap portion of the terminal are permissible.

(b) On distributing frame terminal strips where the strapping arrangement is part of the coded strip and the straps are placed in the strapping notch and soldered, solder and/or solder splashes are permitted on the solderless-wrapped portion of the terminal to a limited degree as indicated in notes on the apparatus drawing. When these terminal strips are used in wired equipment, it may be assumed that the soldering restrictions specified in the notes on the apparatus drawing have been met and a solderless-wrapped connection may be made on these terminals.

(c) It is permissible to solder a connection made on one prong of a 2-prong terminal, without soldering the connection on the other prong provided that extreme caution is taken in the soldering operation so that the heat from the soldering copper will not damage the solderless-wrapped connection on the other prong of the terminal. It is important that the soldering iron be applied to the terminal just long enough to insure a good soldered connection using a minimum amount of solder.

3.10 Where a solderless-wrapped connection is to be made with a wire that has been previously connected, a new shiner of proper length shall be used.

3.11 The 1/32- and 1/64-inch clearance specified in paragraph 5.13 for soldered connections shall apply for solderless-wrapped connections.

3.12 While it is not a requirement that the wire end lie flat against the terminal, it should in no case project to the extent that the required clearance specified in paragraph 5.13 cannot be maintained and in no case shall the wire end extension be more than half the distance to the closest terminal.

3.13 On solderless-wrapped connections, the bare portion of a wire between the point of connection to a terminal and the insulation of the wire should be less than half the distance to the closest terminal. The insulation may, however, overlap the terminal.

3.14 It is not permissible to reapply the wrapping tool over a solderless-wrapped connection to try to correct nonconformance with the requirements specified herein.

3.15 ***Cross-Connection:*** Solderless-wrapped cross-connections that do not meet the requirements covered herein shall be removed and a new connection made which meets the requirements.

3.16 The working length (wrapping portion) of any terminal to be solderless wrapped shall be essentially straight and free of angular bends or crimps. However, a small amount of bowing is permissible provided the terminal will freely enter the bit used to make the solderless-wrapped connection.

3.17 Apparatus that has closely spaced punched-type terminals approved for solderless wrapping, such as EA-, U-, Y-, and similar-type relays, shall have terminals sufficiently spread so that the connection can be placed at the desired position on the terminal and meet clearance requirements. A solderless-wrapped connection may be damaged if it is disturbed. For this reason, it is desirable that any movement of the terminals, such as spreading, after the connections have been made, should be avoided.

MAKING AND PLACING OF CONNECTIONS

A. General

3.18 The connection is made with an approved power-driven wrapping tool or approved hand-grip wire-wrapping tool. (See Fig 21.) The wire used shall be suitably stripped, standard AT&T Technologies coded insulated (or bare) tinned solid copper wire or approved equivalent. The gauge of wire used depends upon the size of the terminal. (See paragraphs 3.01, 3.24, 3.26, 3.30, and 3.32.)

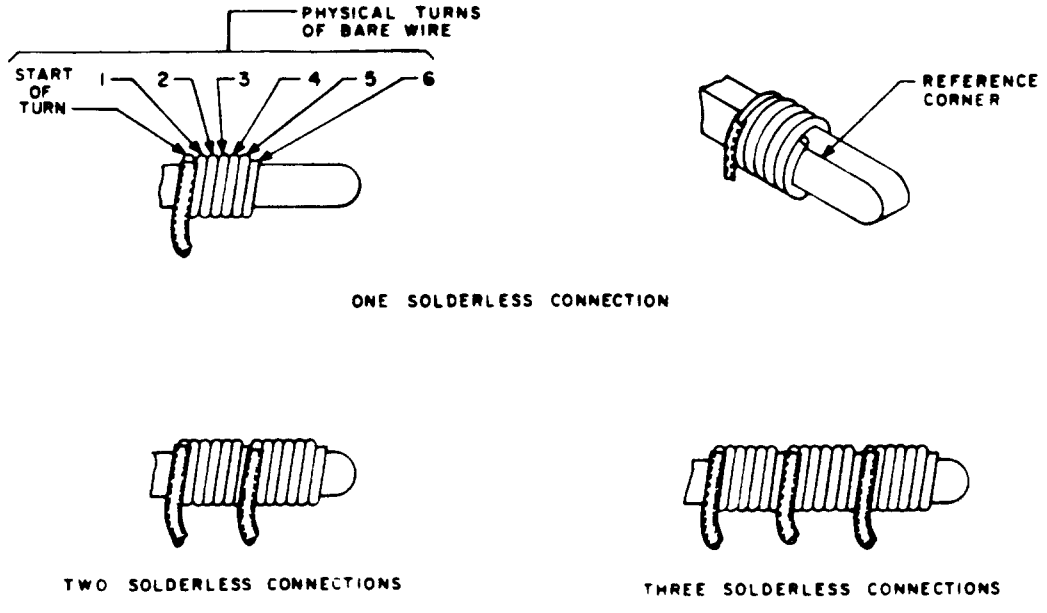


Fig 21—Solderless-Wrapped Connections

(a) The life expectancy of a solderless-wrapped connection made with tinned wire is approximately 40 years. The use of untinned wire will reduce the life requirement by approximately one-half. In addition, under certain environmental conditions, the use of untinned wire may result in noisy and unreliable connections. Therefore, the use of untinned wire for solderless-wrapped connections is limited to certain applications in specifically authorized equipment and apparatus.

(b) A solderless-wrapped connection having partially plated wire is acceptable provided that when the completed connection is viewed from any side there shall be a minimum number of turns, not necessarily adjacent, as listed below, with no copper showing on the surface of the wire as gauged by eye:

(1) ***No. 20, 22, and 24 gauge wire:*** Three turns.

(2) ***No. 26 gauge wire:*** Five turns.

(3) ***No. 28 and 30 gauge wire:*** Three turns.

3.19 Where only one connection is specified on any terminal designed for more than one connection, the connection shall be placed in far enough on the terminal to permit at least one additional solderless-wrapped connection. The above requirement also applies to repaired connections.

3.20 ***Separation Between Turns:*** (No. 20, 22, 24, and 26 gauge wire; for No. 28 and 30 gauge wire, see paragraph 3.34): The minimum number of turns of a connection as specified in paragraphs 3.24, 3.26, and 3.30 may be separated, provided the number of adjacent turns shown in (a) and (b) have spaces that do not exceed 0.005 inch each, as viewed from at least one side of the terminal and gauged by eye. In no case shall the specified minimum number of turns be interrupted by separation in excess of 0.010 inch as viewed from any side. (See Fig 22.)

(a) ***No. 20, 22 or 24 Gauge Wire:*** The spaces between four adjacent turns shall not be greater than 0.005 inch each.

(b) ***No. 26 Gauge Wire:*** The spaces between six adjacent turns shall not be greater than 0.005 inch except on twisted and coined terminals when three spaces may exceed 0.005 inch (up to 0.10 inch, maximum) provided the spaces are not adjacent.

3.21 Overlapping and overlapped turns shall be discounted when determining the total number of turns on a connection. There shall be no more than one bulged turn within the minimum successive turns of a connection. A bulged turn is defined as a start of an overlap where the wire is away from the terminal not more than one-half the circumference of the turn. More than one-half the circumference shall be considered overlapping.

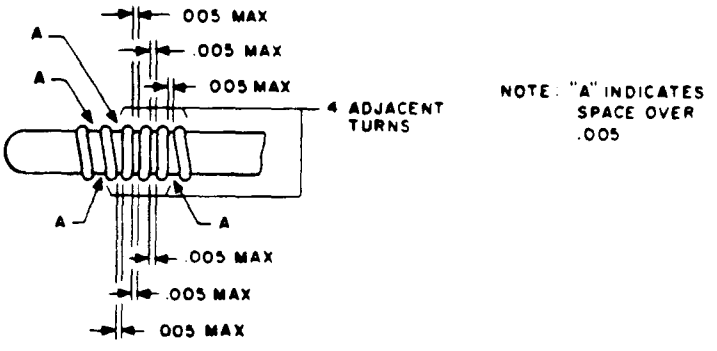


Fig 22—Determining Satisfactory Connection That Has Separation Between Adjacent Complete Turns (No. 20, 22, or 24 Gauge Illustrated)

3.22 In order not to disturb the connection after it is made, test clips, connecting tools, etc, shall not be placed on the helix portion of the solderless-wrapped connection. Because heat will degrade and disturb the connection, solderless-wrapped connections which necessitate the use of heat shrink tubing for insulation shall be soldered before application of the tubing.

3.23 In general, the length of the terminal designed for solderless-wrapped connections is such that two solderless connections can be conveniently made. When it is necessary to make a second or third connection and there is sufficient space on the terminal to make the proper number of turns, the second or third connection may be wrapped in the same manner as the previous connection. (See Fig 21.) As a standard practice, the turns of any connection shall not overlap the turns of any previous connection on the same terminal. In cases where this overlapping is encountered, it should not be considered a defect if the requirements outlined in paragraphs 3.18 through 3.35 are met for the additional connections and providing the previous connections display a minimum of the specified number of successive nonoverlapped turns before the point of overlap. If there is not enough space on the terminal for a second or third solderless-wrapped connection, wrap the wire with a minimum of one and one-quarter turns on the terminal, if space permits, or over a previous connection, and solder all connections on that terminal. (See Fig 23.) Connections to 0.009-inch terminals are covered in paragraphs 3.26 through 3.29.

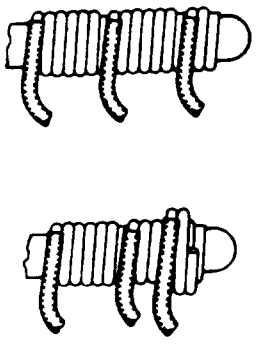


Fig 23—Terminals With Insufficient Space for Third Solderless Connection—All Connections Soldered (Solder Not Shown)

B. Punched and Square Cross-Section Wire Terminals

3.24 The connection shall consist of a minimum of the specified number [see (a), (b), and (c) below] of successive nonoverlapping helical turns of bare wire on the working length (straight portion) or the terminal. The minimum number of successive nonoverlapping turns of bare wire for the various gauges of wire shall be as follows. (See paragraphs 3.32 and 3.33 for No. 28 and No. 30 gauge wire.)

(a) ***No. 20 and No. 22 Gauge Wire:*** Five turns.

(b) ***No. 24 Gauge Wire:*** Six turns.

(c) ***No. 26 Gauge Wire:***

TERMINAL TYPE	MINIMUM TURNS REQUIRED	
	Hand Wrapped	Machine Wrapped
Square (0.045 x 0.045 in)	7	6-1/4
Flattened and Serrated	9	9
Twisted and Coined	9	9
Flat Punched	7	6-1/4
Embossed Punched	8	6-1/4
Square (0.025 x 0.25 in)	6	6
Square (0.025 x 0.35 in)	9	9

3.25 ***Tightness (Product Connections):*** The product of solderless-wrapped connections will be considered as conforming with the intent of requirements when samples of solderless-wrapped connections that have been selected and inspected in accordance with the procedure of AT&T Bell Laboratories Inspection Practices Section IS-301.505 (for shop use) or Inspection Practices Section IS-970.005 (for installation use), or equivalent, meet the criteria given therein. In addition, product connections shall be capable of withstanding a force of 2500 grams for No. 24 and larger gauge wire and 2200 grams for No. 26 gauge wire (as measured with a gauge readable and accurate within ±10 percent) applied in a direction parallel to the axis of the terminal without visible displacement of the connection as a whole.

C. 0.009-Inch Crosspoint Terminals of Crossbar Switches and 0.010 Thick Terminals of the Embossed Type

3.26 The connection shall consist of a required minimum of successive nonoverlapping helical turns (as specified in paragraphs 3.24 and 3.32) of bare No. 24, 26, 28, or 30 gauge wire on the working length of the terminal.

3.27 After the connection has been wrapped on the terminal, the terminal shall not be straightened to remove any twist that occured during the wrapping cycle. While wrapped terminals twisted more than 90° but less than 180° are considered as evidence of poor workmanship, they need not be rewrapped or soldered. Terminals twisted 180° or more are not acceptable and shall be soldered.

3.28 All connections to 0.009-inch crosspoint terminals of crossbar switches that have been previously wrapped, repaired, or where a second connection is added shall be soldered.

3.29 The product of solderless-wrapped connections will be considered as conforming with the intent of requirements in paragraphs 3.26 through 3.29 when samples of solderless-wrapped connections that have been selected and inspected in accordance with the procedure of AT&T Bell Laboratories Inspection Practices Section IS-301.505 (for shop use), Section AA668.005 or Inspection Practices Section IS-970.005 (for installation use), or equivalent, meet the criteria given therein. In addition, product connections shall be capable of withstanding a force of grams (as measured with a gauge readable and accurate with ±10 percent) applied in a direction parallel to the axis of the terminal without visible displacement of the connection as a whole, as specified below:

(a) ***No. 24 Gauge Wire:*** 2500 grams

(b) ***No. 26 Gauge Wire:*** 2200 grams.

(c) ***No. 28 Gauge Wire:*** 1750 grams.

(d) ***No. 30 Gauge Wire:*** 1200 grams.

D. Terminals of Wire-Spring Apparatus

3.30 The connection on the two types of terminals (serrated, twisted and coined) of wire-spring apparatus shall consist of a minimum of specified number of successive nonoverlapping helical turns of bare wire on the working length of the terminal; see (a) through (e) below. The connection shall not start beyond the straight serrated length in the one type nor beyond the straight twisted and coined length of the other type unless excess turns are provided so that the minimum number of turns specified can be applied to the straight serrated and twisted and coined portion. The minimum number of successive nonoverlapping turns of bare wire for No. 22, 24, 26, 28, and 30 gauge wire shall be as follows.

(a) ***No. 22 Gauge Wire:*** Five turns.

(b) ***No. 24 Gauge Wire:*** Six turns.

(c) ***No. 26 Gauge Wire:*** Nine turns.

(1) For field use, a minimum of eight turns will be acceptable for No. 26 gauge wire.

(d) ***No. 28 Gauge Wire:*** Same requirements as in paragraphs 3.32 through 3.35.

(e) ***No. 30 Gauge Wire:*** Same requirements as in paragraphs 3.32 through 3.35.

3.31 The product of solderless-wrapped connections will be considered as conforming with the intent of requirements in paragraphs 3.30 and 3.31 when samples of solderless-wrapped connections that have been selected and inspected in accordance with the procedure of AT&T Bell Laboratories Inspection Practices Section IS-301.505 (for shop use), Section AA668.005 or Inspection Practices Section IS-970.005 (for installation use), or equivalent, meet the criteria given therein.

E. 0.025-Inch Square Terminals Using No. 28 or No. 30 Gauge Wire

3.32 The connection shall consist of a required minimum of successive nonoverlapping helical turns of bare wire on the working length of the terminal; see (a) and (b) below. No. 28 and 30 gauge wire also require a minimum number of helical turns of insulation wrapped around the terminal as specified in paragraph 3.33.

(a) ***No. 28 and 30 Gauge Wire:*** Six turns of alloy 135 wire (cadmium-chromium-copper).

(b) ***No. 28 and 30 Gauge Wire:*** Seven turns of OFHC (oxygen-free high conductivity).

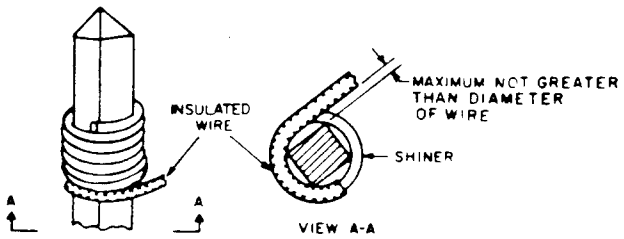


Fig 24—Solderless-Wrapped Connection Using No. 28 or No. 30 Gauge Wire (Alloy 135 Shown)

3.33 ***Turns of Insulation:*** The connections using No. 28 and No. 30 gauge wire shall also have three-fourths of a turn (minimum) of insulated wire wrapped around the terminal (modified wrap.) The insulation shall be in intimate contact with at least two corners of the terminal working length and shall not be farther away than the maximum diameter of the wire as it leaves the third corner as judged by eye. (See Fig 24.)

(a) Where a No. 28 or No. 30 gauge wire is to be terminated on another terminal working length that is 1 inch or less on centers, the insulated portion need only be in intimate contact with one corner of each terminal working length.

(b) The above requirement does not apply to No. 28 and No. 30 gauge bare wire straps.

3.34 ***Separation Between Turns (No. 28 and 30 Gauge Wire):*** The minimum number of turns of a connection as specified in paragraph 3.32 may be separated, provided the number of adjacent turns shown in (a) and (b) have spaces that do not exceed 0.003 inch each, as viewed from at least one side of the terminal and gauged by eye. In no case shall the specified minimum number of turns be interrupted by separation in excess of 0.005 inch as viewed from any side.

(a) ***Six-Turn Connection:*** The spaces between four adjacent turns shall not be greater than 0.003 inch each.

(b) ***Seven-Turn Connection:*** The spaces between five adjacent turns shall not be greater than 0.003 inch each.

3.35 ***Tightness (Product Connections):*** The product of solderless-wrapped connections will be considered as conforming with the intent of the requirements when samples of solderless-wrapped connections that have been selected and inspected in accordance with the procedure of AT&T Bell Laboratories Inspection Practices Section IS-301.505 (for shop use), Section AA668.005 or Inspection Practices Section IS-970.005 (for installation use), or equivalent, meet the criteria given therein. In addition, product connections shall be capable of withstanding a force as specified below (as measured with a gauge readable and accurate within ±10 percent) applied in a direction parallel to the axis of the terminal without visible displacement of the connection as a whole.

(a) ***No. 30 Gauge Wire:*** 1200 grams minimum.

(b) ***No. 28 Gauge Wire:*** 1750 grams minimum.

4. REQUIREMENTS FOR MAKING CONNECTIONS TO QUICK-CONNECT TYPE TERMINALS

GENERAL

4.01 Quick-connect connectors have been designed to permit connection of selected wire without removal of the conductor insulation. The successful use of quick-connect type connectors depends in part upon the terminal design and the method employed to insert the conductors into the slots of the terminal. The following terminology shall apply:

(a) ***Connector:*** Connector is used whenever it refers to the entire piece part, as shown in Fig 25, 29, 32, and 34.

(b) ***Terminal:*** Terminal is that portion of the connector in which a conductor can be inserted for the purpose of making a connection. See Fig 25, 29, 32, and 34.

(c) ***Looping Termination:*** The wire continues to another terminal.

(d) ***Ended Termination:*** The wire does not continue to another terminal.

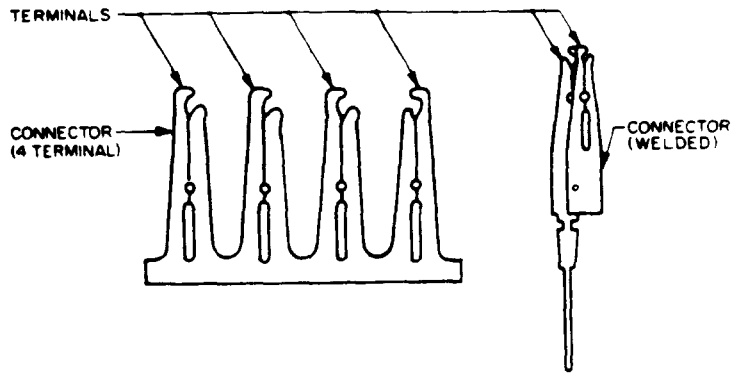


Fig 25—Connectors (Shown Are the Type Used on the 66 Connecting Blocks)

4.02 Approved connector and terminal designs have been established as specified herein and used in various connecting block designs such as the 66-, 78-, 88-, 89-, 94-, and similar type.

4.03 The wire used shall be standard AT&T Technologies coded plastic-insulated (no textile serving) tinned or untinned solid copper wire or approved equivalent. The gauge and type of wire for various types of terminals are shown in Table A. Only one wire may be terminated on each individual terminal.

4.04 When a wire that has been previously connected is reused, the old contact portion of that wire shall be removed.

4.05 Terminals shall be free of all previously connected wire insulation or bare wire which may be lodged between the two contact surfaces of the terminal before another connection is made to that terminal. The 980A tool, or approved equivalent, shall be used to remove the wires from these terminals.

4.06 Approved wire insertion tools have been established for the various connecting blocks and are shown in Table A.

Caution: When seating and cutting conductor, push the tool straight down over the clip. Avoid bending or twisting the clip. It is recommended that the tool be checked periodically for excessive wear, corrosion, dents, and accumulation of foreign matter.

SPECIFIC

A. 66-Type Connecting Blocks (Except G and H)

4.07 Approved terminal designs have been established per X-17176 and are used in various 66-type connecting blocks. (See Fig 25.)

4.08 The tools in Table A, or an approved equivalent, shall be used to make all terminations. Other types of solid conductor wire may be used provided they are skinned of their insulation and cleaned (if enameled) before termination.

4.09 Skinned No. 18 or 19 gauge wire may also be used for the termination. In this case, long nose pliers may be used to complete the connection.

4.10 The wire shall be inserted in the terminal for a minimum depth specified in Table B. The depth shall be defined as the distance from the top of the terminal to the top of the wire insulation measured on the side of the terminal the wire enters. (See Fig 26.)

4.11 Terminals that are bent or misaligned, resulting in a gap greater than 8 mils between the contact surfaces, or terminals that are pushed together shall not be used. (See Fig 27A.) Terminals that have otherwise been bent or misaligned (see Fig 27B) may be used providing the appropriate 714 tool, or equivalent, fits freely on the terminal without binding in any way. The gap shall be defined as the contact surface area between 0.230 inch from the top of the terminal to the top of the plastic block. (See Fig 27C.)

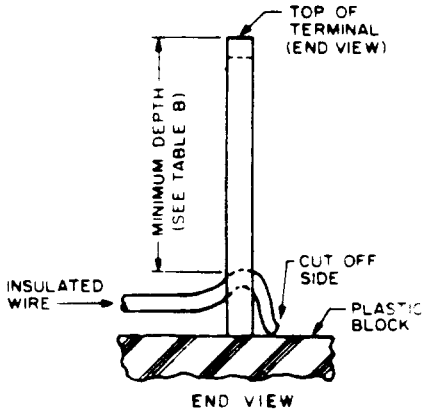
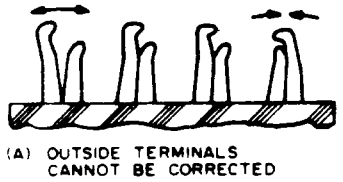
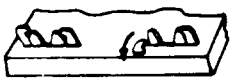


Fig 26—Wire Insertion Depth





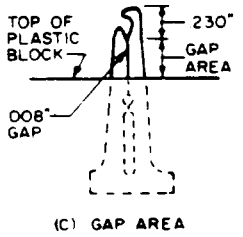


Fig 27—Bent Terminals

4.12 ***Clearance:*** The clearance between bare wire ends and adjacent terminals, bare wire, metal work, etc, shall not be less than 1/32 inch.

4.13 ***Protrusion:*** In cases where the wire is precut, a minimum of 1/16 inch of wire shall protrude from the terminal. This protrusion shall not exceed 1/8 inch maximum.

B. 66G- and H-Type Connecting Blocks

4.14 Approved terminal designs have been established for the 66G and H connecting blocks per X-17176.

4.15 The 714E2 tool, or approved equivalent, shall be used to make all terminations. Other requirements in paragraphs 4.08 and 4.09 apply to the G and H blocks.

4.16 The wire insertion depth specified in paragraph 4.10, Fig 26, and Table B shall apply.

4.17 On the welded terminal connector (see Fig 25), the leads shall be dressed into the terminal as shown in Fig 28. In no case shall the leads be dressed in on the opposite side of this terminal.

4.18 ***Clearance:*** Dimensions for wire protrusion are shown in Fig 28. The 1/32 clearance requirement of paragraph 4.12 shall apply.

4.19 ***Bent Terminals:*** The requirements specified in paragraph 4.11 and Fig 27 shall apply to the 66G- and H-type blocks.

C. 78-Type Connecting Blocks

4.20 The terminals used on 78-type connecting blocks are shown in Fig 29.

4.21 The tool in Table A, or an approved equivalent, shall be used to make all terminations. Other requirements in paragraphs 4.08 and 4.09 apply to the 78-type blocks.

4.22 ***Bent Terminals:*** The 8-mil gap requirement specified in paragraph 4.11 applies to 78-type connecting blocks. See Fig 30 for the gap area.

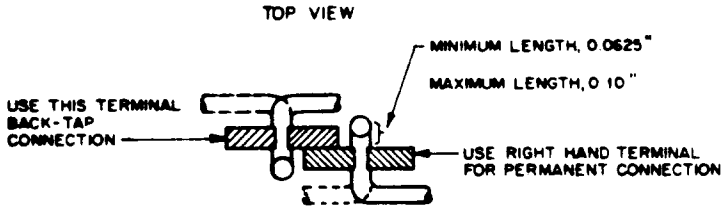


Fig 28—Wiring Method for Connector Used on 66H and Similar-Type Blocks - Welded Terminals

TABLE A

WIRE FOR QUICK-CONNECT TERMINALS

CONNECTOR CODE	WIRE TYPE AND GAUGE						APPROVED TOOL
	BU	BY	DP	DM (R-CABLE)	DT	DY	
66 (except G & H)	22,24	26	22,24	22,24,26	22		714B, AT8762
66G & H						22	714E
78A					22		756C, D KS-21771
78B					22		756D
78C, 112					24		756C
88	22,24	26	22,24	22,24	22,24		788, AT8762 with 88 Blade
89C, D & TB					22		756C & D KS-21771
94	22,24	26					R4710A

Note: Any cable made up of any of the above wires may be used on quick-connect terminals.

TABLE B

DEPTH OF WIRE IN TERMINAL

GAUGE OF WIRE	MINIMUM DEPTH (INCHES)		
	66 (EXCEPT G & H)	66G & H	78
No. 26	0.325		
No. 24	0.280		
No. 22	0.280	0.250	0.250
No. 20	0.280		

4.23 ***Clearance:*** The clearance requirements specified in paragraph 4.12 shall apply.

4.24 On the welded connector, the leads shall be dressed the same as for the 66H connector shown in Fig 28.

4.25 The wire shall be inserted into the terminal gap area for a minimum depth as shown in Fig 31. The gap area is defined as 0.192 inch down from the top of the terminal as shown in Fig 30. See Table A for wire types and gauges.

D. 88-Type Connecting Blocks

4.26 Approved terminal designs have been established and are used in 88-type connecting blocks. (See Fig 32 for connector design.) The wires and tools to make the connection are shown in Table A.

4.27 The wire shall be inserted in the terminal for a minimum depth as shown in Fig 33. The depth shall be defined as the distance from the terminal shoulder to the top of the bare portion of the conductor as shown in Fig 33.

4.28 Terminals that are bent or misaligned, or that do not meet the gap area requirements shown in Fig 33 measured at the entrance of the gap area, shall not be used.

4.29 Where applicable, the connecting block shall be seated into its mating apparatus until all its locks are completely engaged.

4.30 The clearance between bare wire ends and adjacent terminals, bare wire, metal work, etc, shall not be less than 1/32 inch.

E. 89-Type Connecting Blocks

4.31 The requirements specified in paragraphs 4.20 through 4.25 for the 78-type connecting blocks shall apply to the 89-type connecting blocks.

F. 94-Type Connecting Blocks

4.32 Approved terminal designs have been estab lished and are used in the 94-type connecting blocks. (See Fig 34 for connector design.) The wires and tools used to make the connection are shown in Table A.

4.33 The wire shall be inserted in the terminal for a minimum depth as shown in Fig 35. The depth shall be defined as the distance from the terminal shoulder to the top of the bare portion of the conductor as shown in Fig 35.

4.34 Terminals that are bent or misaligned, or that do not meet the gap area requirements shown in Fig 35 measured at the entrance of the gap area, shall not be used.

4.35 The clearance between bare wire ends and adjacent terminals, bare wire, metal work, etc, shall not be less than 1/32 inch.

5. REQUIREMENTS FOR SOLDERING

5.01 ***Solder*** All soldering shall be in accordance with Manufacturing Process Specification 50016, Method D or L. Fluxes in accordance with Manufacturing Standard 17000, Section 1135, are permissible.

(a) Solder having a higher tin content than the usual 45, 50, or 60 percent should be used where extra care must be exercised to avoid damage to apparatus or insulation of wire by heat from the soldering operation.

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

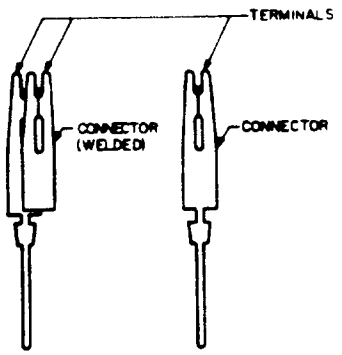


Fig 29—Connectors (Shown Are the Type Used on the 78-Type Connecting Blocks)

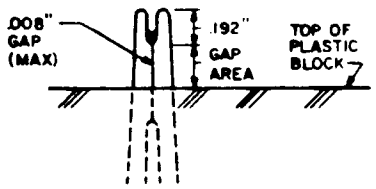


Fig 30—Gap Area for Terminals on the 78-Type Blocks

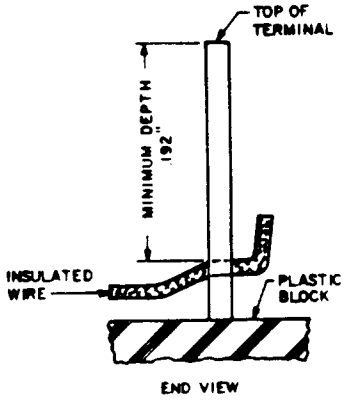


Fig 31—Wire Insertion Depth

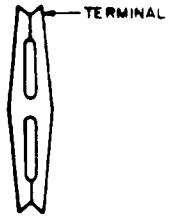


Fig 32—Connector Type Used on 88-Type Connecting Blocks

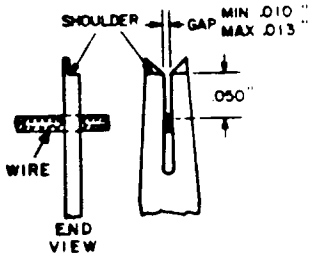


Fig 33—Minimum Insertion Depth and Gap Area for 88-Type Terminals

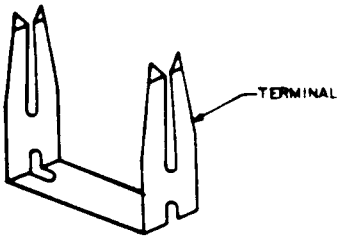


Fig 34—Connector Type Used on 94-Type Connecting Blocks

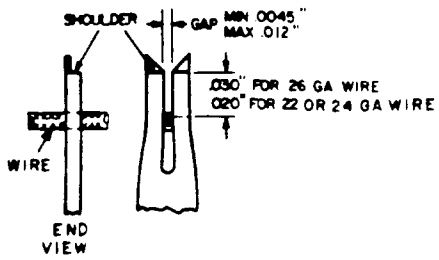


Fig 35—Minimum Insertion Depth and Gap Area for 94-Type Terminals

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

(d) Remove enamel insulation from enameled wire immediately preceding soldering. When this is not practicable, any freshly scraped wires that will not be soldered within 48 hours may be given a coat of thin orange shellac or solder dipped to prevent oxidation.

(e) For printed wiring boards and assemblies, see X-20062.

5.02 ***Application:*** In general, solder should be applied to the top or right-hand side of all terminals, as shown in Fig 36 and 37.

(a) An exception to this practice is when connections are made for left-hand soldering as described in paragraph 2.01(a), (b), and (c).

5.03 ***Holes in perforated terminals*** normally should be filled with solder when wires are connected through the hole in the terminal. Consistent soldering without filling the holes with solder indicates faulty connecting and soldering techniques, which should be corrected. It is not objectionable, however, if occasionally a hole is not filled with solder, provided the soldering is otherwise secure. An exception to the above is on terminals with large holes (greater than 1/16 by 3/32 inch) where it is economically unsound to fill the hole with solder.

(a) Extra care should be taken to fill all holes with solder at terminals that will be inaccessible for verification after being installed, such as jack and lamp strips in switchboards. However, the exception stated above for terminals with large holes may apply.

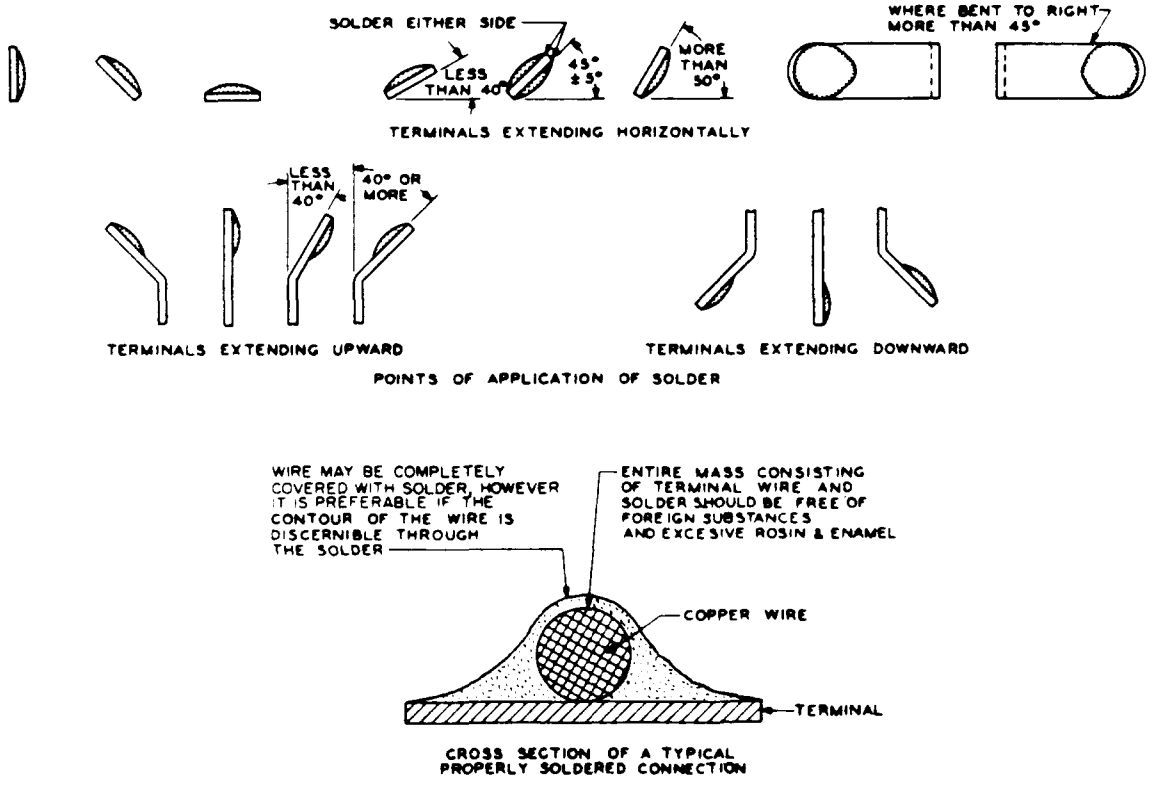


Fig 36—Application of Solder - Wire Connection in the Hole, Hook, or Notch of the Terminal

5.04 ***Where the wire is wrapped around perforated terminals*** (as in the case of wrapped soldered connections), it will not be necessary to fill the hole of the terminal or cover the wire end with solder. Ordinarily, all turns of wire will be covered with solder at the soldered side of the terminal, but, from a requirement standpoint, it is only necessary that the turn nearest the insulation (on the soldered side of the terminal) be covered, as shown in Fig 37.

5.05 ***Wire Terminals (Including Square Cross-Section) and Punched-Type Terminals 1/16 Inch or Less in Width:*** When wrapped connections to these terminals are to be soldered, there shall be evidence of wetting between the wire and the terminal. Ordinarily, all turns of wire will be covered with solder at the soldered side of the terminal, but, from a requirement standpoint, it is only necessary that at least two of the turns be soldered where more than two turns are involved. Where the connection is two turns or less, all turns must be soldered on the soldering side for a punched-type terminal and at least one complete turn must be soldered for a wire terminal.

5.06 ***On spun-in, stand-off, grooved, and similar-type terminals,*** completely cover the wire with solder for at least one half of the circumference of the terminal.

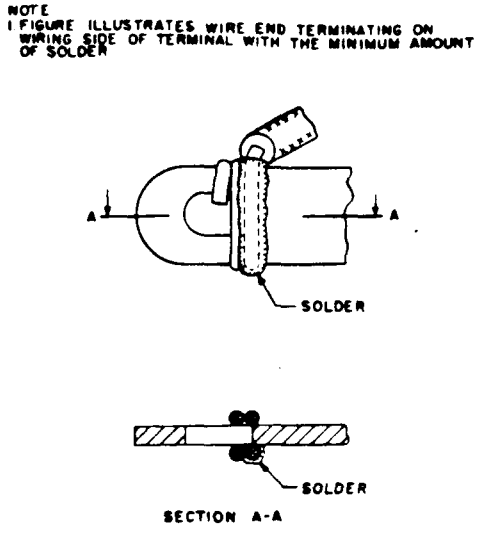


Fig 37—Application of Solder-Wrapped Soldered Connections

5.07 ***Stand-Off Terminals (such as the 202-type, which consists of a terminal insulated from its mounting stud by means of insulating material):*** Special care is required to avoid overheating these terminals during the soldering operation, as excessive heat may loosen the terminal from the insulating material.

5.08 ***Tubular Terminals (such as the cutaway tubular terminals of U.S. Components Co plugs and connectors):*** When the connection is made by inserting the wire into the tubular portion of the terminal, the solder shall fill the cutaway portion of the terminal; the security of the connection will be considered adequate if it will withstand a pull test of 4 pounds minimum. When the connection is made by wrapping the wire around the terminal, the turn nearest the insulation shall be soldered for at least one half of the circumference of the terminal.

5.09 ***Trough-Shaped Terminals (such as on the KS-16671 plugs):*** Completely cover the wire with solder. The security of the connection will be considered adequate if it will withstand a pull test of 4 pounds minimum.

5.10 ***Screw or clamp connections*** should not be soldered to the screw or clamp, unless specified.

5.11 ***Security of Connections:*** Connections should be so soldered to provide a secure metallic connection between the parts soldered.

(a) In the case of enameled wire, sufficient enamel should be removed to insure a satisfactory condition.

5.12 ***Electron-Tube Sockets:*** In order to prevent damage or misalignment of the contacts as well as to reduce the possibility of overheating the contacts and body material, a wiring plug such as the KS-19454 or JE-9, JE-10, or JE-18 wiring plug (supplied by the Star Expansion Products Company), or equivalent, should be used on miniature and jumbo (9 contact) base electron-tube sockets such as KS-16466 and KS-16150, during the wiring and soldering operations. On subminiature sockets, the JE-8 or appropriate wiring plug should be used. For requirements on clearance and free movement of terminals, see paragraph 5.13.

5.13 ***Clearance:*** The clearance between the terminals (or solder or bare wire thereon) and adjacent metalwork such as mounting plates, mounting details, etc, shall not be less than 1/32 inch. The clearance between adjacent terminals (or solder or bare wire thereon), on the same or adjacent pieces of apparatus, shall not be less than 1/64 inch after the terminals of apparatus, such as relays, have been spread and connected. In the case of twisted and coined terminals such as on wire-spring relays, the clearance between terminals (or solder or bare wire thereon) shall not be less than 1/32 inch.

(a) Terminals of apparatus whose design permits movement, such as the floating contact terminals in sockets for electron tubes, crystals, or multiple contact receptacles and plugs, should have a clearance of not less than 1/32 inch measured with the terminals in their most adverse positions. It is intended that this requirement be met when the apparatus in question is checked with its mating apparatus, or equivalent, both in and out of place and without applying other pressures on the terminals. The terminals shall have free movement after the soldering operation.

(b) A minimum clearance of 1/32 inch shall be maintained between terminals of adjacent Miniplas assemblies in their most adverse position, as the assemblies may be subject to a certain amount of movement.

(c) On K carrier cable balancing panels, a clearance of not less than 1/32 inch is required between terminals.

5.14 ***Appearance:*** Solder connections should be neat and clean. Consistent presence of unsightly flux or discoloration is indicative of poor workmanship.

5.15 Avoid excessive globules of solder projecting from the terminal or pile-up of solder on the terminal.

REASONS FOR REISSUE

1. To add paragraph 1.10 covering supplementary AT&T Practices and drawings.

2. To revise paragraph 2.25 covering commercial solder-type terminals to add reference to paragraph 5.03.

3. To revise paragraph 2.26 covering crimp-type terminals to specify crimping in accordance with X-18957 and to add paragraphs (a), (b), and (c).

4. To add paragraph 2.27 covering qualified crimped connection systems listed on ED-94996-01.

5. To revise the titles of Fig 12 and 13 covering solderless connections at split-type and screw-type terminals, respectively, to specify solid wire.

6. To revise paragraph 2.31 covering split-type terminals to specify solid wire only.

7. To revise paragraph 2.35 covering paired wires to add an exception for electronic-type equipment.

8. To revise paragraph 2.39(f) covering switchboard short-multiple cable forms to add reference to green leads.

9. To revise paragraph 2.51(p) covering mounting of pigtail apparatus to clarify requirement.

10. To revise paragraph 2.51(p)(5) covering the location or position of the body of pigtail apparatus to specify new clearance requirements for KS-14603 and KS-20289 resistors.

11. To revise paragraph 2.51(u) covering pigtail resistors, such as KS-8411, to add reference to (804196787) for fiber-resistance shield, P-419378.

12. To revise paragraph 3.20 covering separation between turns to specify No. 20, 22, 24, and 26 gauge wire and to add reference to paragraph 3.34 for No. 28 and 30 gauge wire.

13. To revise paragraph 3.20(b) covering No. 26 gauge wire to specify an exception for twisted and coined terminals.

14. To revise paragraph 3.24 covering punched and square cross-section wire terminals to add reference to paragraphs 3.32 and 3.33 for No. 28 and 30 gauge wire.

15. To revise paragraph 3.24(c) covering minimum number of turns for No. 26 gauge wire to add minimum number of hand-wrapped turns required and to change the minimum number of machine-wrapped turns for square (0.025 in by 0.025 in) terminal from nine to six.

16. To revise paragraph 3.28 covering connections previously wrapped, repaired or where a second connection is added to specify connections to 0.009-inch crosspoint terminals of crossbar switches.

17. To revise paragraph 4.05 covering quick-connect type terminals to substitute 980A in place of 724A tool.

18. Table A was revised to delete W type wire and 756B tool. Also, to add 112 and 89TB connectors.