

LOOSE WIRE FORMS
METHODS AND REQUIREMENTS

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1. GENERAL

1.1 Scope of Section

1.11 This section covers the methods and requirements associated with running and forming cable conductors and bulk wire in loose wire forms held in formation by wire retaining devices such as brackets, wire supports, clips, ties, bands, and other similar devices.

1.12 The requirements covered in this section shall be followed except as modified by drawings or applicable specifications.

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

1.14 At relay rack frames and other similar types of equipment framework utilizing loose wire forms for the main vertical form of the bay or frame wiring, this section will cover both the methods and requirements for the vertical and horizontal breakouts.

1.15 Methods and requirements for fanned forms are covered in Section 210 of the handbook, and the methods and requirements for sewed forms are covered in Section 220.

1.2 Precautions

1.21 Specific precautions to be taken against personal injury, equipment damage, or service interruptions are covered in this section along with the associated methods. General precautions are covered in Handbook 0 and are to be observed at all times.

1.3 Installing Equipment

1.31 The tools and supplies listed below are only those which are normally required to perform loose wire fanning operations.

Tools

R-2726	Cable Sheathing Bag
R-2738	Connecting Bag, General Use
R-4266	Cable Tie Fastening Tool
R-4827	Cable Tie Fastening Tool, Adjustable
R-4366	Combination Butt and Strip Tool
R-2434	8" Wire Scissors
R-1682	5" Electrician Scissors

NOTE: Tool kit 168 Tools are not listed above.

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Supplies

R-2916	Twine
R-4265	Nylon Cable Ties
R-3428	3/4" Wide PVC Tape
R-3412	Wire Markers
R-3694	Wire Markers
RM-583101	Gray Sheet Fiber
RM-552458	1/2" x 32" Lg PVC Tube
RM-552417	3/4" x 33" Lg PVC Tube
RM-552448	1" x 36" Lg PVC Tube
RM-587082	1-1/4" x 23" Lg PVC Tube
RM-552452	1-1/2" x 29" Lg PVC Tube

2. LOOSE WIRE FORMS

2.1 General Requirements

2.11 Loose wire may consist of bulk wire run from outside the bay, intrabay wiring, or switchboard cable leads run loose from the cable butt.

2.12 All loose wiring run in the vertical portion of what would normally be considered as the bay local cable form shall be run through cable brackets, wire retaining devices, etc., as provided. The wires shall be run without slack, but not taut.

2.121 Ties (twine or cable ties) are used at cable brackets and other places to keep the wires in a reasonably good formation. Wires held in place by rings, or other similar retaining devices, do not require tying unless there is a probability of the wires pulling out of the device.

2.122 When wires are run loose through wire retaining devices, rings, etc., they should be located at each breakout point to the apparatus. If there is none, band at this point, use twine or cable tie.

2.123 After wires break out of the vertical loose wire form, they may be run as a horizontal sewed form, loose wire form or as surface wiring. When run as surface wiring, the correct type of coded wire must be used to allow it to be dressed back against the metal mounting plate.

2.13 All loose wiring shall be run and dressed away from any heat producing apparatus, devices, etc., to eliminate the possibility of creating a fire hazard.

2.131 Loose wire forms should be run so they interfere as little as possible with access to apparatus requiring

adjustment, repair, replacement, or cleaning. They should also avoid interference with movable or removable equipment parts.

2.14 Additional bands of twine or cable ties shall be placed on the loose wire form when:

(a) The distance between bands, cable ties, starting stitches or any wire retaining device exceeds 14". Place additional bands approximately midway between points.

(b) Where necessary to restrain the wires from contact with uninsulated metalwork.

(c) Necessary to maintain wires in reasonably good formation.

(d) Wires have a tendency to spring out of the wire retaining device.

2.2 Vertical LW Forms

2.21 The standard spacing of bay vertical forms (as determined by Manufacturing) is approximately 20", however, this is not a fixed dimension and may vary with the design of the framework and the size and shape of the cable form. However, where equipment or apparatus units have been removed and the vertical LW form remains, the supports shall remain intact.

2.22 Breakouts to Unit Wire Retainers: Banding of the bay vertical form is not required at breakout positions serving units equipped with plastic wire retainers (P-255706 or P-41D318) or similar.

2.23 Breakouts to Horizontal Sewed Forms: Where horizontal forms break out of the main vertical LW form, use a double strand of twine placed as a starting stitch around the vertical form with the first stitch being placed on the horizontal leg as close as possible to the main form. The use of a single or double strand of twine depends on the horizontal form diameter at the butt of the breakout point.

2.24 Breakouts to D, BT, and Similar Type Terminal Strips: When the wire guides for the terminal strips are located approximately 1" from the bay vertical upright mounting flange, banding the breakout points of the vertical LW form is

not required. The wires may be run directly from the nearest support or band located directly above the wire guides.

2.241 Loose wire intrabay leads to "D" type terminal strips that terminate at the front side of the frame are run vertically up and down the rear side of the bay, positioned in the wiring guides, and passed through the throat of the terminal strip to the front side. (See Figure 1.)

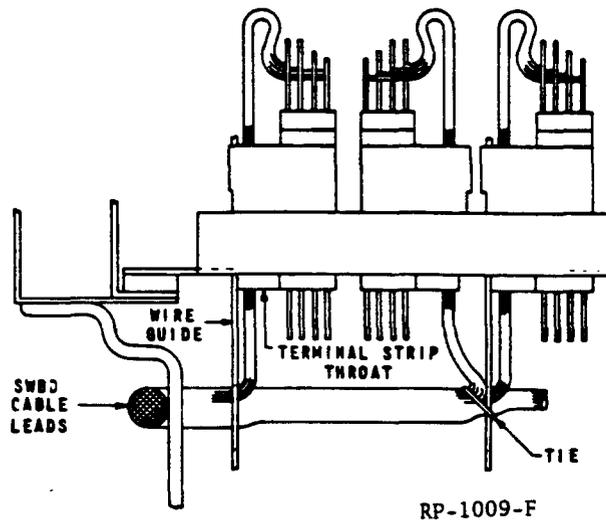
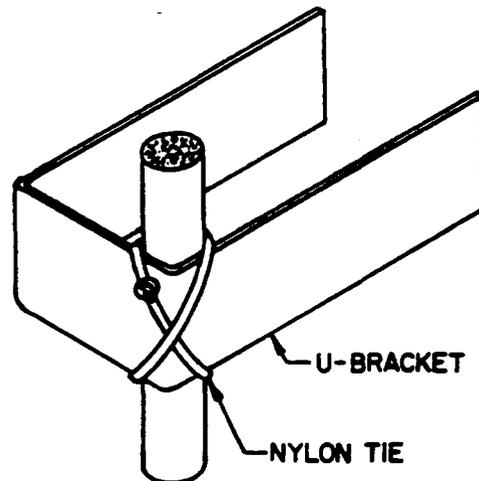


FIG. 1 SWITCHBOARD CABLE TO D TYPE TERMINAL STRIPS (PAR. 2.241)

2.25 At Duct-Type Bays: The switchboard cables or loose wiring entering the duct does not require additional support within the bay. However, the loose wiring should, wherever practicable, be secured within the duct with the nylon cable ties and clamps furnished with the framework. At breakout points, band the wires with twine or nylon cable ties, except shielded wiring which shall be tied with twine (refer to Section 205 of this handbook for use of cable ties).

2.26 At Angle-Type Bays: Loose wiring shall be run through the wiring supports wherever they appear on the bay. Where cable brackets are used, the LW form shall be secured to the brackets with approved twine or nylon cable ties. (Refer to Section 205 of this handbook for use of cable ties.)

2.27 At Channel-Type Bays: Utilizing "U" type cable brackets, the stripped portion of all cables and all unjacketed wires shall be run loose through the "U" brackets. These wires shall be secured to the bracket with approved twine or cable ties according to Figure 2. Breakout points shall be banded or retained by a starting stitch for horizontal sewed forms.



NOTE: FIGURE TO BE EITHER CABLE OR LOOSE WIRE FORM AS REQUIRED.

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FIG. 2 FASTENING LOOSE WIRE TO L1-TYPE CABLE BRACKET (PAR. 2.27)

2.28 At Sheet Metal Box-Type Frameworks such as those used in ESS and uniframe-type framework, loose wiring shall be run through the wiring guides (rosettes), fanning rings, or other wire retaining devices, where provided. Bands and ties are not required unless there is a possibility of the wires pulling out of the retaining devices.

2.3 Horizontal LW Forms

2.31 After breaking out of the bay vertical form, the wire may be fanned directly to apparatus with fanning strips (fanned form), run in a horizontal sewed form, or run as a horizontal loose wire form. They may also be run as surface wire providing the type of wire used permits running against metal framework.

2.32 Loose wire intrabay leads to "D" type terminal strips that terminate on the rear (wiring side) are run vertically up and down the rear side of the bay. When they break out of the vertical form, they are run horizontally above the top rows or below the bottom rows of the terminal strip in a loose wire form. (See Figure 3.)

2.321 Loose wire intrabay leads to "D" type terminal strips that terminate on the front (apparatus side) are run horizontally above the top rows or below the bottom rows of terminals to the terminal strip nearest the frame upright. At this point, the wires are run around the wiring guide and then vertically to the mounting plate with the desired terminal strip location. Refer to Figure 4 for illustration.

2.33 Loose wire leads running horizontally to 227-type terminal strips should either be banded at the breakout point or run through a wire retaining device. Refer to Figure 5 for illustration.

2.34 Loose wire leads running horizontally to 224 (well) type terminal strips may enter the "well" in several ways depending upon the particular arrangement used in manufacturing. Some terminal strips have 2 wire entry holes in the mounting plate, others have only 1 hole in the plate, and others have none. Those that have no holes in the rear plate have one large entry port located off to the side. Refer to Figure 6 for this illustration.

2.341 Where the 224-type terminal strip has 2 holes located in the rear, run the loose wiring for the top row of terminals through the left hole and the wiring for the bottom row of terminals through the right hole (viewed from the rear side). This is a recommended method to eliminate lead crossing inside the "well" and not a requirement.

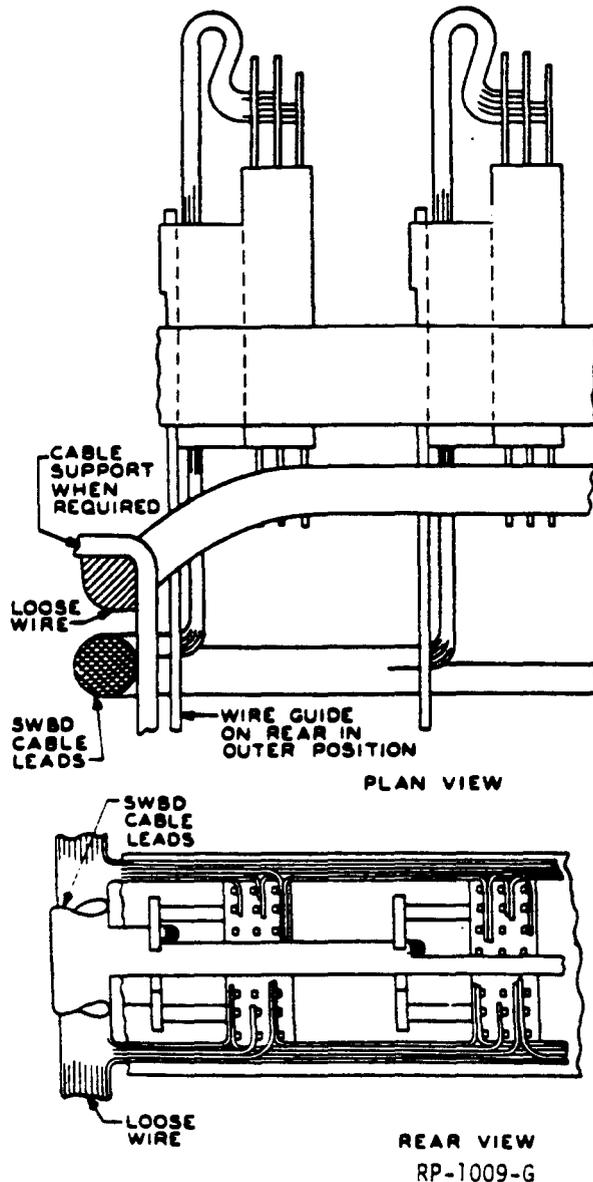


FIG. 3 INTRABAY LOOSE WIRING AT REAR (WIRING SIDE) OF BAY (PAR. 2.32)

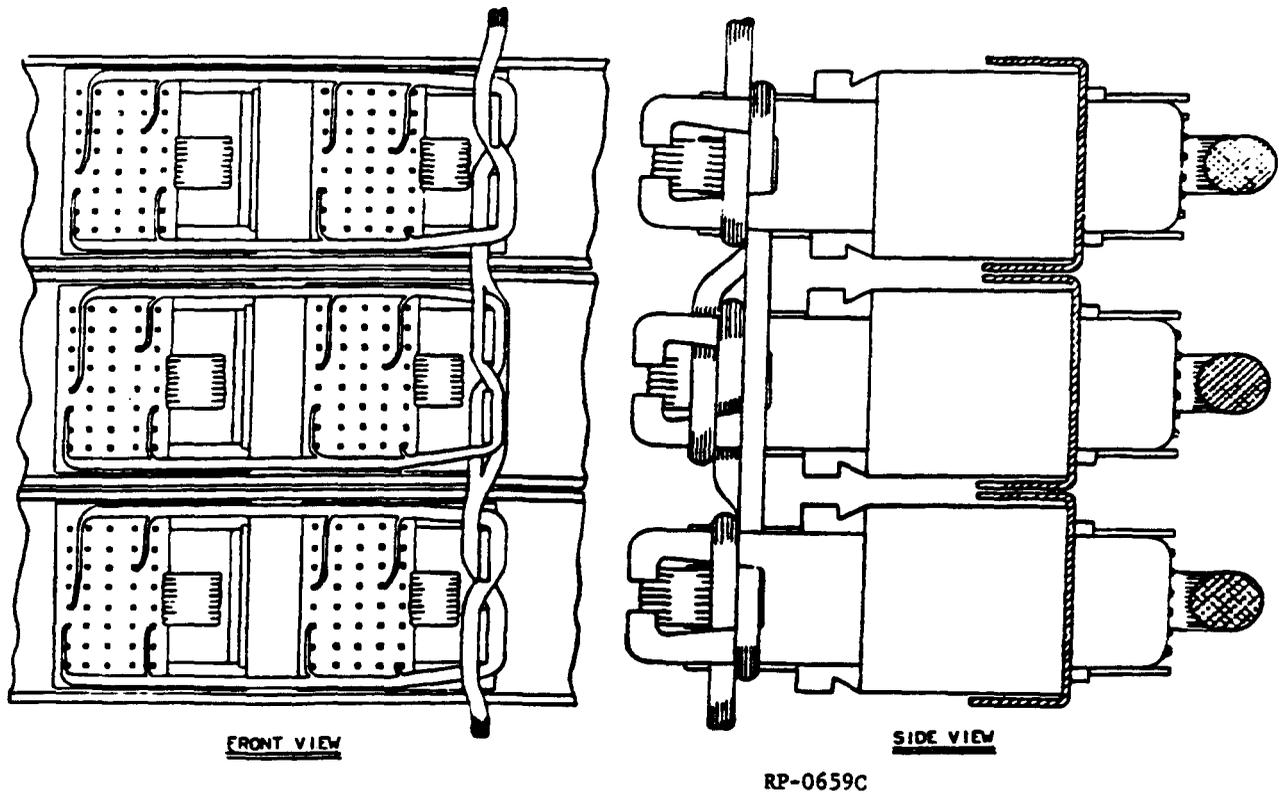


FIG. 4 INTRABAY LOOSE WIRING AT FRONT (APPARATUS SIDE OF BAY)
(PAR. 2.321)

2.4 Spare-Unused Wire

2.41 Although spare leads have been eliminated from almost all of the switchboard cables, there are a few that still have retained "spare" leads. Spare leads were put into a cable for use when regular color coded leads were found to be "open" or "shorted" and require replacement.

2.411 "Unused" leads are regular color coded leads that have not been used due to circuit requirements, i.e., if 10 circuits required a total of 87 pair and a 100 pair cable was furnished, 13 pair would be considered as "unused" leads.

2.42 Unused and Spare leads will be considered as the same for purposes of handling and storing when run in a loose wire form. They shall be handled in the following manner:

(a) Leads from any single cable serving a single unit shall be left long enough to reach the furthest circuit termination point. At that point, they should be doubled back on the form and secured in place.

(b) Leads from any single cable serving several units in a bay shall be left long enough to reach the farthest termination point. These leads should be brought back to the main vertical form, doubled up and secured in place on the vertical form.

NOTES:

1. WHERE NECESSARY TO AVOID EXCESSIVE PILEUP OF WIRES, SWITCHBOARD CABLE LEADS CONNECTED TO TOP HALF OF TERMINAL STRIP MAY BE RUN OVER THE TERMINAL STRIP SUPPORT.
2. WHERE NECESSARY TO AVOID EXCESSIVE PILEUP OF WIRES, LOCAL CABLE LEADS CONNECTED TO LOWER HALF OF TERMINAL STRIP MAY BE RUN UNDER THE TERMINAL STRIP SUPPORT.
3. SURFACE WIRING TO TERMINAL STRIP SHOULD BE RUN HORIZONTALLY BACK AGAINST THE PLATE TO A POINT APPROXIMATELY UNDER THE CORNER OF THE TERMINAL STRIP FANNING STRIP. FROM THIS POINT WIRING SHOULD BE RUN IN THE SAME MANNER AS FOR SWITCHBOARD CABLE.

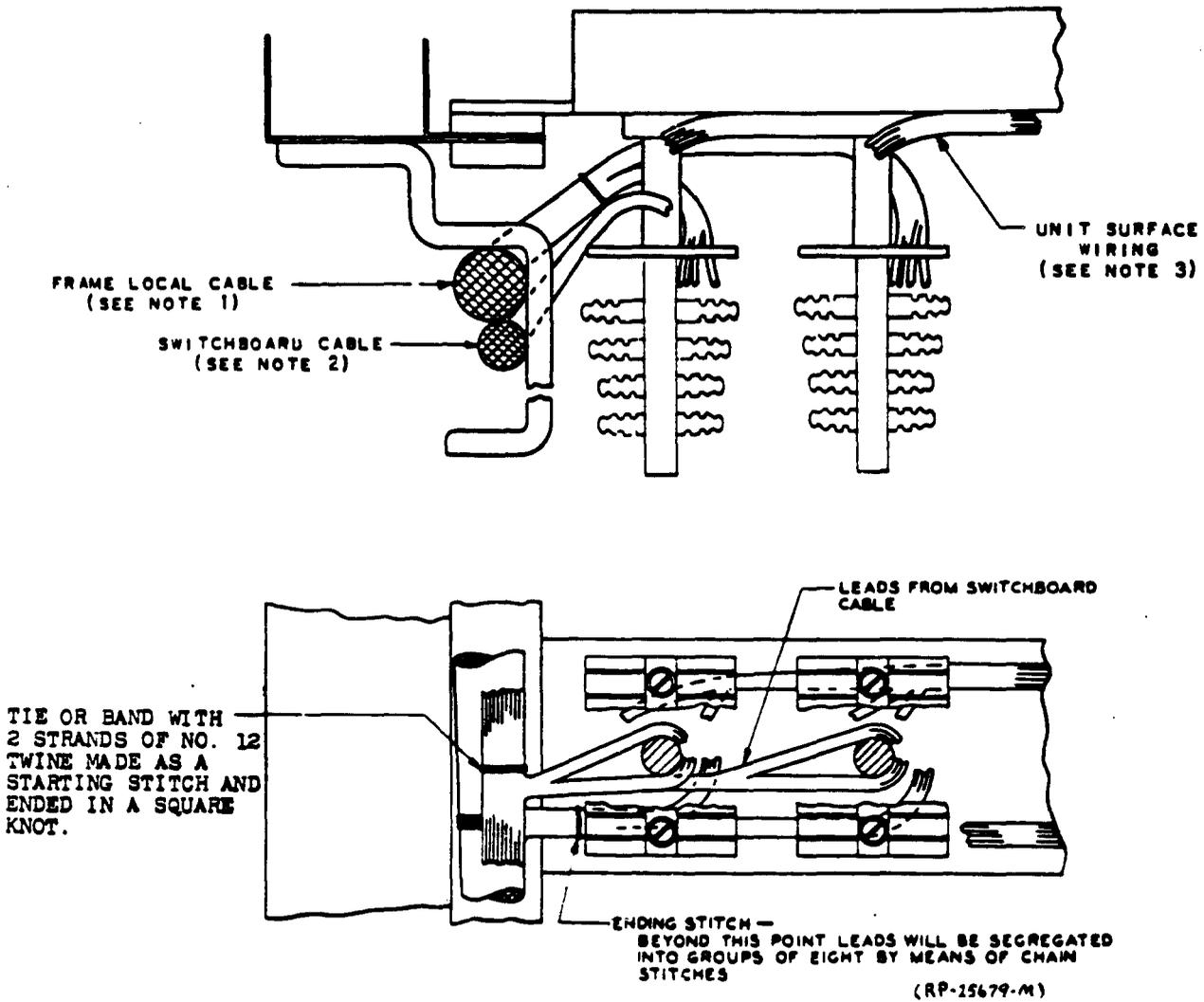
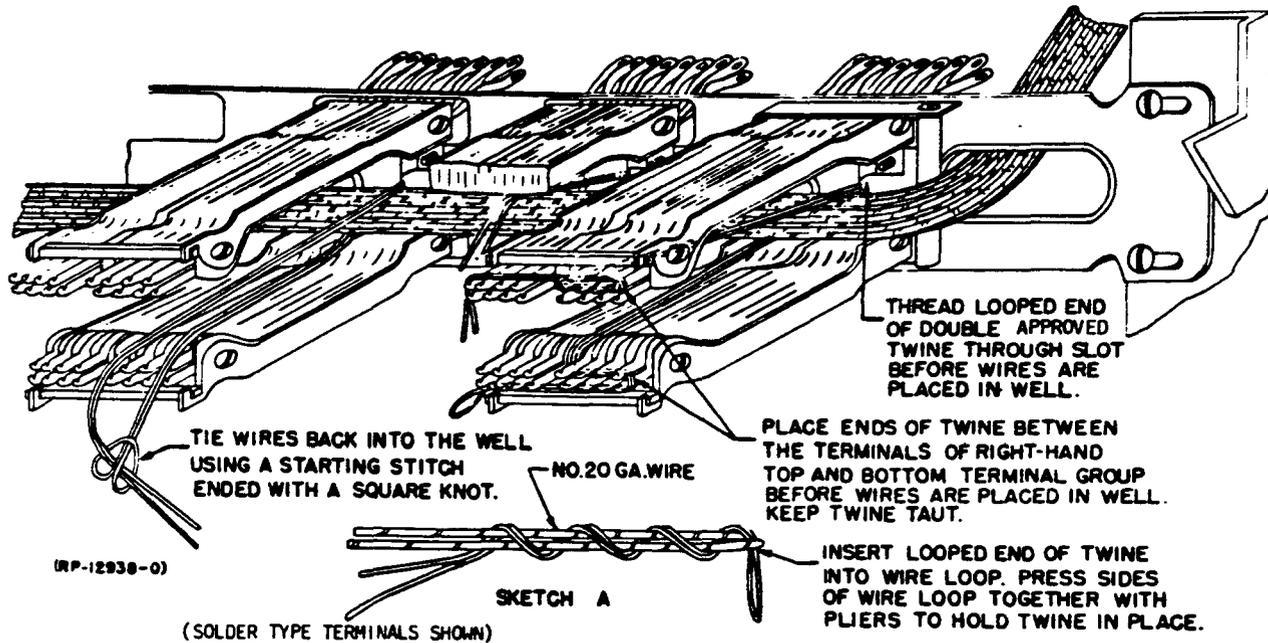


FIG. 5 STRIPS, TERMINAL - 227 AND SIMILAR TYPES - SWITCHBOARD CABLE, FRAME LOCAL CABLE AND SURFACE WIRING - WITHOUT RETAINING CLIP (PAR. 2.33)



PROCEDURE NOTES:

1. TAG LEADS OF EACH INDIVIDUAL CABLE OR GROUPS OF LEADS WITH R-3412 WIRE MARKERS AS THEY ARE RUN THROUGH THE HOLE(S) IN THE MOUNTING PLATE.
2. START WITH THE CABLE OR GROUP OF LEADS NEAREST THE FIRST TERMINAL STRIP AND FAN THE SINGLES AND PAIRS INTO THE PROPER TERMINAL STRIP LOCATION.
3. "C" LEADS REQUIRING SEGREGATION SHOULD BE SEPARATED AND FANNED INTO POSITION LAST.
4. WHERE DUPLICATE COLORED LEADS TERMINATE AT THE SAME TERMINAL STRIP, USE R-3412 MARKERS TO IDENTIFY THEM.
5. SPARE AND UNUSED LEADS SHOULD NOT BE PASSED THROUGH THE MOUNTING PLATE HOLE(S). THEY SHOULD BE LEFT LONG ENOUGH TO REACH THE FARTHEST TERMINATION POINT AND THEN TUBED AT THE REAR HORIZONTAL OR MAIN VERTICAL FORM.

FIG. 6 METHOD OF TYING WIRES IN WELL OF 224 TYPE TERMINAL STRIP (PAR. 2.34)

(c) Where several cables serve one or more apparatus units and more than one of the cables have spare-unused leads, they should be identified, tubed, and secured in place on the vertical form.

2.5 Unequipped Wire

2.51 Unequipped leads run as loose wire shall be run to the future apparatus location to which they would normally terminate if equipped, then left long enough for future termination, identified, tubed, and secured to main form.

2.511 When fanning rings or other wire retaining devices are at the unequipped apparatus location, the leads should be run through the device, doubled back on the form, and secured in place.

2.512 When leads are run loose and no wire retaining devices were provided, the leads should be left long enough to reach the future apparatus location(s) and either be:

- (a) Identified, tubed, and tied back on the main form.
- (b) Identified, tubed, and tied to the framework at the unequipped location.
- (c) Tied back to the main form without identification where only a few leads are involved.

2.52 When an entire vertical or horizontal arm of loose wire or a sewed form serves an unequipped apparatus location, the leads should be enclosed in a PVC tube and secured to the framework with either twine or a nylon cable tie. Refer to Figures 7, 8 or 9.

3. PROTECTION

3.1 Leads run in a loose wire form shall be protected from sharp edges, uninsulated metalwork, heat producing devices, or other hazards that may damage the leads. Refer to Section 225 of this handbook for methods of protection.

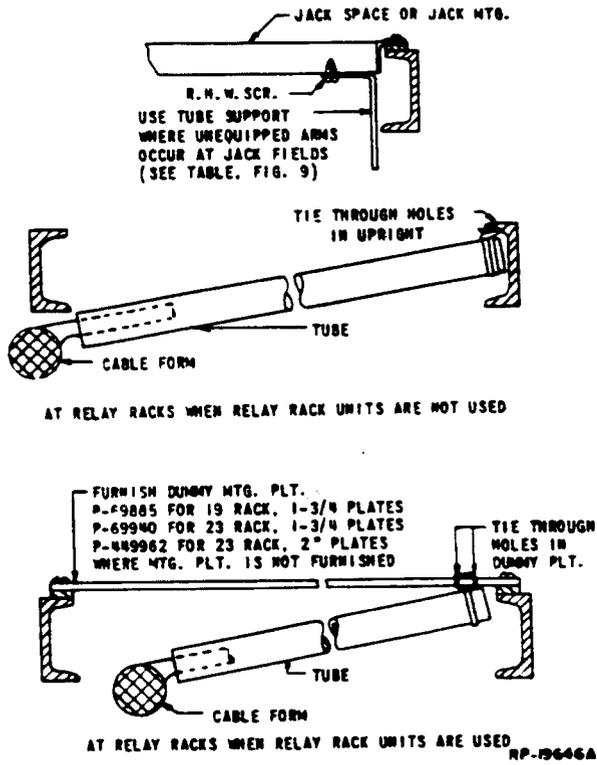


FIG. 7 SUPPORTING COMPLETELY UNEQUIPPED HORIZONTAL CABLE FORMS AT RELAY RACKS (PAR. 2.52)

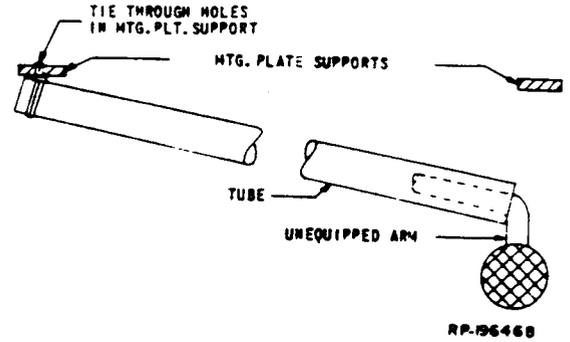


FIG. 8 SUPPORTING COMPLETELY UNEQUIPPED HORIZONTAL CABLE ARMS IN SWITCHBOARDS AND DESKS WHEN MOUNTING PLATES ARE OMITTED (PAR. 2.52)

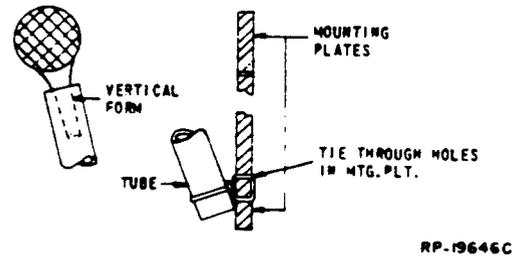


FIG. 9 SUPPORTING COMPLETELY UNEQUIPPED VERTICAL FORMS (PAR. 2.52)

4. VERIFICATION ITEMS

	Verification Items and Brief Statement of Requirements	Reference	
		Par. No.	Fig. No.
4.01	LW vertical forms run through cable brackets, wire retaining devices without slack but not taut.	2.12	
4.02	Secure LW form to brackets, etc., where there is a probability of the pulling out of the device.	2.121 2.14d	
4.03	If there is no wire retaining device at breakout points, apply band of twine or cable tie.	2.122	
4.04	LW run as surface wire must use correct wire codes.	2.31 2.123	
4.05	LW run away from heat producing devices.	2.13	
4.06	LW forms not to interfere with access to apparatus requiring adjustment, repair, cleaning, or replacement.	2.131	
4.07	Place additional bands or cable ties on LW forms when: (a) Distance between retaining devices exceed 14". (b) Restrain wires from contact with uninsulated metalwork. (c) Necessary to maintain good formation.	2.14 (a) (b) (c)	
4.08	Where equipment/apparatus has been removed but LW form remains - supports remain intact.	2.21	
4.09	Where horizontal sewed forms break out of a vertical LW form - band at breakout point.	2.23	
4.10	Duct-Type Bays - No additional supports required, however, band breakout points.	2.25	
4.11	Angle-Type Bays - Run LW form through wiring supports, where brackets are used - secure form to bracket.	2.26	
4.12	Channel-Type Bays - Run LW form through "U" bracket and secure/figure.	2.27	2
4.13	Sheet Metal Box-Type Framework - Run LW form through retaining devices - secure if necessary to prevent wires from pulling out of retainers.	2.28	
4.14	LW forms to "D"-type terminal strips run either above or below T.S./figure.	2.32	3
4.15	LW forms to 227-type terminal strips banded at breakouts or run through wire retaining device.	2.33	5

Verification Items and Brief Statement of Requirements		Reference	
		Par. No.	Fig. No.
4.16	Spare/unused leads of LW form handled as follows: (a) Single cable to one unit - leave long enough to reach far termination point, double back, and secure to form. (b) Single cable serving several units - leave long enough to reach farthest termination point, double back on main vertical LW form, and secure in place. (c) Several cables serving unit(s) - leave long enough to reach far point of termination, identify, tube, and secure to main LW form.	2.42 (a) (b) (c)	
4.17	Unequipped LW run to future apparatus location, left long enough to terminate, identify, tube, and secure.	2.51	
4.18	Unequipped leads run through wire retaining devices should be run through the device, doubled back on the form, and secured in place.	2.511	
4.19	When unequipped leads were run as LW and no wire retaining devices were provided, they should be left long enough to reach the farthest termination point and: (a) Identified, tubed, and tied back on the main form. (b) Identified, tubed, and tied to the framework at unequipped positions. (c) Tied back to the main form without identification when only a few leads are involved.	2.512 (a) (b) (c)	
4.20	An entire vertical or horizontal arm of unequipped wire should be enclosed in a tube and secured to the framework/figures.	2.52	7,8,9
4.21	Loose wire forms protected from sharp edges, uninsulated metalwork, heat producing devices, or other hazards to wire insulation.	3.1	

Vertical lines at side of paragraphs indicate requirements.

Engineering Planning Manager
(Installation)

Reason for Issue:

This includes portions of information from Sections 240, 241, 250 and 251 all of which have been rated minus (-).