

SOLDERED CONNECTIONS
REQUIREMENTS AND METHODS
FOR TYPES OF APPARATUS TERMINALS

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1. GENERAL

1.1 Scope of Section

1.11 This section covers the basic requirements and methods for connecting and soldering switchboard wiring to the types of apparatus terminals, shown in Figure 1.

1.12 Each figure in this section illustrates only conditions to which reference is made in the text and is not to be considered as covering the requirements for other conditions that may be involved.

1.13 The requirements covered in this section shall be followed except as modified by applicable specification and drawings.

1.2 Precautions Against Personal Injury, Equipment Damage and Service Interruption

1.21 General precautions to be taken against personal injury, equipment damage and service interruptions are covered in Handbook 0 and are to be observed at all times, as they apply to the operations being performed. Specific precautions, when applicable, are included in this section with the associated method.

1.3 Arrangement of Tools

1.31 Prior to starting operations covered by this section, the tools and other items required should be arranged at the work location so as to minimize fatigue and inconvenience when handling.

1.4 Verification

1.41 Items for the verification of the equipment installed by the operations covered in this section are listed in Paragraph 4.

1.42 The items marked (P) in Paragraph 4 are so designated to denote that the equipment should be verified before it becomes inaccessible or before a portion of the work becomes indiscernible due to following installing operations.

1.43 The items in Paragraph 4 may also be used as a self-check guide when performing operations covered by this section.

2. INSTALLING EQUIPMENT

2.1 Tools and Supplies

2.11 The tools and supplies ordinarily required for connecting and soldering operations are listed in Section 320 of this handbook.

3. REQUIREMENTS AND METHODS

3.1 Perforated Terminals

3.11 Cable or Loose Wiring: The wires of formed or loose wiring at perforated terminals shall be brought through the hole in the terminal from below or from the left, when possible, and bent against the terminal and away from the apparatus, as shown in Figure 2. Make sure to bend the wire sharply after pulling it through the hole so that it lays flat against the terminal. Then bend the wire end across the end of the terminal at an angle.

3.111 Use extra care when pulling the wire through the hole of "cleaned" terminals to avoid striking the body if the wire breaks. "Cleaned" terminals may have sharp edges around the hole.

3.112 When the lead to be connected is too large for the hole in the terminal, it should be connected by means of a shank connection as outlined in Paragraph 3.4. Use care to avoid damage to the terminal.

3.113 When a sewed cable form 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 in accordance with the requirements for surface wiring. (See Figure 3)

3.12 Surface Wiring: When sleeving is required for the protection of apparatus terminals as covered in Section 360 of this handbook, surface wiring should approach the terminal from the front of the terminal as covered in Section 360 instead of approaching the terminal from the base of the terminal as shown in Figure 3. Connect wires either at the hole in the terminal or by means of shank connections, depending on the circumstances as follows:

(a) When only surface wiring leads are to be connected and it is not necessary to leave the hole in the terminal open for future connections, the leads shall be passed through the hole in the terminal, and then anchored by plier wrapping approximately 1-1/4 turns of bare wire, as shown in Figure 3. It may not always be practicable to use the standard surface wiring connection 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 connect the wire by either a simple hook connection or by wrapping it around the terminal just sufficiently to anchor it before soldering.

NOTE: Shop surface wired connections are normally machine wrapped with 2-1/2 turns of bare wire.

(b) When wiring is to be connected subsequent to the surface wiring, the surface wiring leads should be connected by means of a shank connection as outlined in Paragraph 3.4 and as shown in Figure 3 left-hand view.

3.13 "D" Type Wiring: "D" wiring shall be connected to perforated terminals in the same manner as specified for surface wiring in Paragraph 3.12 except as follows:

(a) When stranded conductors are employed, they shall be connected to perforated terminals by passing the wire through the hole in the terminal and then anchoring it by a simple hook connection, instead of wrapping the wire around the terminal.

(b) When No. 20 gauge or larger diameter wires are employed, they cannot always be connected to relay or electron tube terminals (flimsy terminals) in the standard manner for surface wiring, because of the stiffness of the wire with respect to the terminal. In such cases, it will be satisfactory to wrap the wire around the terminal just sufficiently to anchor it before soldering.

3.14 Commercial Apparatus Terminals:

Perforated terminals of commercial apparatus, such as KS-7862 and KS-8132 electron tube sockets, frequently have the perforations for wire connections so close to the ends that the connections shown in figure 2 for formed and loose wiring at perforated terminals are not satisfactory. In such cases, in order to obtain sufficient contact between the wire and the terminal be-soldering, the wire shall be wrapped either through or back of the hole in the terminal in the manner shown in Figure 3 for surface wiring leads.

3.15 Soldering: Except at wrapped or shank connections, the holes in perforated terminals should normally be filled with solder when wires are connected through the hole in the terminal. 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 commercial terminals with large holes where it is economically unsound to fill the hole with solder.

3.16 Cutting Off Wire Ends: Cut off excess wire after soldering, as shown in Figure 4. Allow sufficient time for the solder to solidify before cutting off the excess wire.

3.2 Notched Terminals

3.21 Breaking and Cutting Off Wire Ends:

Generally the wire end is cut off after soldering, however, when the connection consists of one 22 gauge or smaller diameter wire, the wire end may be broken off at the back edge or the top of the terminal as the connection is completed as shown in Figure 5 provided the rigidity of the terminal used permits breaking the wire off.

3.22 Connect wires (except cross connections which are covered in either Section 500 of this handbook) to notched terminals as follows:

3.221 At Single Notch Terminals,

(either with or without back notch for breaking off wires) draw the wires up into the notch and bend them over flat against the upper or right-hand side of the terminal as shown in Figure 6.

NOTE: On 700A-type terminal strips, it will be permissible to wrap the wire with one and one-half turns around the terminal.

3.222 At Double Notch Terminals, connect the wires as shown in Figure 6. For individual leads, use one complete turn of bare wire where the wire approaches from below the terminal or parallel

to the terminal. Where the wire approaches from above the terminal wrap the bare wire 1-1/2 turns. At twisted double notch terminals, all wire ends shall be cut off to avoid bending the terminal.

NOTE: At switch jacks of universal step-by-step shelve the switchboard wire is considered as approaching parallel to the terminal.

3.223 At Twin Notch Terminals, connect the wires in the outer notch except when supplementary information specifies that the outer notches are to be reserved for strapping or cross-connections. For these cases, connect the switchboard wires in the inner notch. Draw the wire into the notch and bend it over diagonally flat against the upper or right-hand side into the back notch as shown in Figure 6.

3.224 At Double Twin Notch Terminals, Connect the wires in the outer notch unless supplementary information specifies that the outer notches are reserved for strapping or cross-connections. In these two cases, connect the switchboard wires in the inner notch. Draw the wire into the notch and bend it over diagonally flat against the upper or right-hand side into the back notch as shown in Figure 6. Where the wire approaches parallel to the terminal, it will be satisfactory to wrap the wire with 1-1/2 turns, as shown in Figure 6.

3.3 Miscellaneous Terminals

3.301 Commercial Solder Type Terminals:

At Zierick and similar solder type terminals, the connections should be soldered on the side at which the terminal is clamped to the wire as shown in Figure 10. If the terminal has a hole through which the wire runs, the hole should be filled with solder. It is not objectionable if some solder flows to the other side of the terminal.

3.302 Commercial Crimp Type Terminals:

At T & B and similar crimp type terminals used for connecting 16 gauge and smaller diameter wire to equipment or apparatus, the following procedure shall be followed:

(a) Crimp the terminal on the wire tight enough to hold the terminal in place and then fill the wire opening portion of the terminal with solder.

(b) If it is not practical to crimp the terminal, then run the wire through the wire opening portion of the terminal, bent it over the opposite end of the opening, similar to the pigtail lead in Figure 8, and then fill the opening with solder.

3.303 Eyelet Terminals: Connections to this type of terminal are made by threading the wire through the eyelet and bending it over the top surface, as shown in Figure 10. When solder is applied, care shall be taken to prevent the wire from moving while the solder is solidifying.

NOTE: 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.

3.304 Grooved and Stand Off Terminals: Connect wires, as shown in Figure 10, using one full turn of bare wire. Completely cover the wire with solder for at least one-half of the circumference of the terminal. Cut the wire off flush with the terminal after soldering.

CAUTION: EXERCISE SPECIAL CARE TO AVOID OVERHEATING STAND-OFF TERMINALS DURING THE SOLDERING OPERATION, AS EXCESSIVE HEAT MAY LOOSEN THE TERMINAL FROM THE INSULATING MATERIAL.

3.305 Hook Type Terminals: Depending upon the position that the wire approaches the terminal connect wires as follows:

3.3051 When the wire approaches from a form directly opposite the end of the terminal, draw the wire into the notch and bend it over flat against the right-hand side into the concave end as shown in Figure 7 for sewed or loose wiring.

3.3052 When the wire approaches from the apparatus mounting plate or panel, wrap 1 and 1/4 turns of bare wire around the rear of the notch as shown in Figure 7 for surface wiring.

3.306 Prong, Slotted or Forked Type Terminals: Connect wires to these terminals as shown in Figure 10. Clearance between shop-connected wire (including solder) and other prong shall be a minimum of 1/32 inch to provide sufficient space to connect a wire to the opposite prong.

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

3.307 Spun-In Terminals: Refer to Section 333 of this handbook for methods and requirements when connecting pigtail apparatus leads. Connect and solder other leads to spun-in terminals as follows:

3.3071 When the wire approaches the terminal from the same side of the panel, plier wrap the wire with one full turn of wire as shown in Figure 8. Completely cover the wire with solder for at least one-half the circumference of the terminal.

3.3072 When the wire approaches the terminal from the opposite side of the panel, bring the wire through the terminal and either bend it over the terminal end for nonslotted terminals or bring it through the slot for slotted terminals and wrap one full turn of wire around the terminal as shown in Figure 8. On nonslotted terminals only the bent portion of the wire need be soldered for a satisfactory connection. On slotted terminals completely cover the portion of the wire wrapped around the terminal with solder for at least one-half the circumference of the terminal.

3.308 Tubular Terminals: Refer to Section 331 of this handbook for requirements and methods when connecting wires at tubular terminals or electron tube sockets, or KS-16490 connectors. For other tubular terminals, connect and solder wires, as follows:

3.3081 Connecting: Fold the skinned end of wire back before inserting the wires into terminal as shown in Figure 9. The length of bare wire, from skinning point to fold, should be slightly less than depth of terminal. This permits the insulation to be brought up close to the terminal. Where the hole is not large enough to accommodate all the wires, wrap the extra wire or wires with one full turn around the terminal, at a point close to the end of the terminal as shown in Figure 9.

3.3082 Soldering: Heat the terminal and then fill hole with molten solder, keeping the copper on the terminal until the wire has been inserted in the hole.

3.309 Terminals with Testing Lugs: The wires should be connected as shown in Figure 10 to keep the testing lug free of solder and to avoid interference with the placing of tools attached to test cords.

3.310 Wire Loop and Wire Terminals

3.3101 Wire loop terminals, as encountered on 330 type capacitors and similar types are connected as shown in Figure 10.

3.3102 Wire terminals: Connect wire to wire terminals, such as encountered on 231 type repeating coils, and to lead-in wires of pigtail apparatus mounted in tenite strips, by wrapping the wire around the terminal with a minimum of 1 and 1/4 turns of bare wire.

NOTE: Where practicable, it is permissible to connect wires to the lead-in wires of pigtail apparatus mounted in tenite strips (excluding semiconductor apparatus and other pigtail apparatus with a lead-in wire less than 22 gauge) by means of a one to three turn machine wrapped and soldered connection.

3.4 Shank Connections

3.41 Shank Connections shall be made when:

- (a) a lead is designated "SH" on wiring diagram.
- (b) the hole, hook, or notch of the terminal will not accommodate all of the leads which must be connected.
- (c) any individual lead which cannot be connected in the hole, because of its size.
- (d) the hole, hook or notch must be left free for other subsequent wiring operations.

3.42 Shank Connections shall be made by plier wrapping the wire around the shank of the terminal at a point as close as practicable to the back edge of the hole, hook, or notch with a minimum of 1 and 1/4 turns of bare wire, as shown in Figure 11.

NOTE: When shank connections are specified for twin notch or double twin notch terminals, the connection shall be made at the inner notch of these terminals.

3.421 Location of Wire End: While it is desirable to have the wire end terminate on the same side of the terminal to be soldered, the wire end may terminate on the opposite side.

3.422 Length of Wire End: It is not a requirement that the wire end lie flat against the terminal. However, the wire end should in no case project so that the required 1/64" clearance between the wire end and an adjacent terminal cannot be maintained. The wire end should never project more than 1/8".

3.43 Soldering: Ordinarily, all turns of the wire should be covered with solder at the soldered side of the terminal, but, from a requirement standpoint, it is only necessary that the first turn on one side, starting from the insulation of the wire, be covered.

4. VERIFICATION ITEMS

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS	Reference	
	Par. No.	Fig. No.
4.1 <u>Perforated Terminal</u>		
4.11 Formed or loose wiring; bare wire pulled through hole from below or from left side and bent against terminal away from apparatus.	3.11	2
4.12 When sewed cable form is dressed back against mounting plate or panel, and wires approach terminal from base of terminal, wires connected in accordance with requirements for surface wiring.	3.113	3
4.13 Surface wiring; wires connected in the hole or back of hole depending on wiring condition.	3.12	
(a) Connected in hole as shown in handbook figure where it is not necessary to leave hole open for future connections.	3.12(a)	3
(b) Connected back of hole (shank connection) as shown in handbook figure where wiring is to be connected subsequent to surface wiring.	3.12(b)	3

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS	Reference	
	Par. No.	Fig. No.
4.14 "D" Type Wiring; wires connected in accordance with requirements for surface wiring.	3.13	
4.15 Stranded wire conductors should pass through the perforated hole anchored with hook connection.	3.13(a)	
4.16 20 gauge or larger wire connected to flimsy terminals should wrap around terminal sufficiently to anchor before soldering.	3.13(b)	
4.17 Commercial apparatus such as KS-7862 and KS-8132 electron tubes; wires connected in accordance with requirements for surface wiring.	3.14	2,3
4.18 Holes filled with solder (it is not objectional if an occasional hole is not filled provided connection is secure) except on commercial terminals with large holes.	3.15	
4.19 Wire ends cut off a maximum of 1/16" beyond end of terminal.	3.16	4
4.2 Notched Terminals		
4.21 Wire ends cut off flush with terminal except where connection is made with one 22 gauge or smaller diameter wire and rigidity of terminal permits breaking off wire end before soldering.	3.21	5
4.22 At single notch terminals, with or without back notch, wire bent flat against upper or right-hand side of terminal.	3.221	6
4.23 At double notch terminals connections made with 1 turn of bare wire around terminal except where wire approaches from above terminal in which case bare wire wrapped 1-1/2 turns around terminal.	3.222	6
4.24 At twin notch terminals connections made in outer notch except when otherwise specified.	3.223	6
4.25 At double twin notch terminals connections made in outer notch except when otherwise specified; wire drawn into the notch on opposite side from which it approaches terminal; wire bent flat against upper or right-hand side and into back notch.	3.224	6
4.3 Miscellaneous terminals		
4.301 Commercial solder type terminals such as Zierick, and similar type; soldered on side at which terminal is clamped to wire; if terminal has hole through which wire runs, hole filled with solder; not objectionable if some solder runs to other side of terminal.	3.301	10
4.302 Commercial crimp type terminals such as T & B, and similar type; terminals used for connecting 16 gauge and smaller diameter wire should be crimped and soldered or wire drawn through opening, bent over the opposite end of the opening and soldered.	3.302	8

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS	Reference	
	Par. No.	Fig. No.
4.303 Eyelet type; wire threaded through eyelet and bent over top surface.	3.303	10
4.304 Groove or stand-off types; connection made with one full turn of wire. Wire completely covered with solder for at least one-half of the circumference of the terminal. Wire cut off flush with terminal.	3.304	10
4.305 Hook type, when lead approaches from opposite end of terminal, wire drawn into connecting notch and bent flat against right-hand side of terminal and into concave end; when lead approaches from apparatus mounting plate, wire connected at rear of notch.	3.305	7
4.306 Prong type; wires connected per handbook figure; Wire laid and soldered in slot (or fork) when slots are to small or miniature slotted terminals are of insufficient strength to permit wrapping.	3.306	10
4.307 Where spun-in terminals are mounted on opposite side of panel, wire brought through terminal and bent over terminal end; bent portion of wire soldered. Where located on same side of panel, wires wrapped around terminal with one full turn; wire completely covered with solder for at least one-half of the circumference of the terminal.	3.307	8
4.308 Tubular type; insulation of wires close to terminal; extra wires wrapped one full turn around the terminal at point close to end of terminal.	3.308	9
4.309 Terminals with testing lugs; wires connected per handbook figure. Testing lug free of solder and no interference with tools attached to test cords.	3.309	10
4.310 Wire type such as on 213 type repeating coils; bare wire wrapped a minimum of 1-1/4 turns around terminal near end.	3.311	10
4.311 Wire loop type such as on 330 type capacitors; wires connected per handbook figure.	3.312	10
4.4 Shank Connections	3.41	
4.41 Wire wrapped around terminal as close as practicable to edge of hole or notch nearest apparatus with 1 and 1/4 turns.	3.42	11
4.42 Clearance of 1/64 inch between wire end and adjacent terminal.	3.422	
4.43 First half turn of bare wire starting from wire insulation covered with solder.	3.43	



FLAG



FORK



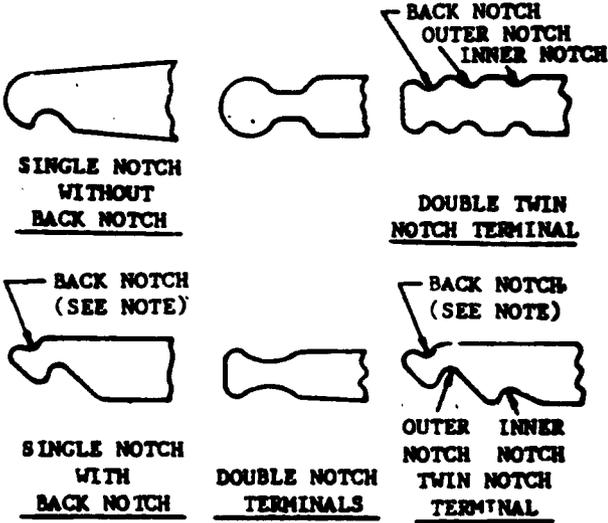
RING



RECTANGULAR

RP-0132

COMMERCIAL "CRIMP TYPE" TERMINALS



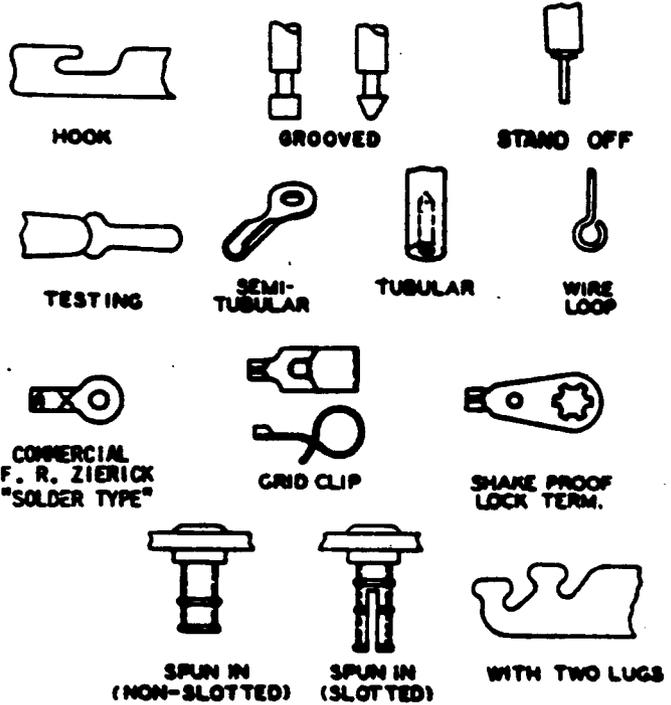
RP-11169-L

TYPES OF NOTCHED TERMINALS

NOTE: THE BACK NOTCH SERVES TO HOLD THE WIRE IN PLACE DURING THE CONNECTING OPERATION. THE OTHER NOTCHES ARE REFERRED TO AS CONNECTING NOTCHES.



TYPES OF PREPARED TERMINALS



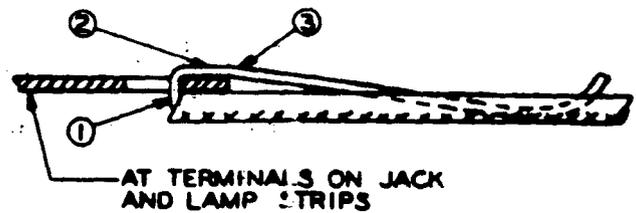
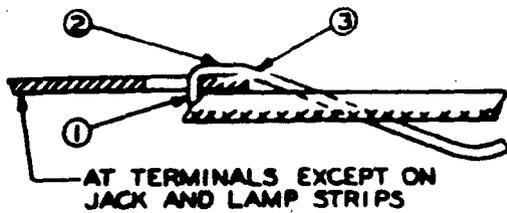
TYPES OF MISCELLANEOUS TERMINALS

RP-11186-L

FIG. 1 TYPES OF APPARATUS TERMINALS (PAR. 1.11)

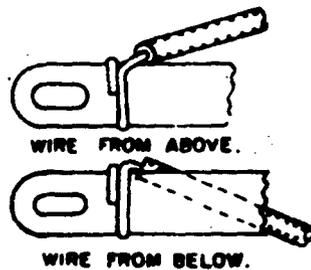
HB 9

9

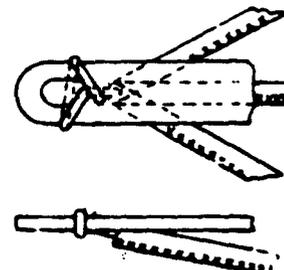


- ① DRAW INSULATION UP TO HOLE, TAKING CARE THAT FRAYED ENDS DO NOT ENTER HOLE. ($\frac{1}{8}$ " MAX. C² BARE WIRE ALLOWED BETWEEN HOLE AND SKINNING POINT).
- ② BEND WIRE DOWN FLAT AGAINST TERMINAL.
- ③ BEND WIRE ACROSS END OF TERMINAL. (RP-11211-L)

FIG. 2 PLIER CONNECTED FORMED OR LOOSE WIRING AT PERFORATED TERMINALS (PARS. 3.11, 3.14)



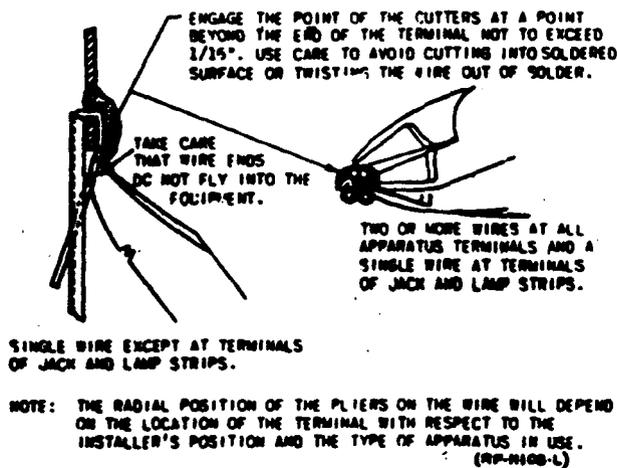
LEADS CONNECTED BEHIND HOLE IN TERMINAL. HOLE LEFT OPEN FOR SUBSEQUENT WIRING



LEADS CONNECTED THROUGH HOLE IN TERMINAL. NO SUBSEQUENT WIRING INVOLVED.

(RP-11775)

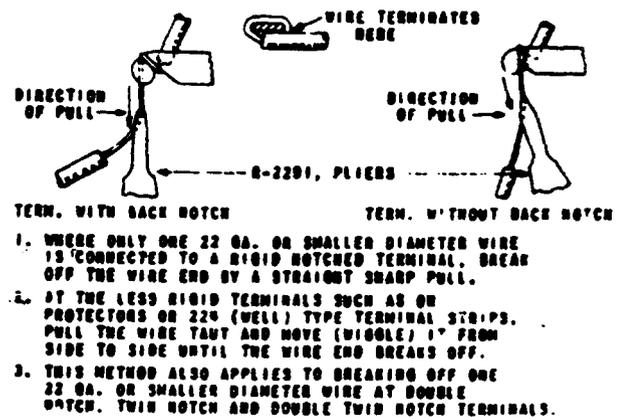
FIG. 3 PLIER CONNECTED SURFACE WIRING AT PERFORATED TERMINALS (PARS. 3.113, 3.12a, 3.12b, 3.14)



SINGLE WIRE EXCEPT AT TERMINALS OF JACK AND LAMP STRIPS.

NOTE: THE RADIAL POSITION OF THE PLIERS ON THE WIRE WILL DEPEND ON THE LOCATION OF THE TERMINAL WITH RESPECT TO THE INSTALLER'S POSITION AND THE TYPE OF APPARATUS IN USE. (RP-1108-L)

FIG. 4 CUTTING OFF WIRE ENDS AT PERFORATED TERMINALS AFTER SOLDERING (PAR. 3.16)



1. WHERE ONLY ONE 22 GA. OR SMALLER DIAMETER WIRE IS CONNECTED TO A RIGID NOTCHED TERMINAL, BREAK OFF THE WIRE END BY A STRAIGHT SHARP PULL.
2. AT THE LESS RIGID TERMINALS SUCH AS ON PROTECTORS OR 22# (WELL) TYPE TERMINAL STRIPS, PULL THE WIRE TANT AND MOVE (WIGGLE) IT FROM SIDE TO SIDE UNTIL THE WIRE END BREAKS OFF.
3. THIS METHOD ALSO APPLIES TO BREAKING OFF ONE 22 GA. OR SMALLER DIAMETER WIRE AT DOUBLE NOTCH, TWIN NOTCH AND DOUBLE TWIN NOTCH TERMINALS.

RP-11544-L

FIG. 5 BREAKING OFF WIRE END AT NOTCHED TERMINALS WHEN COMPLETING CONNECTION (PAR. 3.21)

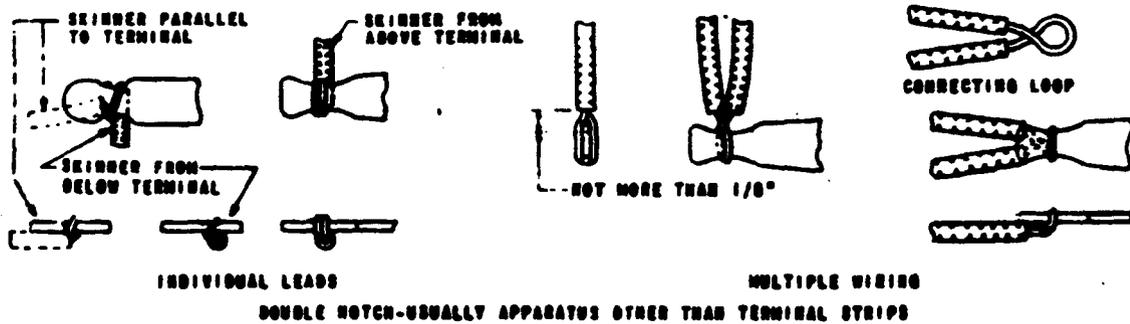
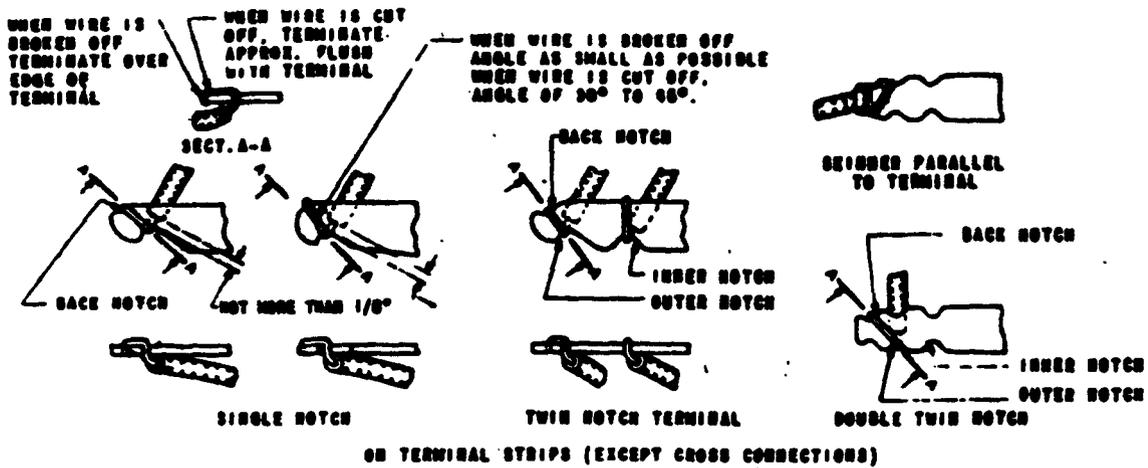
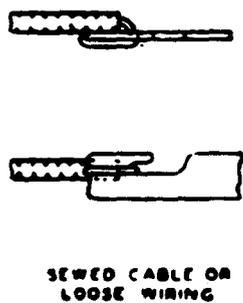


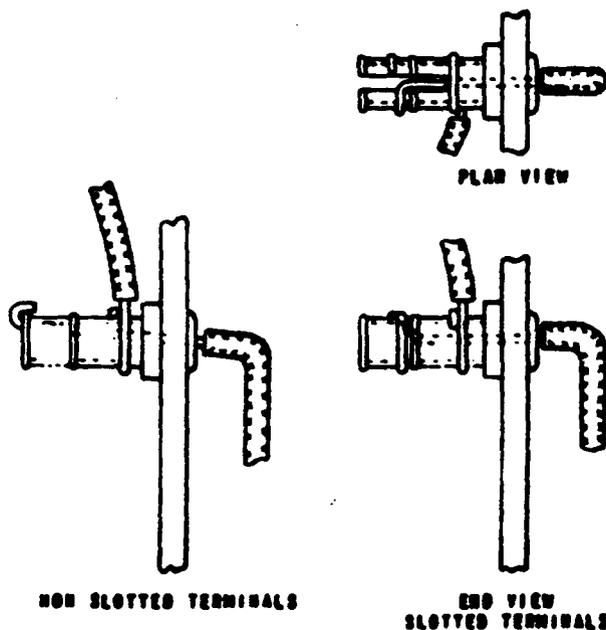
FIG. 6 CONNECTIONS AT NOTCHED TERMINALS (PARS. 3.221, 3.222, 3.223, 3.224)

RP-0133



RP-0134

FIG. 7 CONNECTIONS AT HOOK TYPE TERMINALS (PARS. 3.3051, 3.3052)



RP-18786

FIG. 8 CONNECTIONS AT SPUN-IN TERMINALS (PARS. 3.302b, 3.3071, 3.3072)

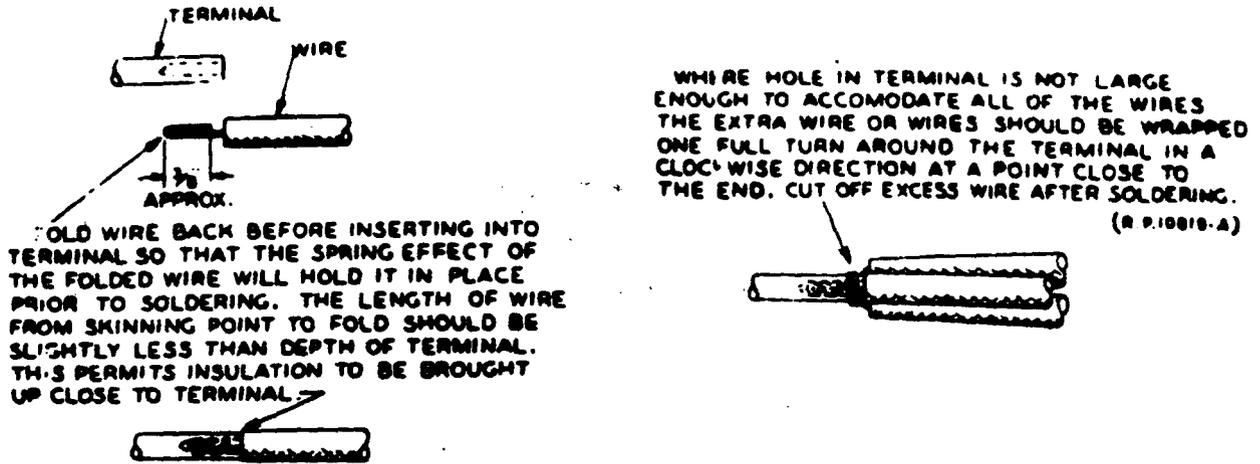


FIG. 9 CONNECTIONS AT TUBULAR TERMINALS (PAR. 3.3081)

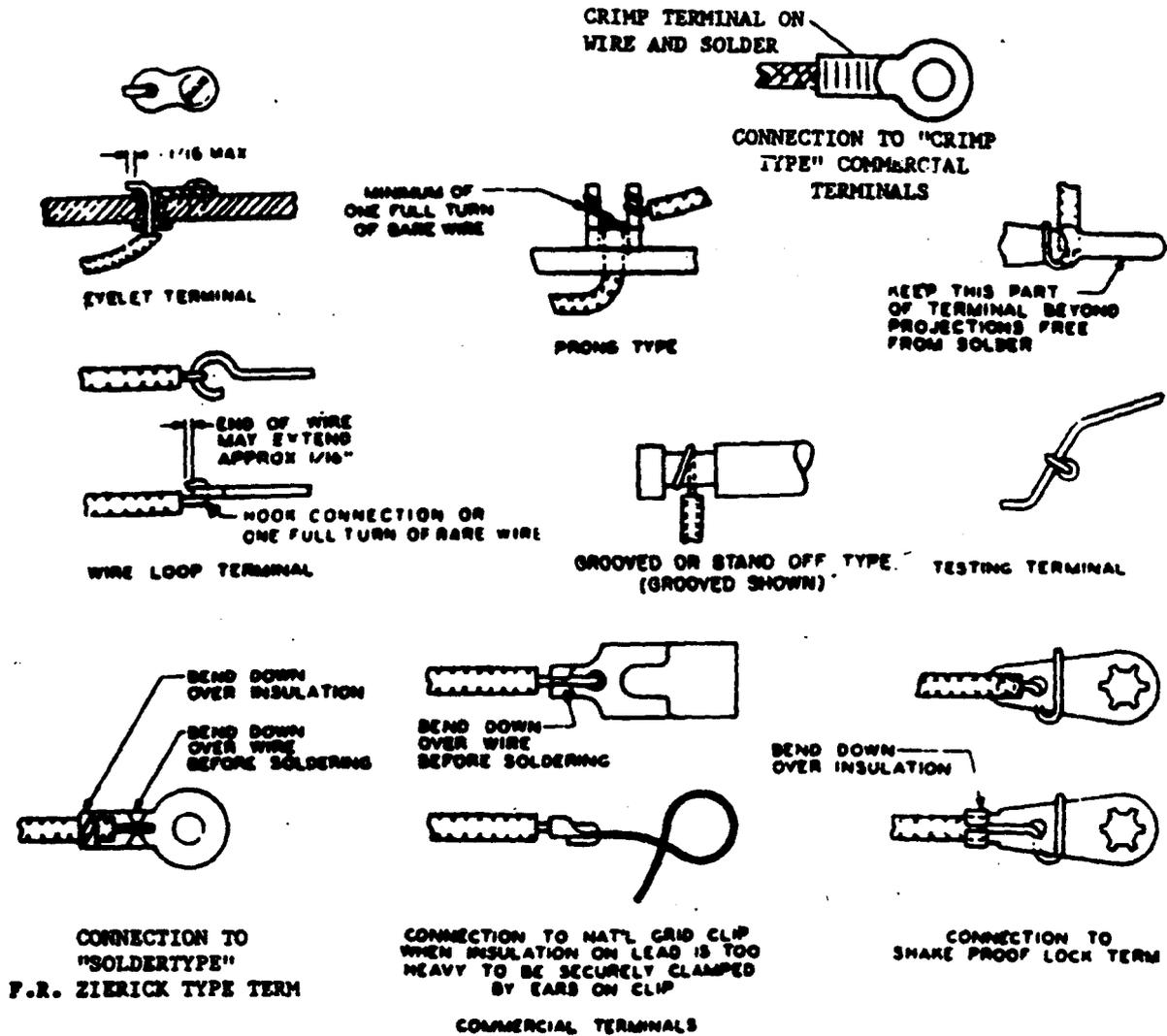
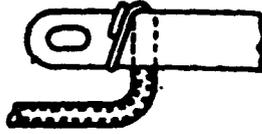


FIG. 10 CONNECTIONS AT MISCELLANEOUS TERMINALS (PARS. 3.301, 3.303, 3.304, 3.306, 3.309, 3.3101)

RP-0136



RP-0135

FIG. 11 SHANK CONNECTION
(PAR. 3.42)

→ Arrowed lines indicate new
or changed information.

[Vertical lines at side of paragraphs
indicates requirements.

Assistant Manager
Common Installation Engineering

Reason for Reissue:
General revision of section and to add
information on Crimp Type Terminals.