

RUNNING CABLE AND WIRE
BASIC INFORMATION

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1. GENERAL

1.1 Scope of Section

1.11 This section covers the basic information concerning precautions, drawings, conservation and defective cables associated with cabling.

1.2 General Information Pertaining to Arrangement of Tools, Precautions, Verification, Specifications and Drawings and Figures

1.21 Refer to Section 1 of this handbook for information pertaining to these items.

1.3 Specific Precautions

1.31 Avoid using snap-on cable retaining brackets installed on cable racks as a support. They may be dislodged by a pull or jerk.

1.32 Handle cable and wire carefully so the normal shape and condition of the cable will not be altered.

1.33 Exercise the greatest care at all times in working offices to guard against such service hazards as operating fuses, breaking off wire and crossing terminals on "in service" and "live" equipment.

1.34 When running cable or wire above or in the vicinity of live equipment, tape their ends by applying a single layer (or as many as required to cover the ends) across the end of the cable and longitudinally along

the sides for approximately 1-1/2 inches. Then-wrap a single layer of tape over the 1-1/2 inch area of the tape previously applied.

1.35 Take extreme care at frames with exposed wiring and switches to prevent cables and wires from coming in contact with the wiring or equipment and damaging it.

1.36 All cable reels shall be checked to verify that the cable tag on the reel agrees with the type of cable on that reel, prior to any cable running operations.

1.37 CAUTION WHEN OPENING CABLE REELS:
Care should be taken when opening a cable reel to cut the wire or band securing the cable in such a manner that the cut ends do not fly up and strike the face.

1.38 CAUTION WHEN CUTTING CABLE:

(a) The use of the R-1514 Cable Shears requires care to avoid personal injury. Ordinarily, the cable cutting operations should be performed by one man. When it is necessary for two men to perform the operation, the man holding the cable should keep his hands at least 6 inches away from the cutting mark. The man using the shears should close them slowly until the blades touch the cable before applying sufficient pressure to sever the cable. Both

men should make certain that they are standing firmly to avoid possible body movement during the cutting operation.

- (b) The R-4131 8-Inch Cable Cutter was designed to cut small cables and loose wire. It is not recommended for cutting cable exceeding 100 conductors. When using this tool, keep the hand holding the cable at least 3 inches away from the cutting mark.

NOTE: The R-1514 Shears and R-4131 8-Inch Cable Cutters should not be used to cut any iron or steel wire such as might be used for packing or crating purposes.

- 1.39 CAUTION WHEN PULLING CABLE: Care should be taken when pulling an end of the cable to prevent it from striking the face. Sitting, crawling or walking on cable racks may lead to serious injury and should be avoided.

2. INSTALLING EQUIPMENT

2.1 Tools

- 2.11 The tools and supplies generally used for operations covered in the 200 Series are as follows:

R-1514 Shears, Cable
 R-3662 Cutter, Steel Strapping, Safety (for cutting band wire on cable reels)
 R-1682 Scissors, Electrician's 5", Serrated
 R-2061 Guide, Cable
 R-4397 Guide, Cable
 R-2118 Strap, Trunk
 R-2122 Tape, Measuring, Woven
 R-2704 Support, Cable Reel
 R-2727 Reel, Cable
 R-3311 Lamp, Test, Flashlight
 R-3409 Dispenser, Coil Cable
 R-3410 Dispenser, Spool Wire
 R-3489 Truck, Platform
 R-3953 Carrier, Cable Reel
 R-4131 Cutter, Cable 8"
 R-4133 Counter, Linear Cable Footage
 R-4145 Puller, Cable, Motor Driven Set
 R-62729 Template, Cable
 ITE-4137 Continuity Test, AC

NOTE: The R-2061 Cable Guide is to be used until all stock has been depleted. The R-4397 Cable Guide will eventually replace it.

2.2 Supplies

RM-669152 Gloves, Cotton
 R-3359 Tape, Gray Plastic Adhesive, 1/2"
 R-3428 Tape, Gray Plastic Adhesive, 3/4"
 R-2916 Twine
 R-3850 Tie, Cable Tag
 ID-217 Tag, New Cable (duplicate of shop tag for indicating bulk cable lengths)
 SD-4-218A Tag, Cable (with carbon attached)
 R-4362 Sleeve, Protective

3. CABLING AND CABLE RACK PLAN DRAWINGS

- 3.1 Cabling and cable rack plan drawings include the following information:

- (a) Location of cable racks
- (b) Layout of the cable runs
- (c) Cable runs shown with heavy outlines indicate present runs (including current order) while light outlines indicate future runs.
- (d) Cross-section views of "regular" and "semiregular" runs illustrating such points are necessary to show changes in the arrangement of the cables. The views show the ultimate height of the cables on the rack, the cross-section designation, the width of the cable rack, code of cable and dimensions for location of the cables on the cable rack.
- (e) Sectional views of the layouts of the cables at such points as are necessary to show arrangement of cables in switchboards, on frames and on racks.
- (f) Location designations on the cable rack consisting of letters and numbers, for use in determining cable route listed in specifications.

(g) Table for "miscellaneous" runs, which lists all "miscellaneous" cross-sections, giving the number of cables at each section per order, the width of the cable rack, the height of the ultimate run and the total capacity of the rack in terms of cables.

3.2 Classification and Types of Cable Runs

3.21 "Regular" cable runs consist of a large group of cables usually of the same code and for a particular group of circuits, with the individual cables, arranged in a predetermined order as indicated by cross-sections on the cable plan drawing.

3.22 "Semiregular" cable runs are runs where groups of cable on a cable rack are given a predetermined location on the rack shown by a cross-section on the job cabling drawing. A semiregular run may consist of regular groups (shown by a cross-section giving individual cable arrangement) and miscellaneous groups, or the groups may consist of cables for a particular group of circuits and miscellaneous cables as shown in a cross-section without individual cable arrangements.

3.23 "Miscellaneous" cable runs consist, in general, of cables which are run one layer at a time (or one clip in height) completely across the rack before the next layer is started, without regard to code, shape or size of the cables. All racks for the "miscellaneous" cable runs on a job are placed on a common level as far as practicable.

3.24 Cable runs are said to be resting, hanging or side runs depending upon the position on which the cable rack straps are placed to which the cables are to be attached. Resting runs are used wherever practicable.

3.25 Due to cramped conditions being encountered under beams and girders, it is sometimes necessary to place cable racks in an inverted position and carry the cables on the flanges of the cable rack channels. Such runs are known as "basket" runs and are so designated on the cable plan drawing.

3.26 Special arrangements and formations of the cables on the rack are not necessary where cables leaving the cable rack are stripped at the top of the frame or rack and the strippers grouped together into a form or placed in fanning rings where they pass down the frame.

4. CONSERVATION OF CABLE

4.1 Selection and Use of Bulk Cable

4.11 Conservation of cable requires that care and judgement be exercised in the selection and use of bulk cable.

4.12 The following procedures should be employed to conserve cable:

4.121 Avoid excessive lengths at turns, breakoff points and terminations.

4.122 Follow routine shown in the cabling specifications and on the cabling plan drawings.

4.123 Select cable in a manner which will result in the accumulation of the smallest number of short lengths.

4.124 Use "symbol" cable (★, & and #) in the runs for which they are specified. Symbol "MC" indicates cable to be used as multiple cable for switchboards.

5. CABLES WITH DEFECTIVE CONDUCTORS

5.1 Cable defects are tagged by the shop to indicate defect and the conductors involved. The following defects may be shown on the tags:

(a) Missing conductors

(b) Open conductors

(c) Breakdown or cross between conductors

(d) Wrong conductor colors

(e) Wrong gauge conductors

(f) Conductors in wrong binders

(g) Missing binders when more than one binder of a unit cable is missing. The Defective Circuit tag will show the number of feet of a cable length affected by the defect.

5.2 Operations to Follow When a Defective Cable Is Received

5.21 Locate shop printed cable tags and write the nature of the defect on the back of the original and duplicate tags.

5.22 Make the defect information conspicuous on the front of the tags.

5.23 While the cable is being run, remove the defective circuit tag from the reel and save. Transfer the tag back to the remaining cable after the running operation is complete.

→ Indicates new or changed information.

[Vertical lines at sides of paragraphs indicate requirements.

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Reason for Reissue:

1. Add tools R-3662, R-4131, R-4397.
2. Remove tools R-1615, R-3195, R-1614, R-2542, R-2281 and ITE-2046
3. Change Paragraph 1.36 and 1.38

SEWED FORMS

COMMON SEWING REQUIREMENTS AND METHODS

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		6.	VERIFICATION ITEMS

1.	<u>GENERAL</u>	1.13	Each figure in this section illustrates only conditions to which reference is made in the text of this section and is not to be considered as requirements for other conditions that may be involved or illustrated. For instance, the figure that illustrates stitching conditions should not be used for determining the type of form to be used.
1.1	<u>Scope of Section</u>		
1.11	This section covers the general requirements and methods of sewing local cable forms, switchboard cable forms, main forms, branch arms, superimposed wiring, and superimposed forms. The requirements covered in this section shall be followed, except as modified by applicable specifications and drawings.	1.2	<u>Precautions Against Personal Injury, Equipment Damage and Service Interruptions</u>
1.12	It is permissible to use either the manually applied nylon cable ties (R-4265) or the pneumatically applied nylon ties (using tools R-4411-L1 or L2) to sew (band) switchboard or local cable forms. However, refer to Section 205 for requirements, methods, and size of form restrictions prior to application of ties.	1.21	The specific precautions to be taken against personal injury, equipment damage, and service interruptions are covered in this section with the associated method. General precautions are covered in Handbook 0 and are to be observed at all times as they apply to the operations being performed.
1.121	Where cable ties are being applied either manually or pneumatically, the spacing requirements of the nylon ties shall be the same as those used for sewing with approved twine (refer to FIG. 16).	1.3	<u>Arrangement of Tools</u>
		1.31	Prior to starting operations covered in this section, the tools and other items required should be arranged at the work location so as to minimize fatigue and inconvenience of handling.

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1.4 Verification

1.41 Items for the verification of operations covered in this section are listed in PAR. 6.

1.411 Items in PAR. 6 may also be used as a self-check guide while performing operations covered in this section.

2. INSTALLING EQUIPMENT

The tools and supplies required for the operations covered in this section are listed below:

2.1 Tools

R-4411-L1, L2 Pneumatic Banding Tools
 *284 Needle, Chicago
 *R-59237 Needle, Sack
 *R-2434 Scissors, 8"
 *R-1102 Spudger, Plastic
 R-4266 Fastener, Cable Tie
 R-4630 Wire Threading Tool

*Indicates tools normally on job in tool kits.

2.2 Supplies

R-4412 Tape, Nylon
 R-4412B Cartridge, Cable Ties
 R-4412A Closure Blocks
 R-3455 Shellac, White
 R-3428 Tape, Gray Plastic
 Adhesive, 3/4"
 R-2916-L8 Twine
 R-4265 Ties, Nylon Cable

3. SEWED FORMS - GENERAL3.01 Sewing - Common Requirements and Methods

3.011 All switchboard and local cable forms (and superimposed wiring thereon) shall be sewed with approved twine or banded with nylon ties, as covered in FIG. 16. The requirements in this figure apply only to forms made by the Installer.

3.012 Wind the twine around the cable forms in a clockwise direction, where practicable, facing along the form toward the butt end of the form.

(a) Where, due to the location of the equipment or personal characteristics, it is unhandy to wind the twine in a clockwise direction, it is permissible to wind it in a counter-clockwise direction.

3.013 Sew all cable forms tightly enough to prevent the stitches from sliding out of place by the pull of the wires (perpendicular to the form) but not so tightly as to damage the insulation of the wires or to cause curling and/or a reduction in the intended length of the form.

3.014 The Sack Needle, R-59237, attached to the end of the twine, as shown in Figure 1, will facilitate passing the twine around and through forms when sewing.

3.0141 Where a sack needle is not available, attach the sewing twine to a piece of twisted No. 18 or larger gauge wire, about 5" long, as shown in Figure 2.

3.015 Avoid the use of metal tools when sewing cables or forms at live fuse panels, or where forms and wiring are so congested and close to the inside of cabinets, covers or mounting details as to make it difficult to sew without operating a fuse or damaging the wiring. Sewing needles may be made of fibre where metal type cannot be used.

3.016 A single stitch or nylon tie shall be applied at each point where wires are brought out of the form except where a large number of wires or large gauge wires are brought out, in which case, two or more stitches may be used. An extra stitch or tie may also be used where necessary to facilitate making up the forms as on small forms where there may be tendency for stitches to slip during the skinning operation.

3.02 Splicing Twine

3.021 Sewing twine may break if given a quick snap or if one strand is pulled tighter than the other. Always tighten stitches with a steady pull,

keeping both strands even and bear in mind the proximity of tools, adjacent apparatus or nails in the forming board. Guide the direction of pull away from these objects.

NOTE: Protect your hands, when necessary, with 1" compress or adhesive tape.

3.022 When a single twine breaks, splice as shown in Figure 3.

3.023 When double strand of twine breaks or needs to be lengthened, splice as shown in Figure 4.

3.03 Types of Stitches Used For Sewing Cable Forms

3.031 Starting Stitch - Make starting stitches as shown in Figures 5 and 6.

3.032 Regular Lock Stitch - Make the lock stitch as shown in Figure 6.

3.033 Winding Stitch - Wind the twine around the cable form in either a clockwise or counter-clockwise direction. Make the winding stitch as shown in Figure 7.

3.034 Ending Stitch - The ending stitch consists of two lock stitches taken close together in place of the regular single lock stitch located at the point where the last skimmers breakout of the form as shown in Figure 16, except as indicated in Paragraph 4.0131.

3.035 Cross Stitch - On large diameter forms where additional rigidity is required, cross stitches are used at the breakout of each branch arm as shown in Figure 8.

3.036 Chain Stitch - The chain stitch shown in Figure 9 may be used to conveniently segregate groups of wire as in the case of 227-type terminal strips.

3.037 Broom Stitch - Where several cables are formed into a single arm and it is necessary to keep a portion of this form near the cable butt to a given thickness or where necessary to keep a portion of the local cable in a flat formation, it may be necessary to use the broom stitch, as shown in Figure

10. The broom stitch is made by sewing between the groups of wire of adjacent cables or between the wires or a local cable. In cases where this stitching is necessary, care should be exercised to avoid damaging the insulation of the wires.

3.038 Double Lock Stitch - Consists of two regular lock stitches positioned immediately adjacent to each other as shown in Figure 14.

3.04 The Use of "F" Stitches

3.041 The "F" stitch is a supplementary regular lock stitch (Figure 11) placed as close as possible to the regular lock stitch and each other. This stitch is used to separate duplicate colored wires connecting to different terminals of the same apparatus or component. The wiring diagram indicates which of colored leads should be formed out under the "F" stitch.

(a) "F" stitches are not required on switchboard cable forms because no color designation is shown for these leads on the wiring diagram and the use of an "F" stitch would serve no purpose for maintenance identification. Extra stitches, not identified by the symbol "F" on the wiring diagram, are sometimes used on switchboard cable forms as a convenient method of separating leads where desired for manufacturing (or installation) reasons.

3.042 "F" stitches shall be located adjacent to the regular stitch toward the tip of the form on both vertical and horizontal forms, as shown in Figure 11. If more than one "F" stitch is used the leads shall be designated "F", "F1", "F2" starting with the one nearest the regular stitch. Use a separate stitch for each like numbered "F" designation.

(a) On ladder-type forms where a cable arm has neither a tip or a butt; the "F" stitches shall be located on the right side of the regular stitch facing the wiring side of the apparatus.

3.043 Number of "F" Stitches - It should be possible to limit the number of "F" stitches at a given point to one, by a proper selection of different colored wires. More than one "F" stitch, however, is permissible where it would be impracticable to select wires with different colors to avoid duplications.

3.044 Where two or more leads of the same color approach a stitch and are to be connected to different terminals of the same piece of apparatus or when one wire of a pair is to be cut and the ends connected to different terminals of the same piece of apparatus, one of the wires is brought out at the regular stitch and each of the other wires at an extra or "F" stitch. Locate the extra stitch or stitches as close as possible to the regular stitch for the wires brought out at this point. (See FIG. 11)

3.05 Fastening Forms to Brackets

3.051 Where cables or local cable forms are to be fastened to crossbars or brackets, the "Chicago" or "Kansas City" stitches, shown in FIG. 12 and 13 shall be used. Use the "Kansas City" stitch wherever secure fastening is of primary importance. Nylon cable ties may be used to fasten forms over 1/2" in diameter to all brackets of a bay (refer to SEC. 205 for requirements and methods for applying nylon cable ties).

3.052 Forms composed of polyvinyl chloride (PVC) insulated wires (such as types BW, BG, BH, BU and BY), polyethylene (PE) insulated wires (such as type BF and shielded pairs in 750 and 760 type cables), teflon (TFE) insulated wires (such as those in KS-19195 and KS-19224 Cables) and double acetate, cotton braid, lacquered (DACBL) insulated wires, (such as type M), shall be protected against contact with metalwork when secured to cable brackets, wiring supports, or other parts of the framework not provided with an approved protective finish such as No. 483. (Refer to Section 225 for methods of providing protection).

4. SEWING FORMS

4.01 Sewing Local Cable Forms

4.011 The starting stitch shall, when possible, consist of a lock stitch as shown in Figures 6 and 15 located at the point of greatest diameter. The sewing shall proceed in both directions from the starting stitch toward the tips of the forms, branches, or arms. Where this is impracticable, use the starting stitches as shown in Figure 5.

4.012 Regular Stitches: Sew all local forms throughout with the lock stitch. Where practicable the stems of the stitches should be located on the side of the form where the skimmers or arms break out as shown in Figure 14.

4.013 Ending stitches for terminating the sewing at the tip of the form should be located at the point where the last skimmers at the tip of the form break out, as shown in Figure 16.

4.0131 Locate the ending stitches at the next to the last breakout point on forms where only one skimmer breaks out at the tip of the form, except where such forms contain stiffening wires carried to the end of the form or spare wires doubled back at the tip of the form.

4.02 Sewing Switchboard Cable Forms

- 4.021 The starting stitch on switchboard cable forms shall be made as follows:
- 4.0211 For forms sewed entirely with the lock stitch and for cable forms sewed with both the lock and winding stitches where the lock stitches precede the winding stitches, the starting stitch should be made as shown in FIG. 5.
- 4.0212 Where two or more cables are formed out as a single round form, place the starting stitch around the wires of only one of the outside cables (regardless of the number of layers) as indicated in FIG. 15.
- 4.0213 Round or oval cable forms sewed with the winding stitch shall have the starting stitches made as shown in FIG. 7.
- 4.022 The regular stitches on switchboard cable forms shall be made as follows:
- 4.0221 In sewing switchboard cable forms, a variation of 1/8" plus or minus from the dimension specified for the distance between the butt of the switchboard cable and the first skinner or set of skinners in the sewed form is allowable.
- 4.0222 The lock stitch shall be used on all forms where the spacing of skinners is more than 1/2"; for resistance forms where the resistances are mounted on 7/16" centers; for forms at 1, 2, and similar type banks; and for all sewed fuse panel forms regardless of the spacing of the fuse posts. Wherever practicable, locate the stems of lock stitches on the side of the form where the skinners or arms break out.
- 4.0223 The winding stitch, as shown in FIG. 7, shall be used on all forms where the spacing of leads is 1/2" or less, such as forms to strip jacks or strip lamp sockets in the face of switchboards or on rack mounted equipment, except as otherwise specified.
- 4.0224 On forms sewed with the winding stitch, the distance between stitches shall be equal to the spacing of the groups of skinners as shown in Figure 7. Portions of the form where no skinners break out shall have the same spacing of stitches as that portion from which the skinners break out.
- 4.0225 Sew loop leads with the type of stitch that would normally be used for other skinners breaking out of the form at that point.
- 4.0226 Where it is necessary to keep down the thickness of a cable form as in the case of the flat-type short multiple forms, sew through the form as shown for multiple cables in Section 235, for those portions of the form which would otherwise be too thick.
- 4.0227 Stitches between the starting stitch and the first set of skinners shall be of the same type as those used for sewing the form where the skinners are brought out, except that where the winding stitch is used and the distance from the butt to the first set of skinners is 1-1/2" or greater the lock stitch should be used between the starting stitch and first set of skinners. The short multiple cable form in switchboards, is an exception to this requirement.
- 4.023 The ending stitch on switchboard cable forms sewed with the lock stitch shall be made as shown in Figures 7 and 8. Where the winding stitch is used the ending stitch should be made as shown in Figure 7.
- 4.03 Sewing Superimposed Wiring to Main Form
- 4.031 The requirements for the number of strands of twine and the spacing of stitches when superimposing wiring (either loose wires or sewed forms) on main forms are shown in Figure 16. The requirements in this figure apply only to sewed forms and superimposed wiring by the installer (which requires less handling than wiring superimposed by the shop.)
- 4.032 "C" wiring forms shall be attached to the main form in accordance with the requirements shown in Figure 16 for superimposed forms.

4.04 Sewing PVC Insulated Wires

4.041 PVC insulated wires (such as BG, BW, BU and DM1) should be sewed into forms in the same manner as textile insulated wires.

4.05 Sewing PE Insulated Wires

4.051 Refer to Section 710 of this handbook for the proper methods of sewing "PE" insulated wires.

4.06 Sewing Rubber-Covered Wires

NOTE: This includes flexible cordage such as KS-15141 and KS-15143 (formerly known as Tirex Wire).

4.061 Where a few rubber and/or neoprene covered wires are to be sewed into a form made up of textile or PVC insulated wires, the rubber-covered wires shall be embedded in the form so that the sewing twine or nylon ties will not cut into the rubber insulation.

4.0611 Where this is impracticable, as at points where the rubber and/or neoprene covered wires leave the main form, two layers of plastic tape shall be applied half-lapped, around the main form and the arm to protect the insulation from the twine or nylon ties.

4.062 Where cable forms that would normally be sewed are made up principally of rubber and/or neoprene covered wires, tape the form completely with two layers of plastic tape lapped, instead of sewing the form with twine.

4.063 Secure superimposed cables of rubber and/or neoprene covered wire to other sewed cables with bands of plastic tape (min. 1-1/4" turns) spaced not farther apart than five times the diameter of the larger cable. At bends, the tape shall extend completely around the bend.

4.064 Where a cable form or rubber and/or neoprene covered wire is to be secured to switchboard cables, cable brackets, or other supports, the cable form may be secured with twine or nylon ties. In such cases, the wires at each stitch or tie shall be protected with 1/64 inch fiber strips about 1 inch wide, placed centrally under the stitch or tie, and wrapped completely around the cable form.

5. ADDING WIRES TO FORMS5.01 Except at Keyshelves and "C" Wiring

5.011 When wires other than the various types of "C" wiring are to be added to existing sewed cable forms, except those in keyshelves, the additional wires may be sewed or nylon tied into a separate form and superimposed on the existing forms, provided that a satisfactory appearance is obtained. Otherwise the additional wires shall be distributed uniformly around the existing forms and secured by means of twine in the usual manner. Refer to Paragraphs for sewing requirements and methods.

→ 5.0111 When adding only a few wires to an existing cable form, it is usually more economical to slide the added wires under the existing stitches instead of resewing or rebanding the form. The quickest way to do this is to slide the tip of the R-4630 Wire Threading Tool under the stitch or tie and passing the added wire through the groove in the tool. This method should not be attempted when adding wires to forms with old, very brittle insulation and twine. In such a case, resew or reband the form area where the leads are added.

NOTE: The R-4630 has a pointed end and requires a certain amount of precaution to avoid personal or cable form insulation damage.

5.0112 The R-4630 Wire Threading Tool will also facilitate removal of twine stitches or nylon ties from cable forms and/or bundles. Slide the R-4630 Tip under the stitch or tie and cut with an R-4633 Diagonal Cutter.

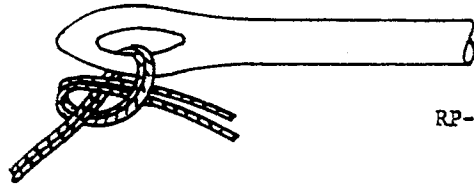
- 5.012 Where the original forms are not protected and the addition of the added wires necessitates the placing of protection, the protection shall be placed as covered in Section 225.
- 5.013 Where wires are added to forms serving double row fuse panels and they break out intermittently along the entire form, sew the wires either along the top or bottom of the form to agree with the skinner breakouts. Where the wires serve fuse posts numbered consecutively, distribute them uniformly around the existing form.
- 5.014 Wiring superimposed on existing sewed cable forms shall not cover up any of the various types of "C" wiring already superimposed on these forms. Refer to Section 201 of definitions covering the various types of "C" wiring.
- 5.015 Where cable forms are provided with fire detection wire, care shall be taken to see that no wiring added to or superimposed on such cable forms is fastened in such a way as to cover either the 1A fire detection wire or the red, type AM, wire of the fire detection loop.
- 5.0151 The fire detection loop return wire (type AM) on the main vertical portion of a bay local cable may be crossed at right angles if only a few wires or the horizontal arms of a supplementary local cable are involved.
- 5.02 At Keyshelf (Except "C" Wiring)
- 5.021 When wires other than type AM wires or "C" wiring of any type as defined in Section 201 are to be added to existing sewed forms in keyshelves, the additional wires shall be distributed uniformly around the outside of the forms and secured with twine or nylon ties in the usual manner. Refer to Paragraphs for sewing requirements and methods. The necessary protection material should then be added in accordance with Section 225.
- 5.0211 When adding wiring to keyshelf forms, and it is difficult to place fiber and tape protection completely around the local cable form in the area under the cord shelf, the added wiring may be protected with fiber and tape as a separate form and secured to the existing form.
- 5.022 When type AM wires, other than "C" wiring of any type as defined in Section 201, are to be added to existing sewed forms in keyshelves they may be sewed into a separate form and superimposed on the existing form or distributed uniformly around the existing form, whichever is more practicable. If the added wires can be placed on the original form so that they are not subject to damage due to raising and lowering of the keyshelf, no additional protection is required.
- 5.023 When the added wires as covered in Paragraphs 5.021 and 5.022 require protection, which, in addition to the protection material on the existing form, would make the cable so bulky that it would rub against the key pan, apron or other metal work resulting in broken wires and improper closing of the keyshelf, (due to the main form extending into the space of and coming in contact with the individual key forms), remove the protection material, on the original cable form and sew all wires into one form, adding the necessary protection required, as covered in Section 225.
- 5.024 Supplementary keyshelf local cables which are formed by the shop and installed in the field, shall be superimposed on the existing form in the usual manner, i.e., a separate form sewed or nylon tied to the regular form.
- 5.025 Wires added to keyshelf local cable forms should be placed within the metal strap or clamp at the position of the keyshelf bracket and within all other form supporting details.
- 5.026 When nylon cable ties are used to form or superimpose leads to the keyshelf, the heads of the cable ties shall be placed in such a manner so as to eliminate any possible rubbing or chafing of the keyshelf form.

6. VERIFICATION ITEMS

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS		REFERENCE	
		Par. No.	Fig. No.
6.01	<u>General</u>		
6.011	Manual or pneumatically applied nylon cable ties may be used to sew (band) switchboard or local cable forms.	1.12	
6.012	Nylon cable ties shall be applied with the same spacing requirements as twine.	1.121	
6.02	<u>Sewing - Common Methods and Requirements</u>	3.01	
6.021	All form (local, switchboard) should be sewn with twine or banded with nylon cable ties (installer made forms).	3.011	16
6.022	Wind twine in clockwise direction, except where not practicable.	3.012	
6.023	Sew forms tight enough to prevent stitches from sliding, however, not enough to damage insulation or cause curling.	3.013	
6.024	At least one stitch or nylon tie shall be taken where wires break out of the form, however, depending upon the amount of wires breaking out of the form two or more stitches may be required.	3.016	
6.03	<u>Splicing Twine</u>	3.02	
6.031	Splice single strand twine correctly.	3.022	3
6.032	Splice double stranded twine correctly.	3.023	4
6.04	<u>Types of Stitches Used for Sewing</u>	3.03	
6.041	Starting stitches made correctly.	3.031	5, 6
6.042	Lock stitches made correctly.	3.032	6
6.043	Winding stitches made correctly.	3.033	7
6.044	Ending stitches made correctly.	4.023 3.034	7
6.045	Cross stitches made correctly.	3.035	8
6.046	Chain stitches made correctly.	3.036	9
6.047	Broom stitches made correctly.	3.037	10
6.05	<u>The Use of "F" Stitches</u>	3.04	
6.051	The "F" stitch should be used to segregate two leads of the same color breaking out of the form at the same place but connecting on different terminals.	3.041 3.044	11
6.052	The "F" stitches should be located adjacent to the regular stitch looking from butt to tip on wire side.	3.042	11

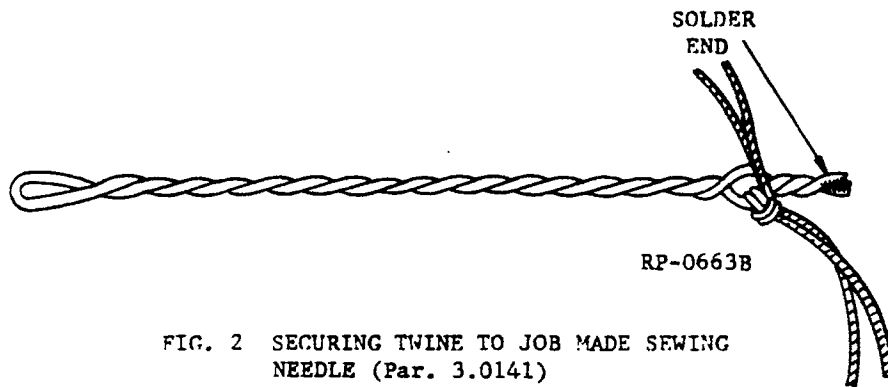
VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS		Reference	
		Paragraph Number	Figure Number
6.053	The "F" stitches on ladder type forms should be located adjacent and to the right side of the regular stitches facing the wiring side.	3.042a	
6.06	<u>Fastening Forms to Brackets</u>	3.05	
6.061	Forms secured to brackets, crossbar, etc., should be secured with "Kansas City" or "Chicago" stitches, nylon ties may be used. SEC. 205.	3.051	12, 13
6.062	PVC, PE, TFE, and DACL insulated wires require protection when fastened to brackets, wiring supports, etc., not having an approved finish.	3.052	
6.07	<u>Sewing Local Cable Forms</u>	4.01	
6.071	The starting stitch should be located at the point where the diameter is the largest and then proceed in both directions toward the tips, branches, or arms of the form.	4.011	5
6.072	Sew forms throughout with lock stitch.	4.012	14
6.073	Ending stitches should be located at the tip of the form where last skinner breakout, except where stiffening wire was used.	4.013	16
6.08	<u>Sewing Switchboard Cable Forms</u>	4.02	
6.081	Forms sewed with lock stitches or lock stitches and winding stitches should be preceded by a starting stitch.	4.0211	5
6.082	Where two or more cables are formed into one round form, the starting stitch should only be placed around the wires of one cable.	4.0212	15
6.083	(+ or -) 1/8" is the allowable distance of variation for stitches between the butt and the first skinner.	4.0221	
6.084	Lock stitches should be used on forms where the breakout spacing is over 1/2" - stems of the stitches to be located on the skinner side of the form.	4.0222	
6.085	Winding stitches should be placed on forms where the breakout spacing is less than 1/2", such as, jack strips, lamp strips, etc. The spacing should be equal for the entire length of the form.	4.0223 4.0224	
6.086	Sew loop leads with normal stitch being used for the skinner breakouts of the form.	4.0225	
6.087	Lock stitches may be followed by winding stitches.	4.0227	
6.09	<u>For Superimposing Wiring to Main Form - See Figure.</u>	4.031	16
6.091	For superimposing "C" wire form to main form - See Figure.	4.032	16

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS		REFERENCE	
		Par. No.	Fig. No.
6.092	Sew PVC (BG, BW, BU or DM1) wires the same as the textile covered wires.	4.041	
6.093	Where a few rubber and/or neoprene covered wires are in the same form with textile covered wires, they should be imbedded in the form to prevent cutting the insulation. Where imbedding is impossible, protect with 3/16" lapped gray friction tape.	4.061 4.0611	
6.094	Where form is principally rubber and/or neoprene covered wire, the form should be taped and if superimposed to another form, use bands of the tape spaced not farther apart than five times the diameter of the largest cable form.	4.062 4.063	
6.095	Where rubber and/or neoprene covered cable form has been secured to brackets, supports, or other forms, use bands of twine or nylon ties, but protect forms with fiber strips.	4.064	
6.10	<u>Adding Wires to Forms (Except Keyshelf and "C" Wiring)</u>	5.01	
6.101	Wires should be distributed around the form evenly sewed or nylon tied into form and superimposed neatly.	5.011	
6.102	When adding wires into old cable form cause stitches to break, resew entire form.	5.0111	
6.103	Adding wires or forms may require added protection.	5.012	
6.104	Where form serves double row fuse panels and wires break out intermittently along form, distribute the wires evenly around form and sew.	5.013	
6.105	Wiring superimposed on existing form should not cover up various "C" wiring previously superimposed.	5.014	
6.106	Superimposed wires should not cover fire detection or loop return wiring, except on vertical portion of form where only a few wires may cross.	5.015 5.0151	
6.11	<u>At Keyshelves (Except "C" Wiring)</u>	5.02	
6.111	Wires other than "AM" & "C" should be distributed evenly around the existing form and sewed or nylon tied in the usual manner.	5.021	
6.112	"AM" wiring other than "C" type should be sewed into a separate form and superimposed or distributed evenly around the form and sewed.	5.022	
6.113	Add necessary protection to avoid rubbing against key panel or other metalwork.	5.023	
6.114	Supplementary shop formed local cables should be superimposed to existing keyshelf form.	5.024	
6.115	Wires added to the keyshelf local cable should be placed within the metal clamp or strap.	5.025	
6.116	When nylon cable ties are used, position tie heads to eliminate possibility of chafing.	5.026	



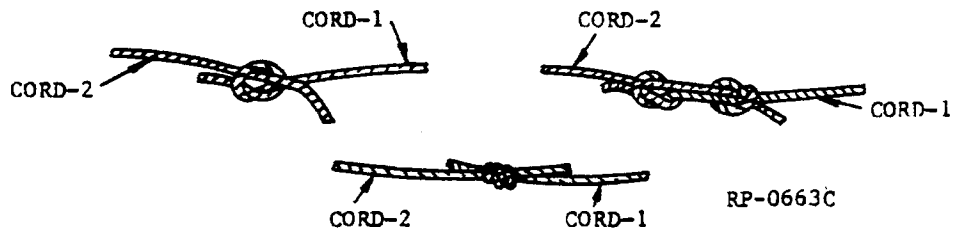
RP-0663A

FIG. 1 SECURING TWINE TO SACK NEEDLE
R-59237 (Par. 3.014)



RP-0663B

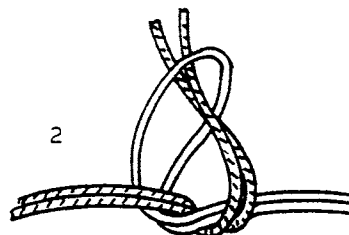
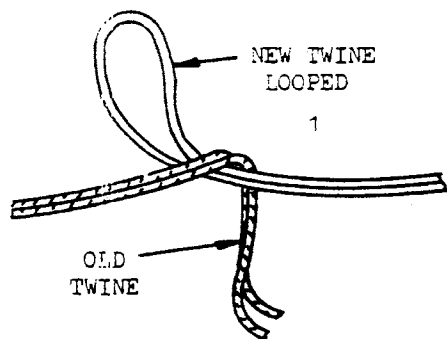
FIG. 2 SECURING TWINE TO JOB MADE SEWING
NEEDLE (Par. 3.0141)



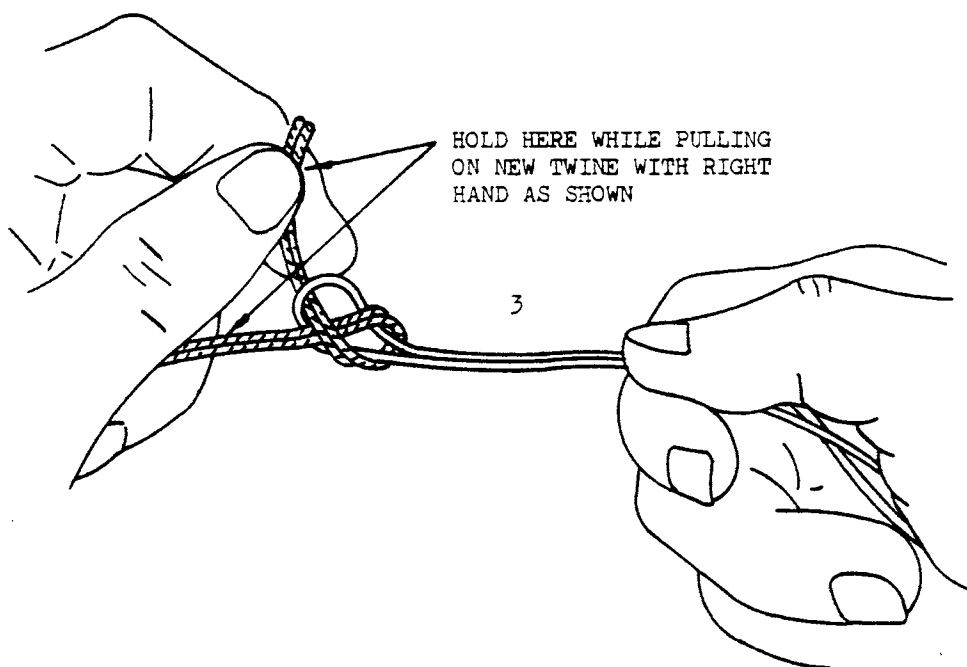
RP-0663C

FIG. 3 SPLICING SINGLE TWINE
(Par. 3.022)

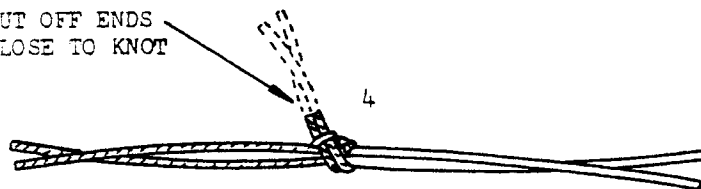
LOCATE SPLICE SO IT WILL NOT INTERFERE
WITH THE MAKING OF STITCHES



PASS ENDS OF OLD
TWINE THRU LOOP
OF NEW TWINE



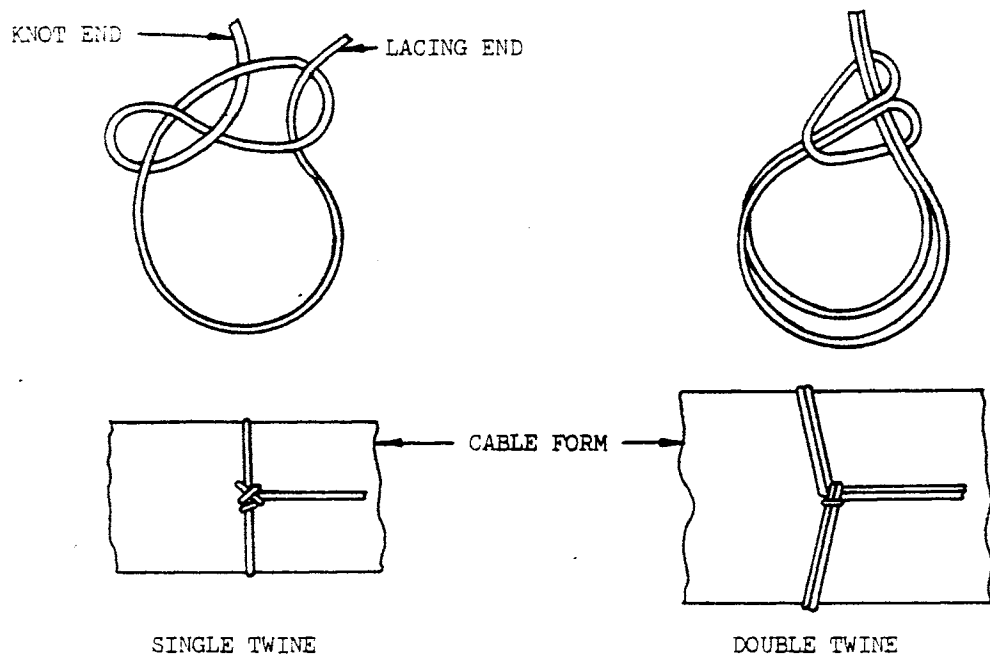
CUT OFF ENDS
CLOSE TO KNOT



THE COMPLETED KNOT

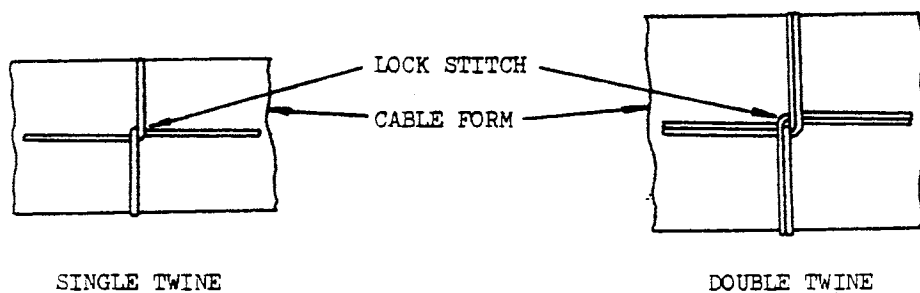
RP-0663D

FIG. 4 SPLICING DOUBLE TWINE
(PAR. 3.023)



RP-0663E

FIG. 5 STARTING STITCHES FOR CABLE FORMS
SEWED IN ONE DIRECTION ONLY
(PARS. 3.031, 4.011, 4.0211)



RP-0663F

FIG. 6 STARTING STITCHES FOR CABLE FORMS
SEWED IN BOTH DIRECTIONS
(PARS. 3.031, 3.032, 4.011)

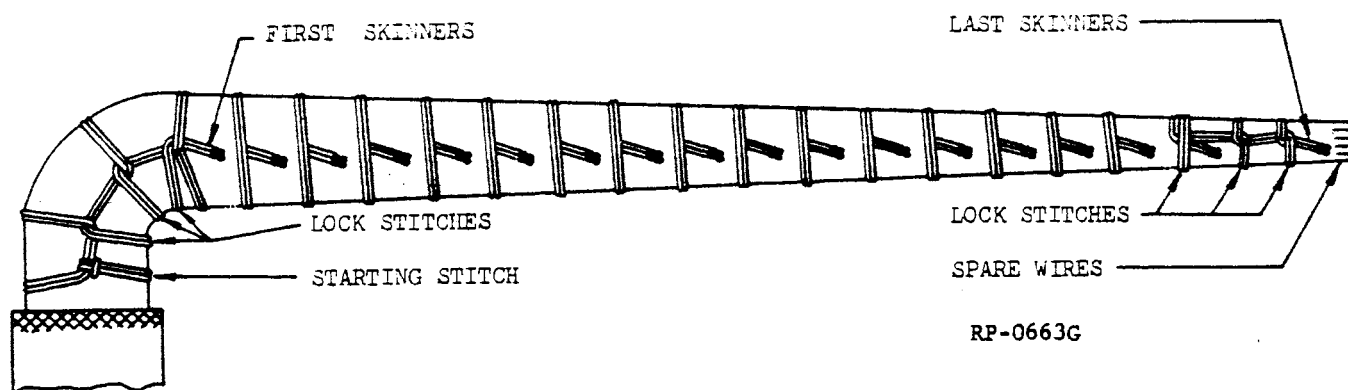


FIG. 7 SINGLE LEG CABLE FORM AT RIGHT ANGLES TO BUTT SEWED WITH WINDING STITCH
(PARS. 3.033, 4.0213, 4.0223, 4.0224, 4.023)

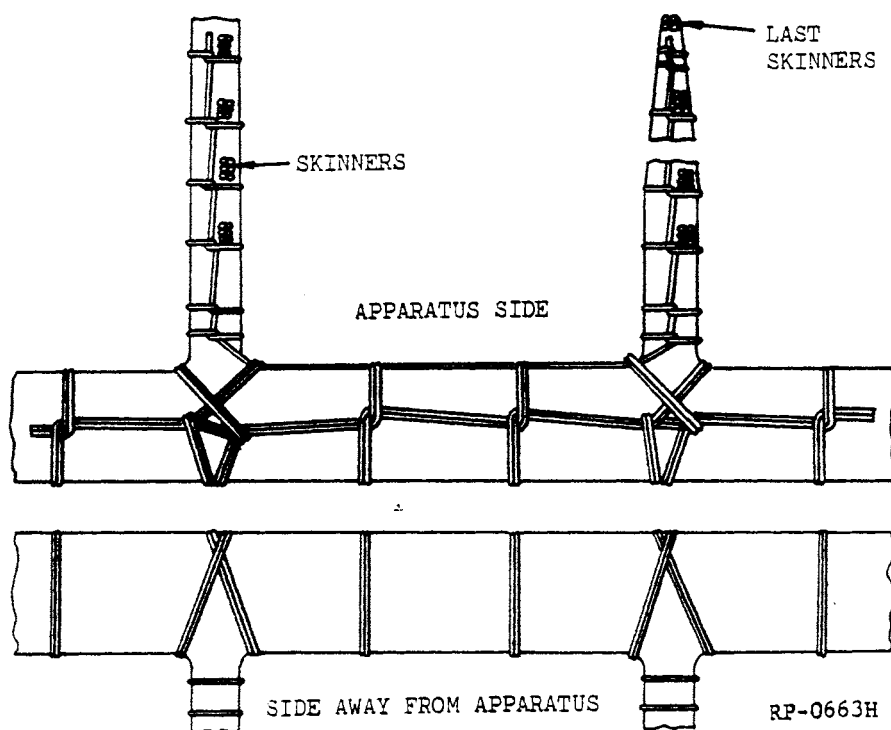
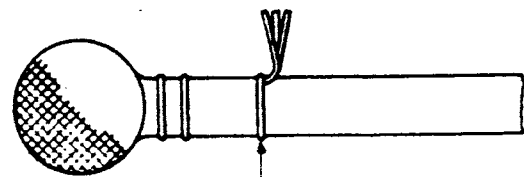
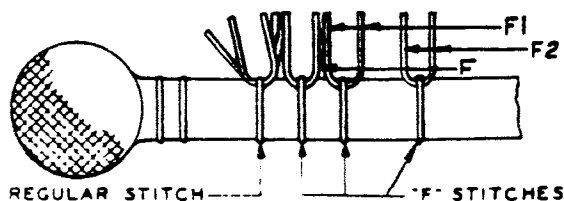


FIG. 8 CROSS STITCHES ON LARGE DIAMETER FORMS (PARS. 3.035, 4.023)

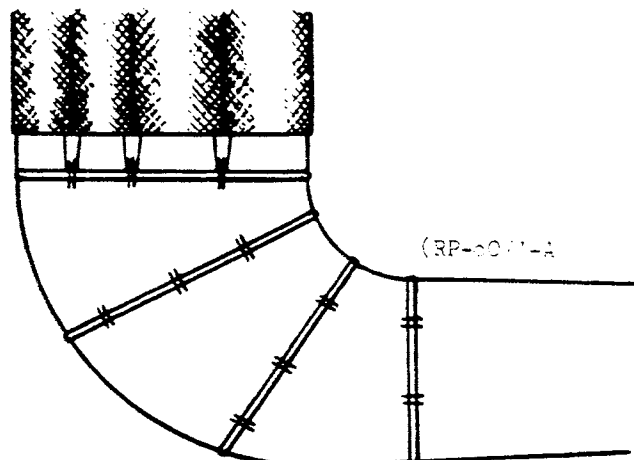
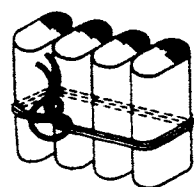


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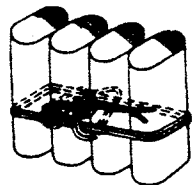
FIG. 9 CHAIN STITCHES
(PAR. 3.036)REGULAR STITCH
NO "F" LEAD
(REGULAR STITCH ONLY)REGULAR STITCH — "F" STITCHES
THREE "F" LEADS - TWO APPROACHING
IN THE SAME DIRECTION AND THE OTHER
IN THE OPPOSITE DIRECTION
(TWO "F" STITCHES)

RP-0663K

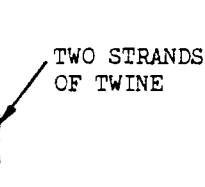
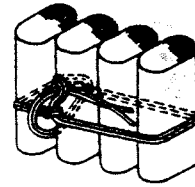
NOTE: "F" STITCHES SHALL BE PLACED AS CLOSE AS PRACTICABLE TO THE REGULAR STITCH, AS WELL AS CLOSE TO EACH OTHER.

FIG. 11 "F" LEADS AND "F" STITCHES
(PARS. 3.041, 3.042, 3.044)FIG. 10 BROOM STITCHES
(PAR. 3.037)

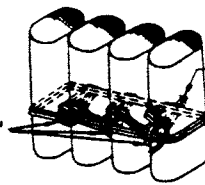
STARTING STITCH



SECOND STITCH

TWO STRANDS
OF TWINE

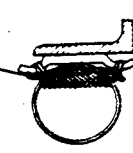
FIRST STITCH

PULL ALL
STITCHES
TIGHT

COMPLETED STITCH

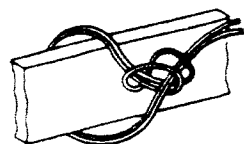
TIE WITH
DOUBLE
KNOT AND
CUT ENDS
OFF SHORT

ENDS OF TWINE WRAPPED
ONCE AND IN OPPOSITE
DIRECTIONS AROUND TWINE
AT REAR OF CABLE AND
TIED WITH DOUBLE KNOT

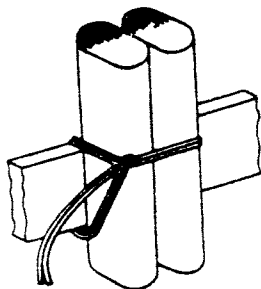
STARTING
STITCHSTARTING
STITCH
TIGHTCOMPLETED
STITCH

RP-0663L

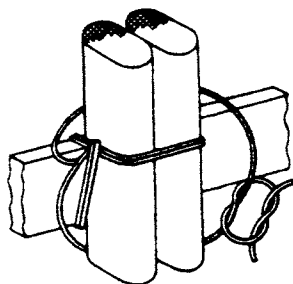
FIG. 12 "CHICAGO" STITCHES
(PAR. 3.051)



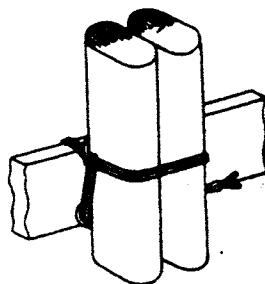
STARTING STITCH



FIRST STITCH

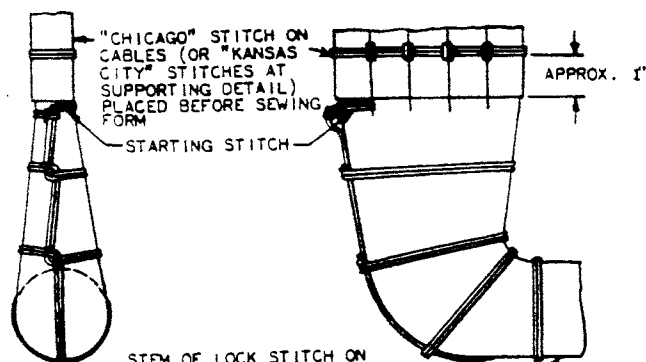


BEFORE TIGHTENING

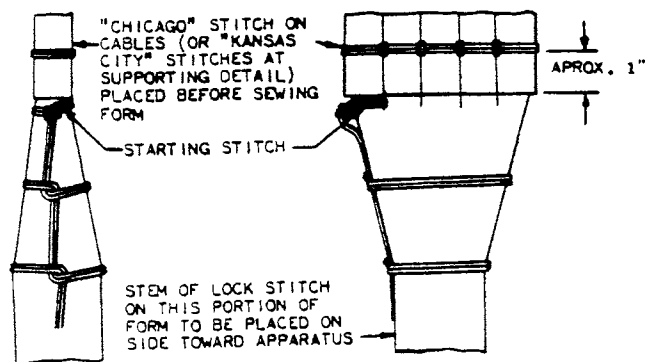


COMPLETED STITCH

RP-0663M

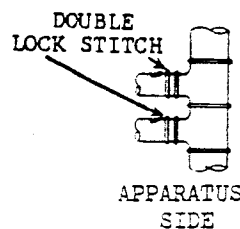
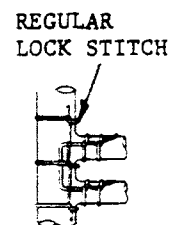
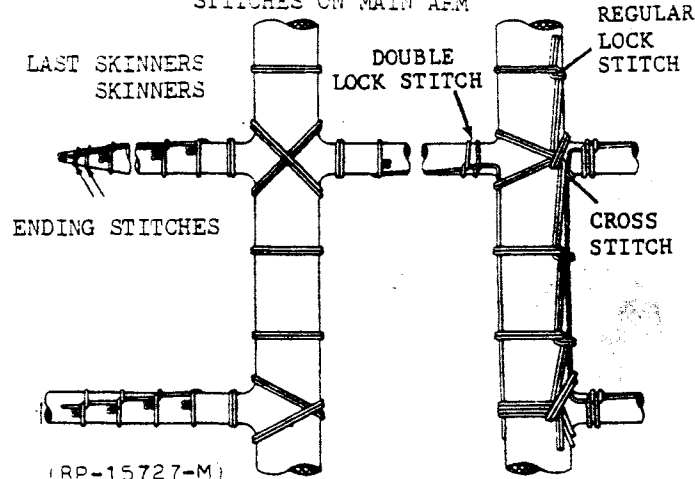
FIG. 13 "KANSAS CITY" STITCHES
(PAR. 3.051)

CABLE FORMED AT RIGHT ANGLES TO BUTT



CABLE FORMED STRAIGHT FROM BUTT

(RP-13033-M)

FIG. 15 SEVERAL CABLES IN RECTANGULAR
FORMATION FORMED OUT AS A SINGLE
ROUND CABLE ARM
(PARS. 4.011, 4.0212)APPARATUS
SIDESIDE AWAY
FROM APPARATUSSMALL DIAMETER FORM HAVING SPACING OF
ARMS EQUAL TO OR LESS THAN SPACING OF
STITCHES ON MAIN ARMAPPARATUS
SIDESIDE AWAY
FROM APPARATUSNOTE: THE DOUBLE LOCK STITCH SHALL BE LOCATED
AS CLOSE AS PRACTICABLE TO THE MAIN FORM.FORM HAVING SPACING OF ARMS GREATER THAN
SPACING OF STITCHES ON MAIN FORMFIG. 14 SEWING LOCAL CABLE FORMS
(PARS. 3.038, 4.012)

SPACING OF STITCHES (SEE NOTES 1 AND 2)								
Main Form Without Branch Arm or Skinner Breakout	Main Form With Branch Arm Or Skinner Breakouts				For Superimposed Wire			For Superimposing Forms
Place stitch every 2 inches on main form where it is not necessary to conform to the spacing of branch arms or skinner breakouts.	Space between breakouts of branch arms or skimmers.	Break-Out	Mid-Point	2" Spacing	Break-Out	Mid-Point	2" Spacing	
	1/2" or less	X			X			
	Over 1/2" to 2"	X			X			
	Over 2" to 4"	X	X		X	X		
	Over 4" to 8"	X		X	X		X	
See A	Over 8"	X		X	X		X	
	See A B C D E							See F G H

NUMBER OF STRANDS OF TWINE FOR ORIGINAL FORMS

In determining the number of strands of twine to use for sewing original forms, the maximum diameter of each separate part (main form or branch arm, straight or tapered) is the controlling dimension for that part.

- Use 1 strand of approved twine for all sewing on forms (main form and branch arms) where the maximum diameter of the forms is not greater than 1-1/2".
- Use 2 strands of twine for sewing the entire main form and all branch arms of the main form where the maximum diameter of the forms is greater than 1-1/2".
- Where cable forms are to be protected with tape, it is permissible to double space stitches, providing the space between stitches does not exceed 3".

BANDS OR TIES

Where bands or ties are specified in the handbook or on the drawing for tying forms, use bands of 2 strands of twine, made as a starting stitch and ended with a square knot, for the entire form. Place the bands at approximately 8" intervals on Horizontal Forms, and approximately 14" on Vertical Forms unless otherwise specified. The requirements of this paragraph should not be considered as those requirements necessary for securing forms to cable brackets, supports, etc.

EXCEPTION: Where a specific handbook section specified size of twine different from the above, the specific handbook section shall be followed.

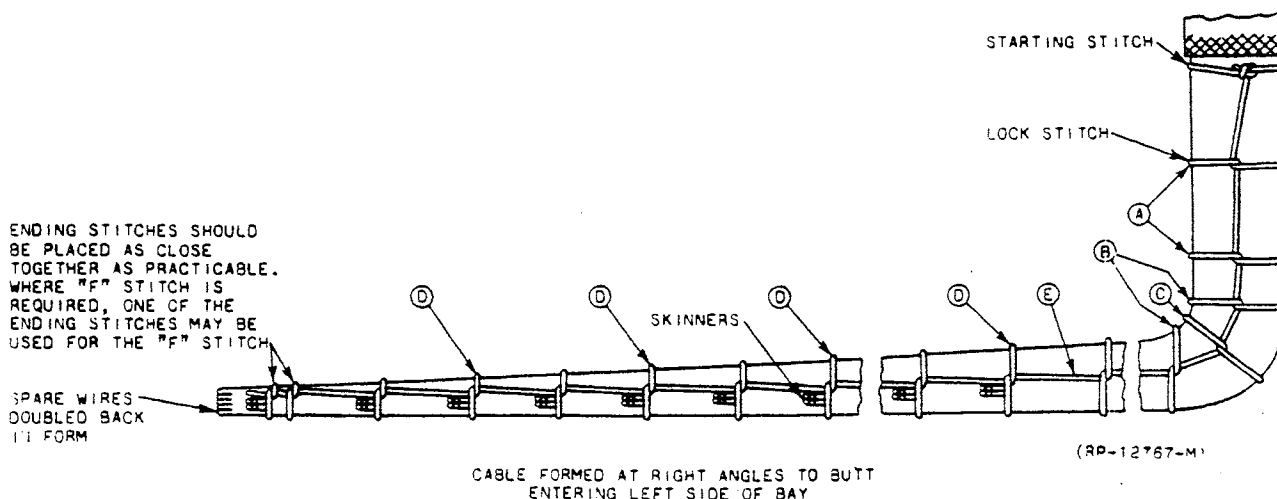


FIG. 16 SEWING REQUIREMENTS FOR SEWED FORMS AND SUPERIMPOSED WIRING
(PARS. 3.011, 3.034, 4.013, 4.031, 4.032)

(Continued on next page)

18

**NUMBER OF STRANDS OF TWINE FOR
SUPERIMPOSED WIRING AND FORMS**

(a) When superimposing wires around a form, or superimposing one form on another; if the maximum diameter of the original form and superimposed wires together is not greater than 3", use 1 strand of twine; if it is greater than 3", use 2 strands of twine.

- A Place stitch every 1-3/4" (2" max.) on that part of form not having branch arm or skinner breakouts.
- B Place stitch at beginning and end of each bend and at beginning of branch arms.
- C Place intermediate stitches at bends so that stitch spacing does not exceed 2" on the outside radius.
- D Place stitch at each branch arm and skinner breakout and at midpoints to maintain equal spacing as nearly as practicable but not to exceed 2".
- E Place stem of stitches on side of form adjacent to apparatus. On single leg forms at double row fuse panels use the stem of the lock stitch to separate the upper and lower sets of skimmers. (Shop forms may have the skimmers separated by an extra stitch.)
- F Space stitches on that portion of a form which is to be superimposed and which is not controlled by branch arm or skinner breakouts, every 4 inches.
- G Place stitches used for superimposing one form on another midway between each stitch of the superimposed form except, as covered in H.
- H Where shop formed cables are to be superimposed place superimposing stitches every 4 inches. Place additional stitches at breakouts of branch arms or skimmers as required to prevent the superimposed form pulling away from the main form at these locations.

NOTE 1: Place additional stitches where F stitches are specified on the drawing as covered in Paragraphs 3.041 to 3.044 and Figure 12; where an extra stitch as covered in Section 220 is required; where large gauge wires are involved or where additional rigidity is required on large diameter forms as covered in Paragraph 3.035.

NOTE 2: Forms serving 286, 287 and similar type multi-contact relays or 218-type terminal strips mounted on 2-1/8" centers, should have stitches spaced 2-1/8" apart on that portion of the form where the vertical branch arms for these equipments break out.

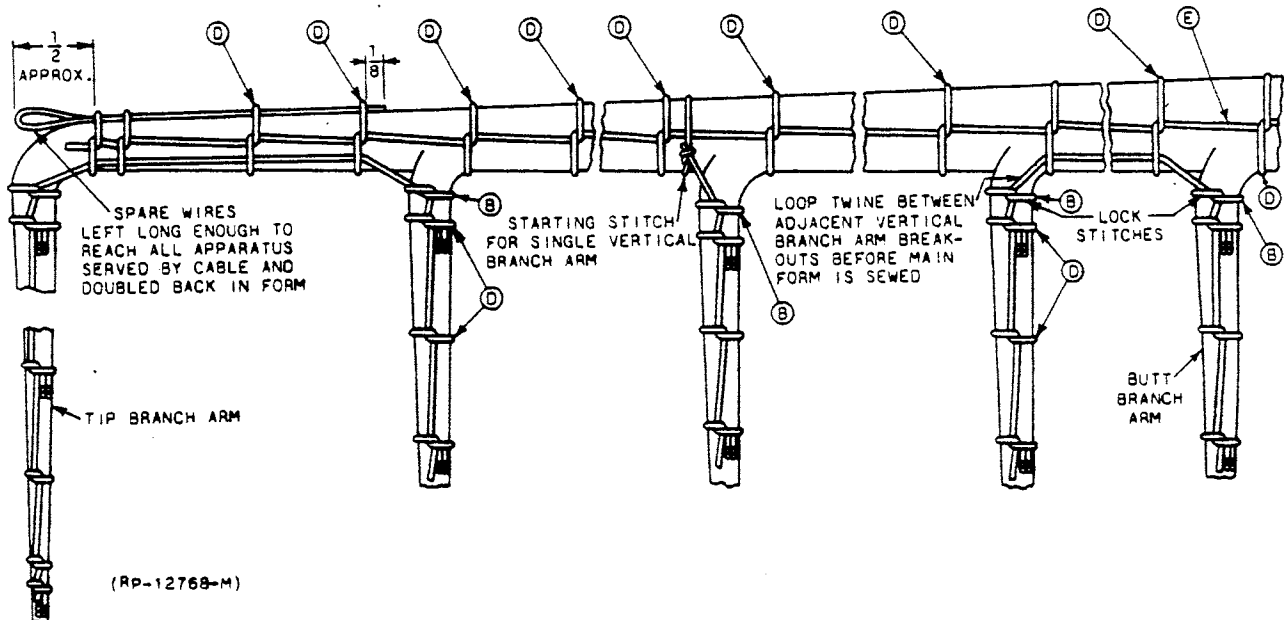


FIG. 16 SEWING REQUIREMENTS FOR SEWED FORMS AND SUPERIMPOSED WIRING
(PARS. 3.011, 3.034, 4.013, 4.031, 4.032)

(Continued on next page)

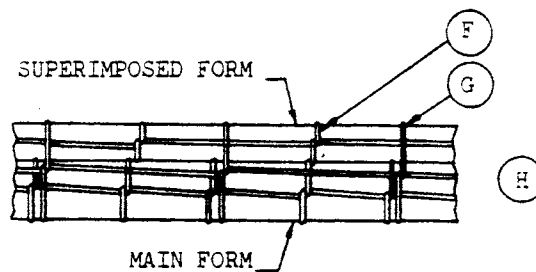


FIG. 16 SEWING AND BANDING (NYLON TIE) REQUIREMENTS FOR SEWED FORMS AND SUPERIMPOSED WIRING
(PARS. 3.011, 3.034, 4.013, 4.031, 4.032)

(continued from preceding page)

→ Indicates new or changed information.

[Brackets at side of paragraphs indicate
a requirement.

Engineering Planning Manager
(Installation)

REASON FOR REISSUE:

To remove reference to varnished cotton cloth.
To introduce use of R-4630 Tool for cutting
ties.

SEWED FORMS
PREPARATORY OPERATIONS

CONTENTS

1.	GENERAL	3.	METHODS
1.1	Scope of Section	3.1	Ladders
1.2	Precautions Against Personal Injury, Equipment Damage and Service Inter- ruptions	3.2	Lighting
2.	INSTALLING EQUIPMENT	3.3	Bulk Wire
2.1	Tools	3.4	Wire Spool Dispenser
2.2	Supplies	3.5	Running Sheets
		3.6	Form Boards

1. GENERAL

1.1 Scope of Section

1.11 This section covers the basic prepara-
tory information, tools and methods
required to perform the operation of
"making up" sewed forms.

1.12 Although the basic principles covered
herein apply to all jobs, some varia-
tions from the specified procedures
may be found practicable under certain
conditions. For example, the R-3410 $\leftarrow$
Wire Spool Dispenser will handle 25
wire spools and would be very useful
when making up large forms or a large
number of forms. However, when small
forms or a small number of forms are
being made up, this tool may not be
worthwhile.

1.13 Each figure in this section illus-
trates only conditions to which refer-
ence is made in the text and should
not be considered as covering other
requirements or conditions that may be
shown.

1.2 Precautions Against Personal Injury,
Equipment Damage and Service Inter-
ruptions

1.21 The specific precautions to be taken
against personal injury, equipment
damage, and service interruptions are

covered in this section with the asso-
ciated method. General precautions
are covered in Handbook 0 and are to
be observed at all times, as they ap-
ply to the operations being performed.

2. INSTALLING EQUIPMENT

2.1 Tools

See HB 250	Clamp, C (Size as Required)
R-3410	Dispenser, Wire Spool
R-3788	Drill, 1/4" Electric
See HB 250	Drills, Twist (Size as Required)
R-9430	Hammer, Claw
R-1652	Rule, Folding 6 Ft.
R-2529	Saw, Crosscut 20"
R-3145	Seat, Rolling Ladder
R-5460	Stool, Three Position

$\leftarrow$ 2.2 Supplies

RM-626122	Canvas, Flameproofed
Obtain	Hooks, Screw (Size as Required)
Locally	
Obtain	Nails (Size as Required)
Locally	
Obtain	Screws (Size as Required)
Locally	
R-2916	Twine
R-3455	Shellac, White
SD-48-125,	Sheets, Connecting
126, 126A,	
127, 127A	

NOTE: Tools included in the wireman
168 Kit not listed.

3. METHODS

3.1 Ladders

3.11 Arrange for sufficient ladders (where required) or three position stools at the location where the forming operation is to be performed. When the forming operation is to be performed on a working bay of equipment, refer to Handbook 0 for the necessary precautions to prevent service interruptions.

3.111 Check all ladders being used to insure that they are in proper working condition and that blocks are provided for ladders that are not equipped with brakes.

3.112 Check the near vicinity of the working area to insure there are no projecting ends of cable rack, threaded rods, etc. Where such conditions do exist, pad these conditions with layers of canvas or other suitable materials to prevent possible personal safety hazards.

3.2 Lighting

3.21 Arrange for suitable lighting facilities to insure that the working area is sufficiently illuminated. Refer to Handbook 0 for information pertaining to temporary lighting and auxiliary equipment.

3.3 Bulk Wire

3.31 When bulk wire has not been furnished or when additional wire is required, it should be requisitioned as shown below, showing the number of feet required, the gauge and type of wire required, the colors and indication of whether it is single, paired, triple, etc.:

Example:

100 ft. 22BG Green Single Wire
75 ft. 20BN Slate & Red-Slate
Paired Wire
50 ft. 22BH Yellow, Yellow-Green &
Red-Green Triple Wire

NOTE: Refer to Section 103 of this handbook for various types of bulk wire.

3.311 In case a wire code has been superseded, the former or lower numerical code will be furnished until the stock of wire is depleted. After that point, the higher numbered code will automatically be furnished.

3.32 Check all bulk wire before it is used. Examine the insulation to see that it conforms to that specified on the wiring diagram or, in the case of substitution, see that the correct type has been furnished. Detailed information on the construction of wire is given in Section 103 of this handbook.

→ 3.4 Wire Spool Dispenser

3.41 The R-3410 Wire Spool Dispenser will accommodate 25 spools of wire and should be used to perform large cable forming operations.

3.5 Running Sheets

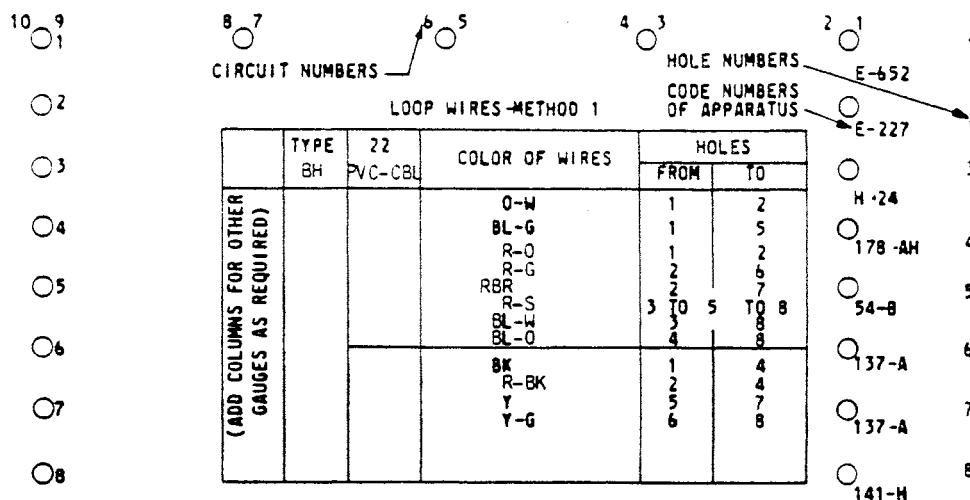
3.51 Make up layout sheets in the case of complex forms or where continuous reference to the drawings would be difficult. A typical layout sheet is shown in Figure 1 for apparatus on mounting plates. For reference purposes mark the hole number of each piece of apparatus on the circuit drawing.

3.511 The analysis effort necessary to determine the wiring and strapping required for circuit groups, and the associated numbering and stamping on terminal strips, relays, etc., should be combined whenever possible. Forms SD-48-125 thru -127 may be requisitioned (see Handbook 250) for use when laying out miscellaneous wire and cable conductor ends at these various terminating locations.

3.6 Form Boards

→ 3.61 When forming operations necessitate the use of a forming board and standard forming tools are not adequate or available and the forming operation is to be performed in the office equipment room, the use of lint free fire retardant materials shall be used. (Refer to Handbook 0, Section 20.)

CIRCUIT _____ T- _____ ISSUE: _____
 CIRCUIT WIRED _____ EQUIPPED _____
 MISC. RELAY RACK - BAY _____



TYPE
GAUGE

LOOP WIRES - METHOD 2

HOLE NO.	FUNCTIONAL DESIG.	C										22		PAIR		PAIR	
		R-BL	R-G	R-BR	R-S	R-W	R-BL-W	R-O	R-G-W	R-O-W	S	S-W	O	O-W			
1	SL																
2	BY																
3	S																
4	ON																
5	SU-2																
6	A-RES																
7	B-RES																
8	C-RES																
9	PL-RES																
10	SU																
11	PL COND																
12	PL REL.																
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	

WIRES FROM SWBD CABLE

CODE	CA. NO.	FROM	TO	COLOR OF WIRE	HOLE	CIRCUIT NO.
24M	NO. 1		REL. RACK	1 - 10 PRS.	1	CKTS 1 - 10
				11 - 20 PRS.	7	CKTS 1 - 10
70M	NO. 1		REL. RACK	1 - 10 PRS.	1	CKTS 1 - 10
				11 - 20 PRS.	6	CKTS 1 - 10
				181 - 190 PRS.	5	CKTS 1 - 10
				RED TRACER	7	CKTS 1 - 10
				191 - 200 PRS.	4	"F" STITCH CKTS 1 - 10
				RED TRACER	8	CKTS 1 - 10

(RP-12750A)

FIG. 1 RUNNING SHEET FOR APPARATUS ON MOUNTING PLATES
(PAR. 4.51)

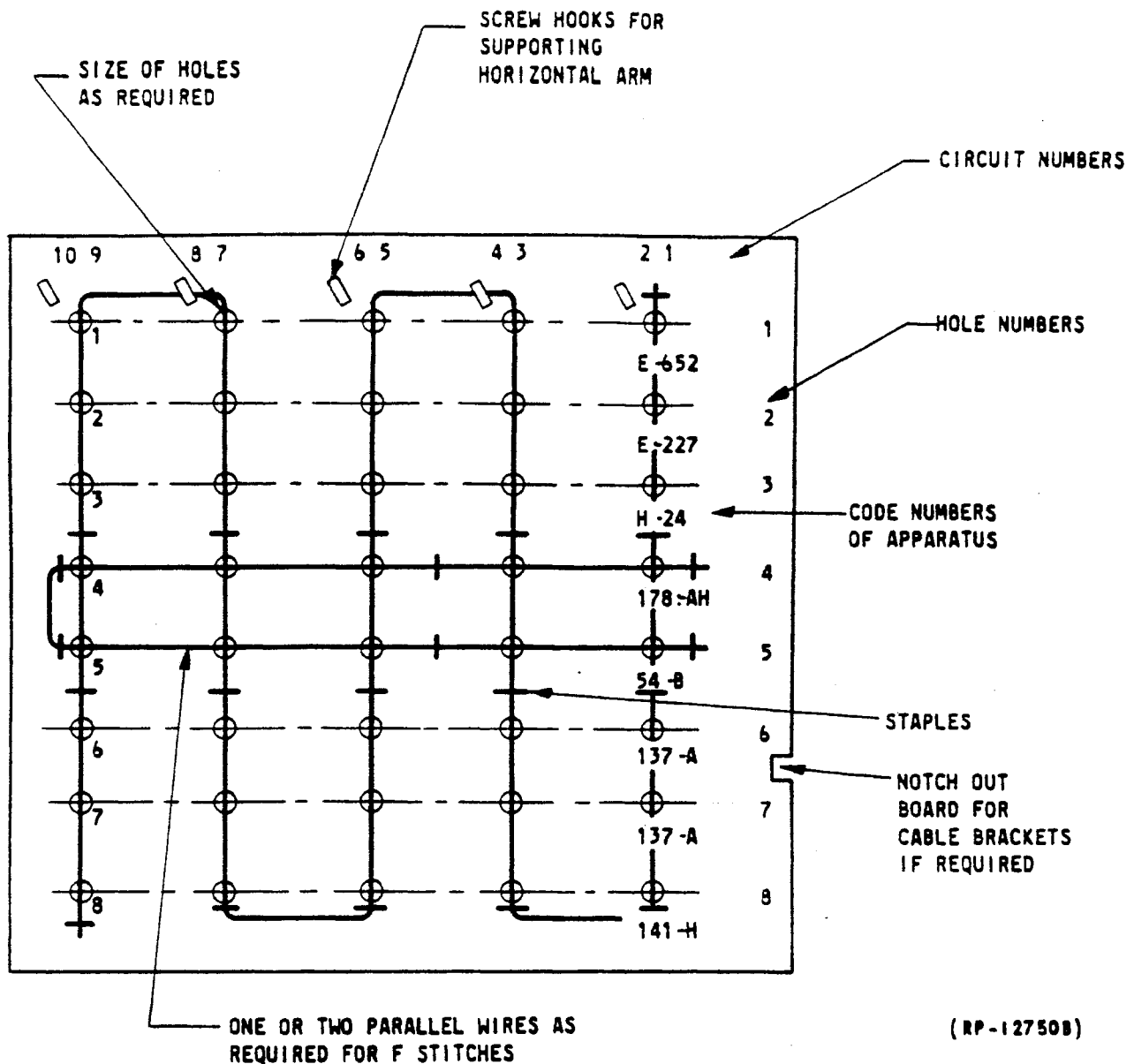


FIG. 2 TYPICAL FORM BOARD FOR RELAY RACK
(PARS. 3.65, 3.66)

3.62 Obtain a board of the proper size and lay out all holes, notches and slots that will be required. If a drawing or sketch of the required form is available, attach it to the face of the form board. In this case the drawing or sketch should locate holes, nails, etc. Arrange to reinforce large form boards when necessary with narrow strips, nailed to the back of the board, where nails or screw hooks are to be installed.

3.63 Consider how the form board will be supported. C clamps are usually suitable but in the case of very large form boards other means of support are generally necessary.

3.631 At or near live equipment take extra precautions when supporting form boards so that the support does not come in contact with the apparatus terminals. Where practicable, approved twine or nylon ties can be

SEWED FORMS
SUPERIMPOSING, SECURING, PROTECTING AND SUPPORTING

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1. GENERAL

1.1 Scope of Section

1.1.1 This section covers requirements and methods for superimposing, securing, protecting and supporting sewed cable forms, loose wire forms and supplementary local cable forms.

1.1.2 The requirements covered in this section shall be followed, except as modified, by job specifications and/or drawings.

1.1.3 Each figure in this section illustrates only conditions to which reference is made in the text and should not be considered as covering other conditions that may be shown.

1.2 Precautions

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

2. INSTALLING EQUIPMENT

2.1 Tools

- R-1682 5" Electricians Scissors
- R-3209 Insulated Sewing Needle
- R-4266 Cable Tie Fastening Tool
- R-4827 Cable Tie Fastening Tool
(Variable Setting)

This section includes material from BSP's 800-612-153, 800-612-156 and 800-612-157 Copyright 1977, 1980 and 1979, Respectively, by American Telephone and Telegraph.

2.2 Supplies

- R-2916 Twine
- R-3359 1/2" Wide Gray PVC Tape
- R-3428 3/4" Wide Gray PVC Tape
- R-4065 Adjustable Nylon Cable Form Clamp
- R-4265 1 1/4" (Max.) Nylon Cable Tie
 - L-1
- R-4265 2" (Max.) Nylon Cable Tie
 - L-2
- R-4265 3" (Max.) Nylon Cable Tie
 - L-3
- R-4265 4" (Max.) Nylon Cable Tie
 - L-4
- R-4458 PVC Insulated Strip
- KS-7851 Fiber Glass Sleeving
 - L-3
- RM-583101 1/64" Gray Sheet Fiber
- RM-591127 3/4" Wide Gray Friction Tape
- RM-552458 1/2" X 32" Lg. PVC Tubing
- RM-552417 3/4" X 33" Lg. PVC Tubing
- RM-552448 1" X 36" Lg. PVC Tubing
- RM-587082 1 1/4 X 23" Lg. PVC Tubing
- RM-552452 1 1/2" X 29" Lg. PVC Tubing

3. REQUIREMENTS AND METHODS

3.1 General

3.1.1 Shop made forms should be left in the shipping boxes as long as possible to eliminate potential form damage. When ready to position on the frame, straighten out all unnecessary kinks and bends in the form so it can be placed, secured and connected with a minimal amount of effort.

NOTICE - NOT FOR USE OR DISCLOSURE OUTSIDE THE BELL
SYSTEM EXCEPT UNDER WRITTEN AGREEMENT

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3.12 Shop formed cables, as opposed to installer made local cables, are furnished with skinner lead lengths 1-2" longer than what would be considered as normal. This additional lead length allows for some flexibility in placing the supplemental form on the existing frame form.

3.13 Shop made or installer made local cable forms that are added to an existing frame form, shall be superimposed by sewing or banding with approved twine or banded with nylon cable ties.

3.14 Where forms pass through metalwork, casings, or other within confined areas of a keyshelf, the added wires should be distributed evenly around the existing form to eliminate possible insulation damage.

3.15 When cable forms are superimposed on existing cable forms they shall not:

A. Cover up any of the various types of "C" wiring in the form, or "C" wiring previously superimposed on the form.

B. Cover up or make inaccessible any wiring associated with unused circuits, circuit features or options, or feature wiring sewed back on the form.

C. Cover up any existing fire detection wire (RED), or any of the AM or BH loop return wires. It may however, cross these leads at right angles.

D. Come within 2" of open wire (not enclosed in armor or in conduit) carrying service current (AC service).

E. Interfere with apparatus which may require repair, adjustment, replacement or cleaning.

F. Interfere with movable parts, or removable equipment, such as keyshelf braces, etc.

3.2 Placing Forms

3.21 Place the superimposed form on the side, bottom, or in front of the existing wiring (viewed from wiring side). Ordinarily place the superimposed form to the right side or in front of the existing vertical form, or in front or below of the existing horizontal form. This placement will facilitate utilization of shop made forms with long skinner lead lengths (see Figure 1).

3.22 If the optional placement of this superimposed form, as shown in Figure 1, does not absorb the long skinner lead lengths furnished in shop formed cables, the leads should be reskinned as required to provide proper dress of the skinner leads.

3.3 Superimposing Forms

3.31 Supplementary formed local cables shall be superimposed on the existing form by either sewing with twine, banding with twine or banding with nylon ties.

3.311 When superimposing loose wire, or one form on another form, a single strand of twine shall be used when the combined diameter of the (2) forms totals 3" or less. A double strand of twine shall be used when the combined diameter is greater than 3".

3.312 Stitches used for superimposing one form on another shall be placed 4" apart. These stitches should be placed approximately midway between the stitches of the superimposed form which should have stitches spaced at 4" intervals.

3.313 Additional stitches shall be placed at break-outs of branch arms, or skinner lead break-outs as required to prevent the superimposed form from pulling away from the main form (refer to Figure 2).

3.32 Where two or more closely adjacent parallel unsupported forms or arms serve the same or adjacent apparatus and presents an unworkmanship appearance, they should be banded together with twine or nylon ties at both ends and at intermediate points as necessary to make a compact neat appearing form.

3.33 When superimposing KS-21112 or KS-19689 types of coaxial cable(s) to other coaxial cables, local cable forms, or switchboard cable forms with bands of twine or nylon ties, the following procedures should be used.

A. Embed these cables in the middle of other cables not requiring special protection and band with either twine or nylon cable ties. These cables shall not make physical contact with either the twine or cable ties.

B. Where it is impossible to embed these cables inside other cables not requiring special protection, or at cable form breakouts, two layers of R-3428 PVC Tape or a layer of RM-583101 Gray Sheet Fiber, approximately one inch wide shall be applied around the form before securing with twine or cable ties.

C. Secure superimposed KS-21112 or KS-19689 Type Coaxial Cable(s) to sewed cable forms or to other cables with R-3428 or R-3359 PVC Tape applied with a minimum of one and a one-half turns. The spacing of these PVC Tape Bands shall not be spaced farther apart than five times the diameter of the largest cable in the form. Where tape is applied at bends, it shall completely cover the bend of the form.

D. Where cable forms that are normally considered as sewed forms are made up principally of rubber or neoprene insulated wire, or KS-21112 or KS-19689 Type Coaxial Cables, tape the form completely with R-3428 or R-3359 Gray PVC Tape instead of sewing with twine.

3.4 Securing Forms

3.41 Methods and Requirements

3.411 Secure sewed forms to cable brackets or other framework details with nylon ties or approved twine unless otherwise specified. Where forms or tubes are more than 3/8" in diameter, use two strands of twine. If forms are less than 3/8" in diameter, use a single strand of twine.

3.412 When securing the form in place with twine, use either the Chicago or Kansas City stitch. Where additional rigidity is required, the Chicago stitch shall be applied (refer to Figures 3, 4 and 5).

3.413 Nylon ties shall not be used on forms 1/2" or less in diameter for securing to cable brackets or other supports. Vertical wiring (whether loose wire, local cable or switchboard cable) shall not be secured to horizontal wiring, towel bars or other supports designed for supporting horizontal wiring. Refer to Section 205 of this handbook for the method of applying nylon ties.

3.414 When securing cable forms made up principally of rubber or neoprene insulated wire or KS-21112 or KS-19689 Type Coaxial Cables to cable brackets, towel bars, or other parts of the framework, protect the form with a layer of RM-583101 1/64" Gray Sheet Fiber wrapped around the cables prior to securing to the cable bracket, etc. When securing a cable form that has only a few KS-21112 or KS-19689 Coaxial Cables that cannot be embedded into the cable form, wrap the cable form with at least two layers of fiber sheeting, or slit a section of semi-rigid tubing and place around the form before securing to framework. Be careful not to crush or distort these cables and do not use cable ties for securing.

3.42 Specific Applications

3.421 Where a vertical cable form is being secured to a vertical bar, and the weight of the form is such that it may slip and sag, it shall be wrapped tightly with five or six turns of plastic tape around the bar and form immediately below the uppermost tie. Tape shall not be used if the bar is notched to engage and hold the twine.

3.422 Secure cable forms run on woodwork with the R-4065 Adjustable Nylon Clamp. Secure the clamp with screw and washer as shown in Figure 6.

3.4221 To apply the R-4065 Adjustable Nylon Clamp, wrap the clamp around the form, lock it in place and cut off the excess material before securing it to the woodwork. Make certain the clamp is in the desired position before tightening because this type clamp cannot be released after being locked in place.

3.4222 Space the clamps at approximately 20" intervals. Extra clamps shall be used at bends, breakout points or where extra support is required. Generally, a strap clamp can be used at each point of support with the mounting holes of alternate clamps being placed on opposite sides of the form. Where additional support is required, place two clamps adjacent to each other with the mounting holes placed on opposite sides of the form.

3.4231 Fasten keyshelf local cable forms, including any supplementary forms, securely to the keyshelf bracket with a strap clamp, or nylon tie as shown in Figure 3.

3.4231 Before tightening the strap or clamp, locate the fiber protection so that it will extend an equal amount on each side of the bracket and strap or clamp, as judged visually. The ends of the fiber detail should overlap. If P-160084 or P-44C680 Fiber Details are not available, similar details may be cut from 1/64" Sheet Fiber (RM-583101). Cut the details approximately 1/4" longer than the circumference of the form and approximately 1/4" wider than the width of the bracket and strap or clamp where the form rests. When nylon cable ties are used to secure the cable, the fiber shall not be used. Instead, apply two layers of tape around the form to protect the cable from damage by the bracket and nylon tie.

3.4232 Where keyshelf brackets are furnished for local cables less than 3/4" in diameter, the form shall be built up sufficiently with wrappings of strip fiber or friction tape so that they can be securely fastened to the bracket by the strap, clamp, or nylon tie. Forms built up in this manner will not require the fiber protection as specified for the regular forms.

3.4233 Where the keyshelf bracket is located on the same side of the keyshelf as the keyshelf brace, the end of the strap clamp or the locking head on the nylon tie should not protrude so as to result in a hazard when closing the keyshelf.

3.5 Form Protection

3.51 General - Irradiated PVC (IPVC) Insulated Wire (such as type-DP), PVC Insulated Wires (such as BW and BY), Lacquered Cotton or Cotton Braided PVC Insulated Wires (such as BW or BH), Polyethylene (PE) Insulated Wires (such as type 4F and

4F10) Solid pairs in 750 and 760 Type Cables), and Teflon (FPE) Insulated Wires (such as those in KS-19195 and KS-19124 Cables) shall be protected against contact with metalwork when secured to cable brackets, wiring supports, or other framework parts not provided with an approved finish of gray insulating baked enamel (see Table A for conditions and type of protection).

3.52 All wires, whether formed or loose, shall be protected where there is a possibility of them coming in contact with sharp edges on cable brackets, wiring supports, or other parts of the equipment framework, regardless of the type of wire insulation.

3.521 All wires, regardless of the type of insulation, shall be protected at locations where there is a possibility of them being abraded by movable parts of the equipment.

3.522 In bending wire or cable forms around edges of cable brackets, wiring supports, or other part of the equipment framework, the wiring shall, where practicable, be dressed away from edges or corners that might cause damage to the wire insulation. Where this is not practicable, protection shall be provided. In no case shall wiring be dressed flat across edges or corners of metalwork, or protective strips, or other materials used to protect the wiring from metalwork.

3.53 Coaxial cables having foam type dielectric (such as the KS-21112 Type Cables) or a semi-solid type dielectric (such as the KS-19689 Type Cables) are easily deformed (crushed or distorted) when secured to other cables, cable brackets, towel bars, etc., with twine or nylon cable ties, and shall be handled according to Paragraph 3.33.

3.531 Do not kink or bend these cables beyond their normal bending radius. The bending radius for the KS-19689 Cable is 1" and for the KS-21112 Cable it is 1/2".

3.54 PVC Insulated Wires having an outer covering of lacquered cotton (PVC-CL), such as type BW or irradiated, PVC (IPVC) Insulated Wires, such as type DP, which are generally designated as SW1, D2, D3, D4, or D5 on applicable wiring drawings do not require protection except as specified in Paragraphs 3.52, 3.521, 3.522 and 3.57.

3.55 Rubber or neoprene Insulated Wire (such as KS-15141, KS-15143 or KS-20195) and similar types of flexible wire shall be protected against contact with both the metalwork, twine, clamps, or clips used to secure such wiring to cable brackets, towel bars, wiring supports, or other parts of the framework, whether or not a protective finish is provided. (Do not use nylon ties.)

3.56 PVC Insulated Conductors of KS-13385 Wire do not require protection when sewn or banded together. However, where such wire is to be secured to cable brackets or other framework parts, it shall be protected from contact with the metalwork and twine with sheet fiber.

3.57 Where forms pass through thin metal openings, the breaking of the hole edges or notches is not adequate and protection is required. If fiber escutcheons are not provided, either the form or the metalwork, whichever is practicable, must be protected.

CAUTION: PLASTIC TAPE SHALL NOT BE APPLIED TO METALWORK HAVING NITROCELLULOSE LACQUERED FINISHES, SUCH AS THE 472 FINISH. THE FINISH WILL SOFTEN FROM THE ADHESIVE.

3.58 At units having fiber escutcheons, modify the escutcheon as required. If the combined size and shape of the original and superimposed local cable interferes with the reinstallation, remove the twine from the superimposed local cable in the area where it passes through the metal and spread the wires uniformly around the existing form. Apply protection as required.

3.59 Care shall be taken not to cover up the fusible fire detection loop wire with protective materials.

3.6 Keyshelf Protection

3.61 Keyshelf cables in switchboards and desks, having keyshelf aprons with cable boots over the cable hole, shall be protected by sheet fiber extending from a point approximately 1" back of the clamps which fasten the cable to the framework, to a point not less than 4" beyond the first bend inside the apron.

3.62 When keyshelf aprons have fiber escutcheons, the cables shall be protected by fiber extending from a point not less than 1/2" beyond the rear edge of the cord shelf, to a point not less than 4" beyond the first bend inside the apron for cables entering from the bottom, and to a point not less than 1" beyond the first bend inside the apron where the cables enter at the top.

3.63 At test boards, such as the 17B and 18B Toll Test boards that have keyshelf panels with fiber escutcheons, the keyshelf cable shall be protected by fiber extending not less than 1" on each side of the cable opening in the panel.

3.64 Where straps or clamps are used to secure keyshelf local cables, the P-160064 or P-44C680 Fiber shall be placed under the strap or clamp to protect the form from damage. If nylon cable ties are used to secure the form, two layers of tape shall be placed under the nylon tie to protect the form from damage.

3.65 Keyshelf cables in switchboards and desks not equipped with aprons shall be protected by fiber where they are likely to be damaged by cord weights or other moving parts. The fiber shall be covered with a single layer of tape (PVC or Friction) applied evenly with a half lap.

3.66 Added wiring which consists entirely of wire types not normally requiring protection from contact with metalwork, such as types AM and BH, additional protection is not required when it is placed on the existing form so as not to be subjected to damage by raising or lowering the keyshelf, except in the area where the wiring passes through the keyshelf apron.

3.7 Protection Methods

3.71 General - The materials generally used for protecting wiring include: Gray Friction Tape (RM-591127), Gray PVC Tape (R-3428 and R-3359) Gray Sheet Fiber (RM-583101), Non-Rigid Tubing (RM-552458, RM-55417, RM-552448, RM-587082, RM-552452), Fiber Glass - PVC Coated KS-7851L-3 Sleeving and P-44F895 Clear PVC Sleeving (see Table A). Except as otherwise specified, cable protection material shall extend at least 1/2" inch beyond each end of the wiring protection area.

CONDITIONS	TYPE OF WIRE INSULATION	TYPE OF PROTECTION	NOTES
A Form or Wire Secured To Brackets, Etc., With An Approved (483) Finish	All Except The Following	None	1
	PE, Rubber or Neoprene	Friction Tape	2, 4, 5, 6, 7
		Fiber	3, 5, 11, 13
B Form or Wire Secured To Brackets, Etc., Not Having An Approved (483) Finish	Any	Friction Tape	2, 4, 5, 6, 7
		Fiber	3, 5, 11, 13
		Tubing	5, 8, 14
C Possible Contact With A Sharp or Jagged Edge	Any	Friction Tape	2, 4, 5, 6, 7
		PVC Tape	1, 2, 5, 7, 8, 9, 10
		Fiber	1, 3, 11, 13
		Tubing	1, 5, 8, 14
		PVC Strip	1, 12
D Possible Damage From Moving Parts, Abrasion Or Chafing	Any	Fiber	1, 5, 11, 13
		Tubing	1, 5, 14
E Possible Damage To Keyshelf Form	Any	Fiber	1, 17, 19, 20
		Friction Tape	1, 4, 6, 7, 18
		PVC Tape	1, 9, 10, 18
F Possible Damage From Oil Dripping	Any	PVC Tape	2, 9, 10, 15
		Tubing	16
G Possible Damage From Heat Device	Any	Fiber	8, 11

TABLE A - FORM PROTECTION
(FARS. 3.51 and 3.71)

NOTES:

1. All wires whether formed or loose, shall be protected where there is a possibility of them coming in contact with sharp edges of cable brackets, wiring supports, or other parts of the equipment framework.
2. Plastic adhesive backed tape shall not be used to protect PVC, rubber, or neoprene insulated wire subjected to pressure from twine, nylon cable ties or metalwork.
3. Where rubber or neoprene insulated wires, or other types of flexible wire is secured to brackets, towel bars, supports, etc., they shall be protected with a strip of fiber placed around the cables and centered under the twine band or stitch.
4. Wind friction tape tightly and evenly with at least a half-lap and the last two turns applied at right angles to hold the end secure.
5. Extend the protection a minimum of 1/2" beyond each side of the point requiring protection.
6. Apply a coat of shellac over the friction tape, thin with solvent as required.

7. Friction tape shall be used in place of plastic tape where pressure is exerted against the form. A constant pressure applied against the plastic tape will create an undesirable "Cold Flow" condition.
8. Plastic tape or PVC tubing shall not be used for protection in areas where a soldering iron or other heat producing devices might come in contact with the tape.
9. Plastic tape shall not be applied to metalwork having nitrocellulose lacquer finish.
10. Wind plastic tape tightly and evenly with at least a 3/16" lap and the last two turns applied at right angles, without tension, to hold the end secure.
11. Where the use of tape or PVC Tubing is impracticable, use 1/64" sheet fiber cut to fit the condition. The fiber may be secured to the framework, or where conditions permit, shaped into a sleeve and banded with twine or nylon cable ties to the form. Stitches shall be spaced a maximum of 4" apart.
12. The R-4458 PVC Insulated Strips can be applied (friction fit) to the flange edge of the unequal duct type bay or other similar applications thereby eliminating the form taping operations.
13. Cut 1/64" sheet fiber to fit the surface of the bracket or support to which the form may be in contact. Where possible, use the P-68616 Fiber Detail for this purpose. Tie the fiber to the bracket or support with twine or nylon ties to hold the protection in position.
14. Where a straight portion of a form requires protection, a proper length of PVC Tubing may be split lengthwise and wrapped around the form (1/2" minimum lateral overlap) and secured in place with nylon cable ties or two strands of twine spaced at 4" maximum intervals.
15. Overlap the edges of the tape and locate them on the side of the form opposite the source of the oil dripping.
16. PVC Tubing may be substituted for tape when used to protect against oil drippings or when wiring or long lengths of local cables require protection from metalwork with unapproved finish.
17. Cut 1/64" sheet fiber to extend from a point 1" back of the rear support clamp (or cord shelf) to a point at least 4" beyond the first bend inside the apron. Where aprons are not provided, extend the fiber along the straight portion of the form to a point near where the form is secured to the bracket. Make up a detail for the bend inside the apron as shown in Figure 2. Cut sheet fiber as required to wrap around the straight portion of the form in the shape of a sleeve, place the fiber details around the form with the edges and the ends overlapping 1/2" and temporarily hold the details in place with bands of tape or twine.
18. Start the taping at a point 1" back of the end of the fiber outside the apron. Continue taping over the fiber details and extend it to a point 1/2" beyond the bracket inside the keyshelf. Tape the form at all other locations where it is attached to, or may come in contact with metalwork.
19. When cable boots are not provided and fiber escutcheons are to be used on the keyshelf apron, fit the escutcheon around the form so as to leave sufficient clearance between one side of the escutcheon and the form to avoid undue strain on the form when the keyshelf is opened. In general, do not allow clearances greater than 3/8" when the keyshelf is closed. Provide a clearance of 1/8" between the top of the form and the escutcheon.
20. Drill and file the escutcheon as required so they fit close but not too tight around the form. Remove all sharp corners and edges.

3.72 Taping - Gray Friction Tape (RM-591127) or Gray Plastic Adhesive Tape (R-3428, R-3359) should be used to protect cable forms, except where there is a tendency to chafe, or a possibility of damage from moving parts. The plastic tape is satisfactory protection against oil drippings, however, it should not be used in locations where a hot soldering iron or other heat producing devices might come in contact with the tape. Plastic tape should not be used where it might be subjected to constant pressure, such as on wiring secured to framework.

3.721 Friction Tape should be applied to a cable form by winding it tightly and evenly around the form or wires with an overlap of at least half the width of the tape. The last two turns shall be applied at right angles to the form so the end will adhere to the taped portion of the form. After taping, apply one coat of R-3455 Shellac to the form. If the shellac is too thick and heavy, thin as necessary with R-4343 Shellac Solvent.

3.722 PVC Tape (R-3359 or R-3428) should be kept as clean as possible during application to assure a good adhesion and prevent unraveling (flagging). Due to the tendency of the PVC Tape to recede, the last two turns shall be applied at a right angle to the form and shall be applied without tension. Do Not apply shellac to the PVC Tape.

3.723 PVC Tape shall be applied to a cable form in the same manner as described in Paragraph 3.721.

3.73 Tubing - Semi-rigid PVC Tubing may be used for protection of small cable forms or loose wiring leads where taping is impracticable because of the long length of wiring requiring protection. PVC Tubing should not be used in locations where soldering irons or other heat producing devices might come in contact with the tubing.

3.731 Semi-rigid PVC Tubing may also be used to protect long lengths of local cables which are fastened to metal framework with an unapproved finish or where there is danger of contacting sharp edges. The appropriate diameter tubing may be slit lengthwise and applied around the form and secured in place. A minimum 1/2" lateral overlap of the tubing is required.

3.74 Gray Sheet Fiber - 1/64" (RM-583101) may be substituted for tape or tubing where cable forms or wiring requires protection. However, sheet fiber shall not be used for protection against oil drippings.

3.741 When cable forms are to be secured to brackets, towel bars, etc., not having an approved protective finish, or where cable forms require protection from the twine or nylon cable ties used to secure the forms to the brackets, etc., sheet fiber strips should be cut and wrapped around the form prior to the securing operation.

3.75 PVC Protection Strip - R-4458 PVC Strips should be applied to the edges of framework, such as those found on unequal duct type bays, where the danger of sharp edges could damage the cable forms. These PVC Strips are friction fit onto the framework and are furnished in 42" lengths, however, they can be cut to fit individual conditions requiring protection. Because these strips are "friction fit" type, lengths under 5" are not recommended unless they are secured in place (see Figure 8).

3.76 Fiber Escutcheons are used to protect stationary cable forms passing through metalwork (such as cable forms on toll repeater panels and sender casings) and shall be cut out and fitted closely around the forms to ensure proper separation between the form and the metalwork. Where the cable form passes through the escutcheon, the form shall be taped to prevent scuffing by the sharp edges of the fiber.

3.77 Sleeving - The KS-7851 L3, PVC Coated-Fiber glass Sleeving, should be used as a means of protection where there is a possibility of damage from heat producing devices. However, this sleeving is only furnished in very small diameters to accommodate a few leads in a loose wire form or individual component axial leads.

3.771 Clear PVC Sleeves are being furnished by some manufacturing locations to protect the bare unconnected wire ends of local cable forms. These P-44F895 Sleeves are BTL approved under the ASTM-D922 Specification and therefore can be used in a similar manner as the KS-7851 L3, Sleeves.

3.8 Supporting Methods

3.81 General - Cable supports, cable brackets, towel bars, wooden cleats, or other supporting details, as illustrated in Figures 9, 10 and 11, shall be used except where their use is impracticable.

3.811 Where it is impracticable to secure the cable forms to supports, brackets, etc., or to the metal framework, they shall be securely tied to adjacent forms or cables which are fastened to the supports, brackets, etc., with approved twine or nylon cable ties.

3.812 Where cable forms are to be fastened to "L" and "U" Type Cable Brackets, or similar type brackets, the forms shall be secured with nylon cable ties or approved sewing twine.

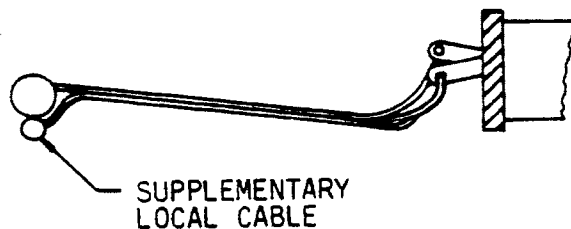
3.813 Cable forms shall be supported at approximately 20" intervals.

3.814 Where leads at unequipped positions (other than at the tip of the form) require additional support to hold the form in proper position, place a split PVC Tube over the form and secure to support Detail P-423307.

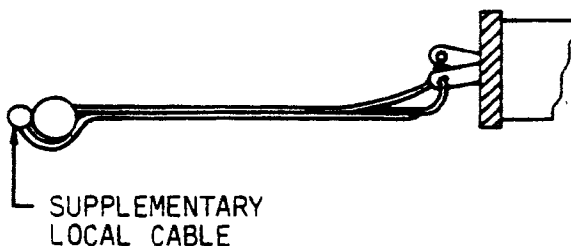
3.82 Specific Applications - Support partially equipped fuse and lamp panel forms that are not selfsupporting, per Figure 12. One support placed midway between the butt and tip of the form will generally be sufficient. An additional support shall be provided where the tip of the form is not equipped.

3.821 Where it is necessary to support a form serving a single row fuse panel of 60 fuse capacity or a lamp panel form at the center of the form, using a P-423307 Support, place a split PVC Tube over the form at the center of the form and tie to the P-423307 Support.

3.822 Use brackets, as shown in Figure 13 to support cable forms for relays, resistances and similar apparatus on strip type mounting plates, where the distance between equipped apparatus positions or between the equipped apparatus and the butt of the form exceeds 15".



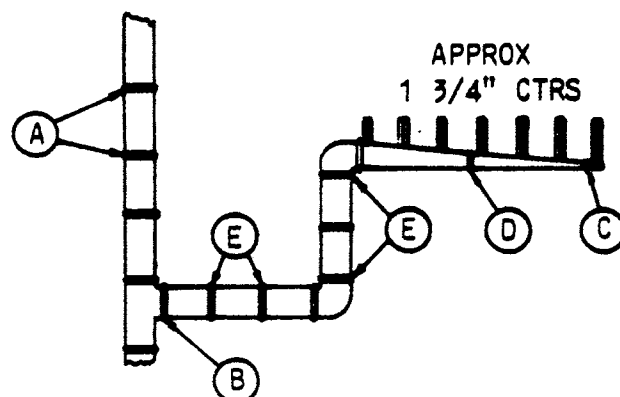
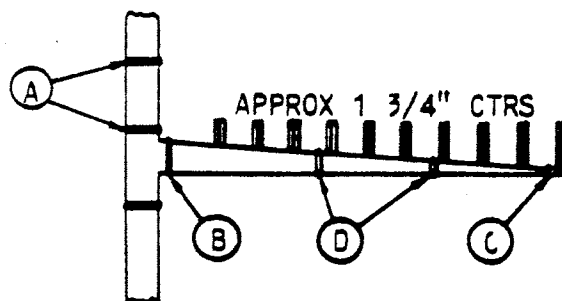
NOTE: PLACED TO RIGHT SIDE (VERTICAL FORM)
OR BOTTOM SIDE (HORIZONTAL FORM)



NOTE: PLACED ON FRONT SIDE OF EITHER
HORIZONTAL OR VERTICAL FORMS

RP-0073

FIG. 1 OPTIONAL PLACEMENT OF SHOP FORMED SUPPLEMENTARY
LOCAL CABLES (PARS. 3.21, 3.22)



- A MAIN LEG BANDED AT 8" INTERVALS AND AT BRANCH ARMS.
- B PLACE BAND AT START OF BRANCH ARM.
- C PLACE BAND AT TAIL END OF BRANCH ARM.
- D WHERE MAIN FORM IS CONNECTED ON 1-3/4" OR LESS INTERVALS - PLACE BANDS AT 8" OR LESS INTERVALS.
- E WHERE FORM IS NOT CONTROLLED BY BRANCH ARM - PLACE BANDS AT 4" INTERVALS.

RP-0074

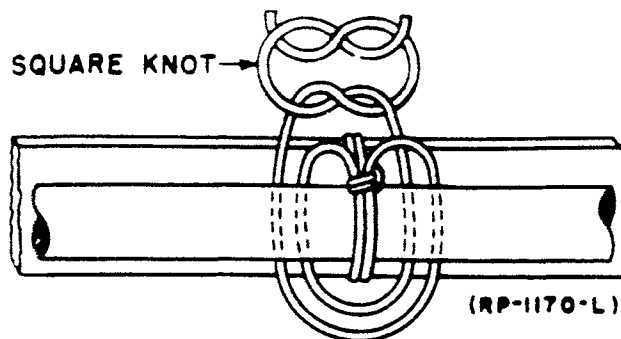


FIG. 3 SECURING FORM PARALLEL TO SUPPORT
WITH KANSAS CITY STITCH
(PAR. 3.412)

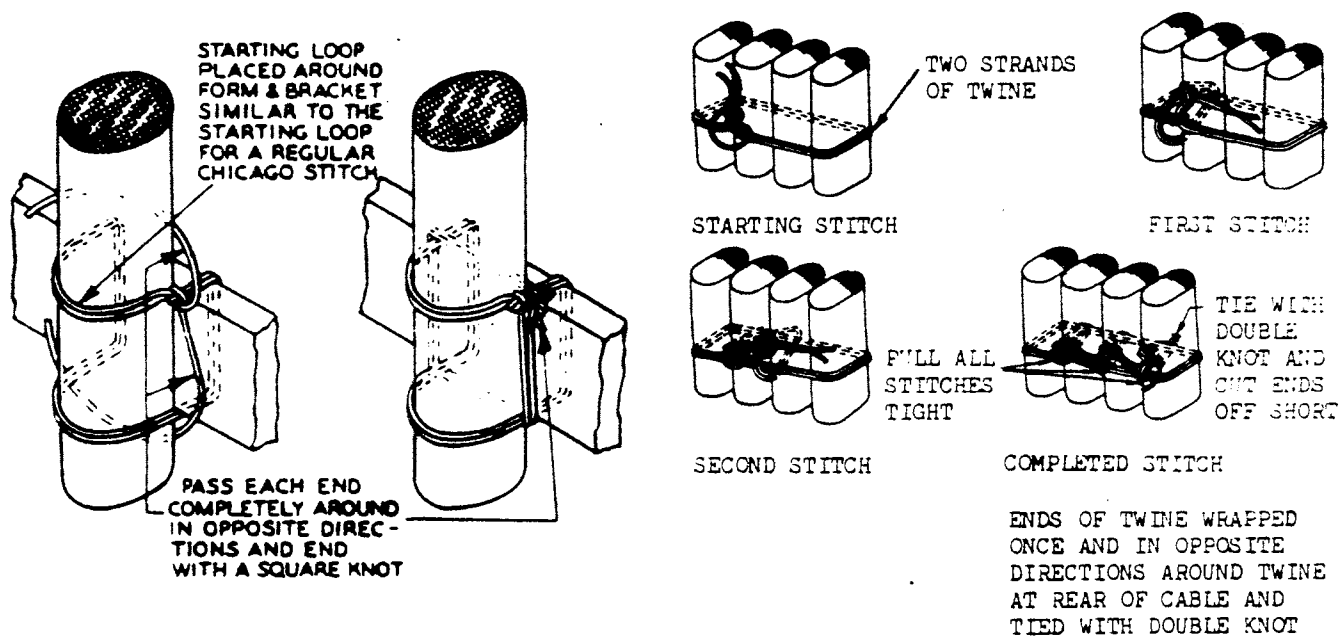


FIG. 4 SECURING FORM PERPENDICULAR TO
SUPPORT WITH CHICAGO STITCH
(PAR. 3.412)

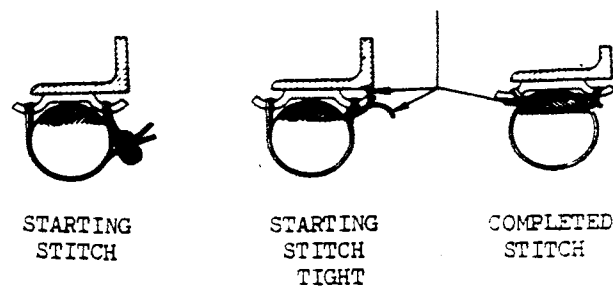


FIG. 5 SECURING BAY CABLE
(PAR. 3.412)

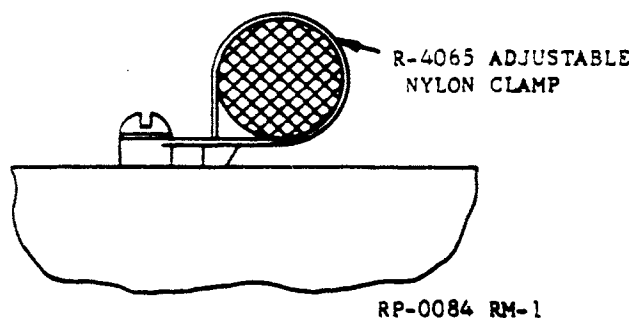


FIG. 6 SECURING SEWED FORMS ON WOODWORK
(PAR. 3.422)

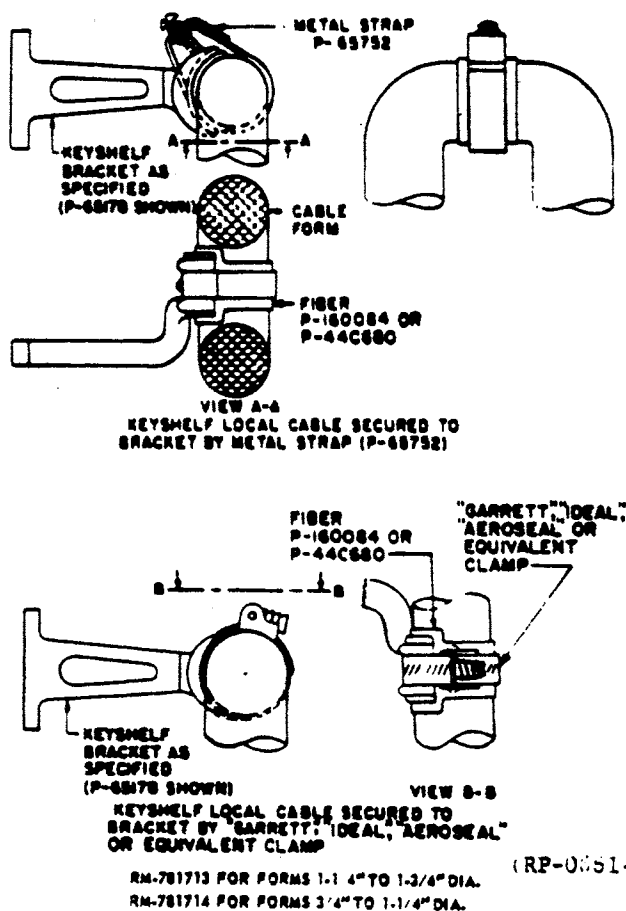


FIG. 7 FASTENING KEYSHEAF LOCAL CABLES TO BRACKETS
(PAR. 3.423)

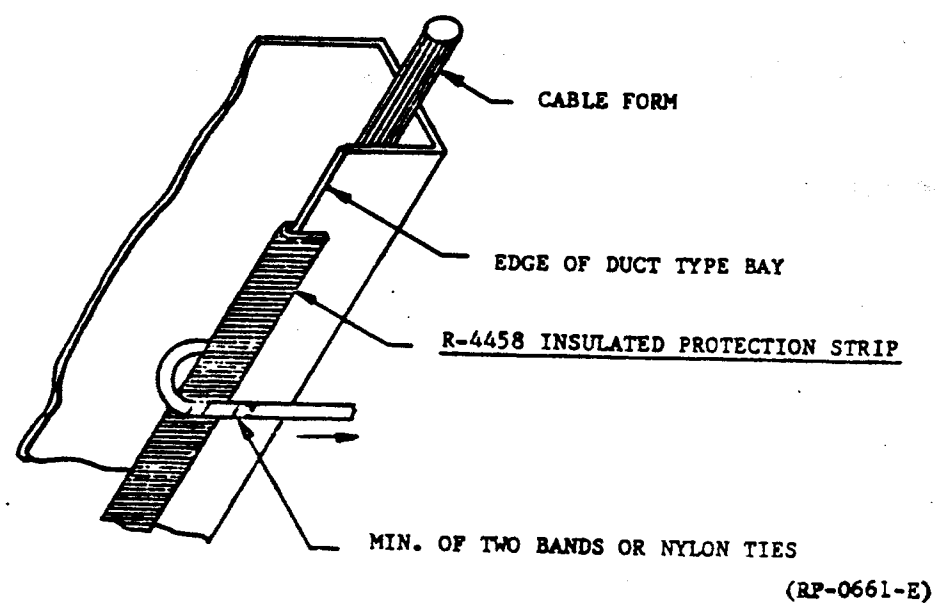
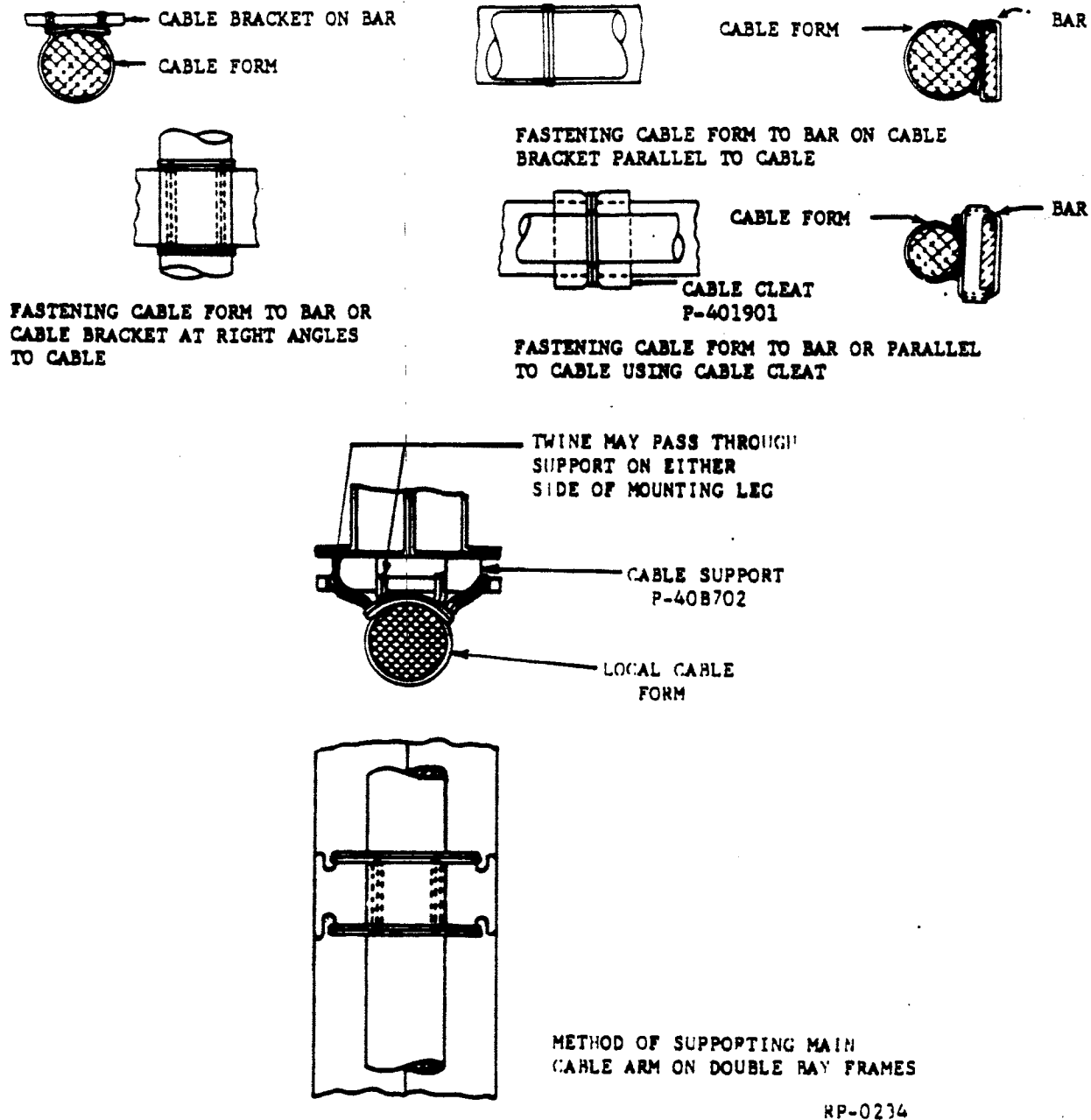


FIG. 8 R-4458 INSULATED PROTECTION STRIP
(PAR. 3.75)



HP-0234

FIG. 9 FASTENING CABLE FORMS TO CABLE BRACKETS OR BARS
(PAR. 3.81)

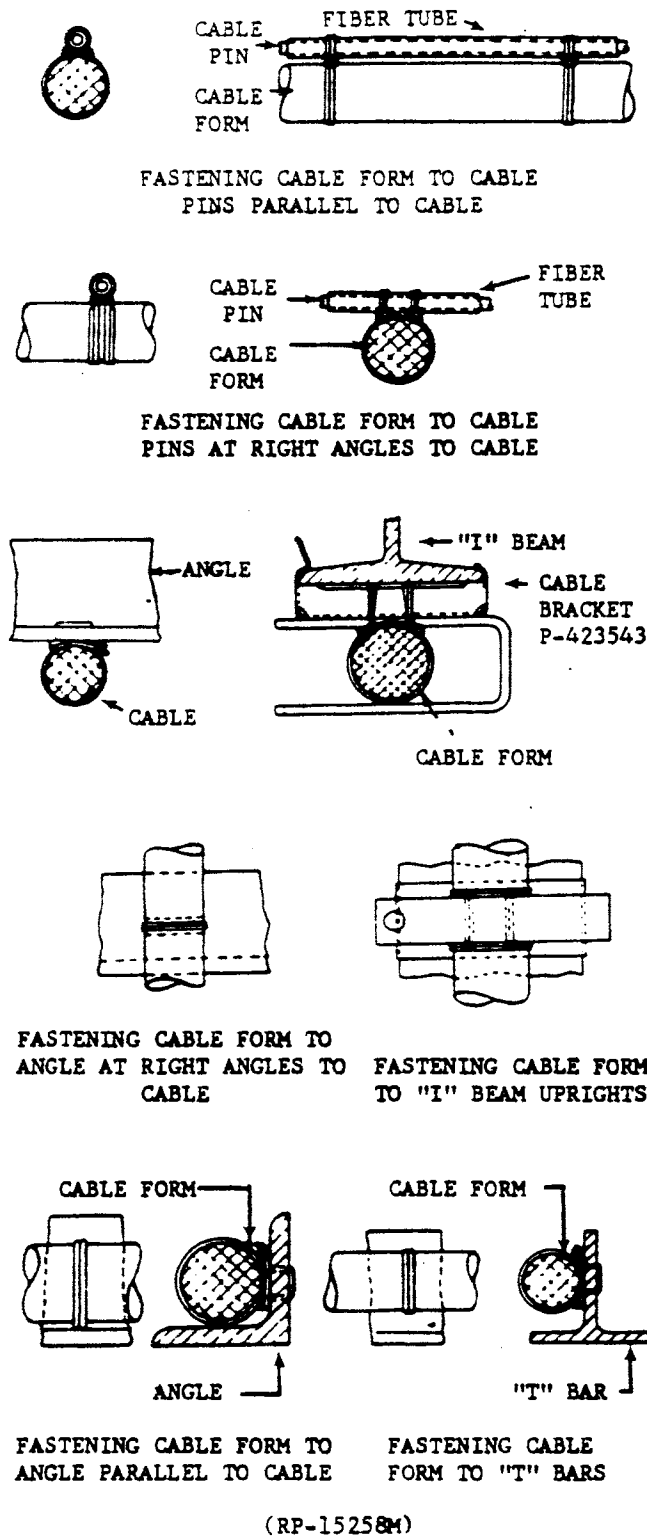


FIG. 10 FASTENING CABLE FORMS TO CABLE PINS
ANGLES, "T" BARS AND "I" BEAMS
(PAR. 3.81)

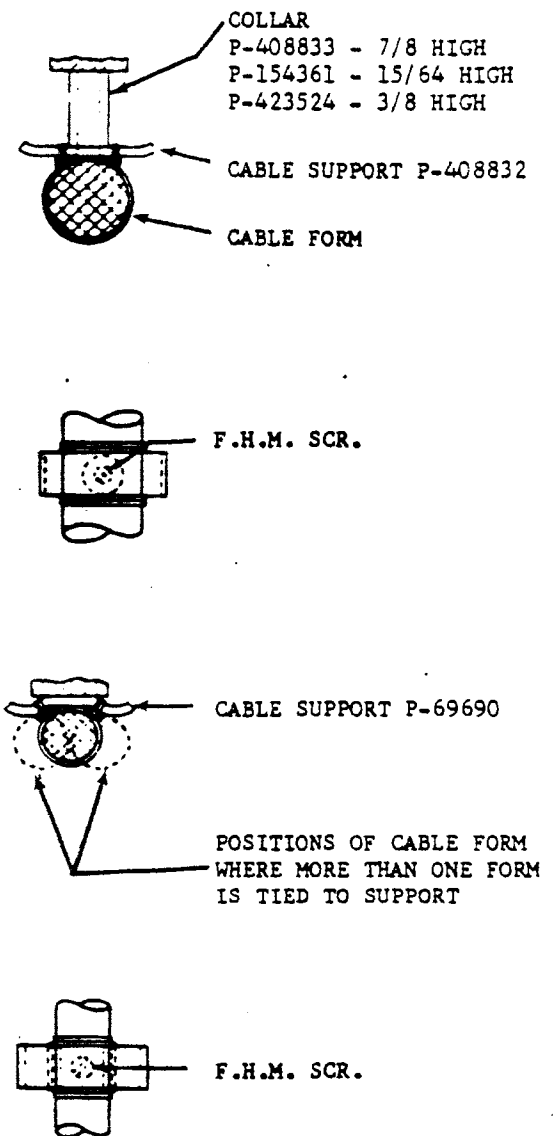


FIG. 11 FASTENING CABLE FORMS TO
CABLE SUPPORTS
(PAR. 3.81)

(RP-15260M)

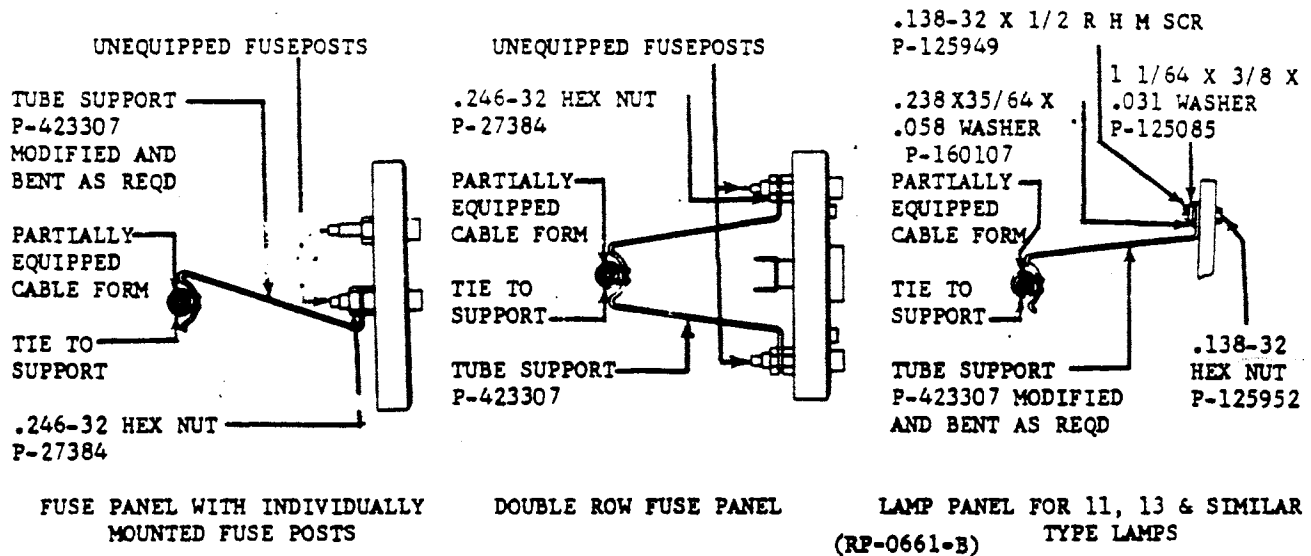


FIG. 12 SUPPORTING CABLE FORM AT PARTIALLY EQUIPPED FUSE AND LAMP PANELS
(PAR. 3.82)

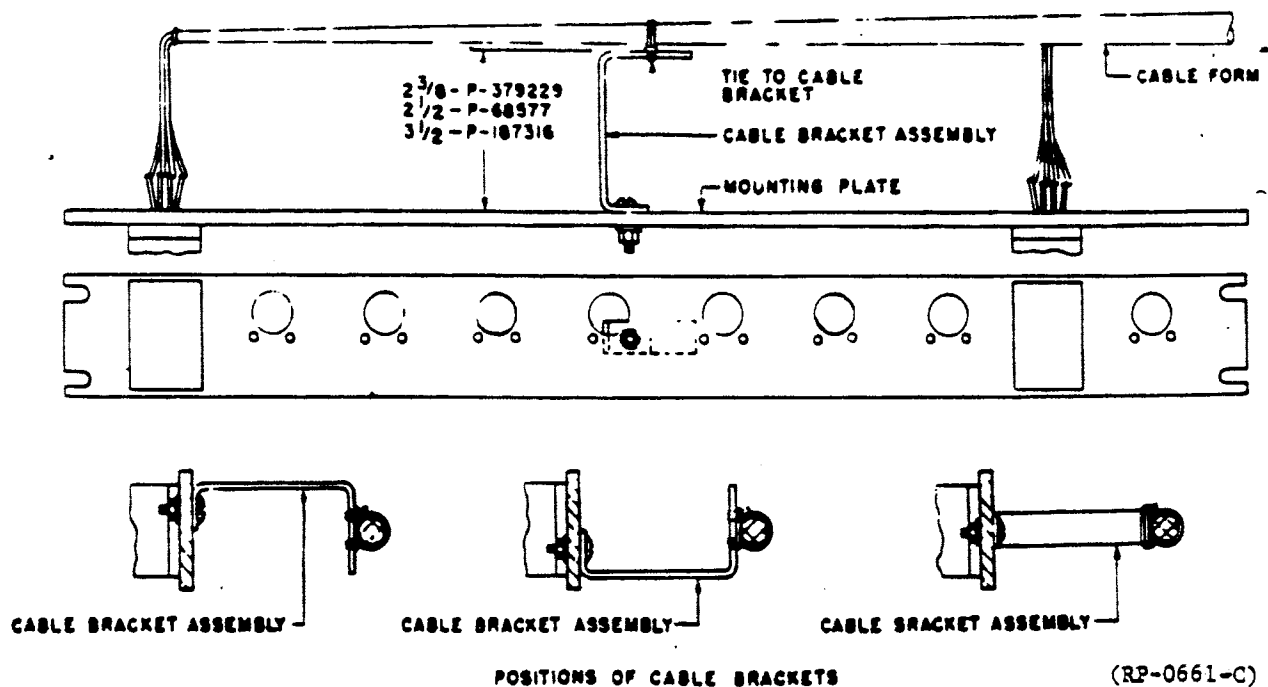


FIG. 13 SUPPORTING CABLE FORMS AT UNEQUIPPED APPARATUS POSITION
(PAR. 3.822)

4. VERIFICATION

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS		Reference	
		Par. No.	Fig. No.
4.01	Local cable forms superimposed by sewing or banding with twine or cable ties.	3.13 3.31	
4.02	Forms passing through metalwork, casing, etc. - spread leads around form to prevent insulation damage.	3.14	
4.03	When superimposing cable forms they shall not:		
	A. Cover up various types of "C" wiring.	3.15A	
	B. Cover up wiring for unused circuits, features or options.	3.15B	
	C. Cover up fire detection wire or loop return wires.	3.15C	
	D. Come within 2" of open service current.	3.15D	
	E. Interfere with repair, adjusting, cleaning or replacement of apparatus.	3.15E	
	F. Interfere with movable or removable equipment.	3.15F	
4.04	Reskin shop formed cable leads when skinner leads are too long for proper dressing.	3.22	1
4.05	Use (2) strands of twine when superimposing and combined diameter of forms is greater than 3".	3.311	
4.06	When superimposing - space stitches approximately 4" apart.	3.312	
4.07	Additional stitches required at branch arm and skinners.	3.313	2
4.08	At closely adjacent parallel unsupported forms - band them together for appearance.	3.32	
4.09	When superimposing KS-21112, KS-19689 to other coaxial cables, LC forms, or switchboard cable forms they shall:		
	A. Not make physical contact with twine or cable ties.	3.33A	
	B. Be embedded inside of other cables in form or protect with tape or fiber.	3.33B	
	C. Where impracticable to embed, band with 1-1/2 laps of tape.	3.33C	
	D. Be completely taped with PVC tape, when the form is principally made up of rubber, neoprene, or KS-21112 or KS-19689 Coaxial Cables.	3.33D	
4.10	Secure forms or tubes over 3/8" in diameter with (2) strands of twine to brackets, towel bars, etc.	3.411	
4.11	Do not secure forms 1/2" or less in diameter to brackets, etc.	3.413	
4.12	Rubber, neoprene, or KS-21112 and KS-19689 Coaxial Cables require protection when securing to brackets, etc.	3.414	
4.13	Vertical form secured to vertical bracket should utilize tape to prevent slipping.	3.421	
4.14	Forms run on woodwork should be secured with R-4065 Clamps spaced at 20" intervals.	3.4221 3.4222	6

4. VERIFICATION (Cont'd)

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS		Reference	
		Par. No.	Fig. No.
4.15	Use fiber protection with R-4065 Clamp.	3.4231	7
4.16	Forms under 3/4" diameter should be built up with fiber strips or tape to fit securely.	3.4232	
4.17	Types of wire, condition, and protection per Table A.	3.51	
4.18	Protect all wiring from sharp edges.	3.52	
4.19	Protect all wiring from abrasion.	3.521	
4.20	No wiring to be dressed taut across edges or corners of metalwork, protective strips, etc.	3.522	
4.21	Foam type dielectric coaxial cables require protection.	3.53	
4.22	Do not bend cables beyond normal bending radius.	3.531	
4.23	SW1, D2, D3, D4 or D5 does not require protection except as specified in Paragraphs 3.52, 3.521, 3.522 and 3.57.	3.54	
4.24	Rubber, neoprene and similar flexible wire shall be protected from metalwork, twine, clamps or clips when secured to brackets, etc. (no nylon cable ties).	3.55	
4.25	KS-13385 Wire requires protection when secured to brackets or other framework parts.	3.56	
4.26	Forms passing through thin metal opening - protect.	3.57	
4.27	Protection material not to cover up fire detection wire.	3.59	
4.28	At keyshelf aprons with fiber escutcheons cables shall be protected with fiber.	3.62	
4.29	Keyshelf cables in switchboards and desks shall be protected by sheet fiber.	3.63	
4.30	Where straps or clamps are used to secure local cables, place fiber under strap or clamp. If nylon ties are used, protect with two layers of tape.	3.64	
4.31	Protect keyshelf cables from cord weights and other moving parts.	3.65	
4.32	Do not use PVC Tape to protect against moving parts where chafing is possible, or where subjected to pressures, or heat producing devices.	3.72	
4.33	Last two turns of friction tape applied at right angles - apply one coat of shellac.	3.721	
4.34	PVC Tape applied with an over-lap and last two turns applied without any tension. Do not shellac PVC Tape.	3.722	

4. VERIFICATION (Cont'd)

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS		Reference	
		Par. No.	Fig. No.
4.35	Do not PVC Tubing where heat producing devices could come in contact.	3.73	
4.36	PVC Tubing slip lengthwise has a minimum 1/2" lateral over-lap.	3.731	
4.37	Do not use sheet fiber to protect against oil dripping.	3.74	
4.38	Use sheet fiber strips to protect form from uninsulated metalwork and twine or nylon ties used for securing.	3.741	
4.39	When using R-4458 PVC Strips for protection, secure lengths under 5" long.	3.75	
4.40	Fiber escutcheons should be cut and fit around form to provide proper separation of form and metalwork.	3.76	
4.41	Use cable supports, brackets, etc., where practicable.	3.81	9, 10, 11
4.42	Where (Paragraph 3.81) is impracticable, secure to adjacent forms or cables that are secured.	3.811	
4.43	Where forms are to be fastened to "L, U", and similar brackets, use twine or nylon ties.	3.812	
4.44	Support cable forms at approximately 20" intervals.	3.813	
4.45	Where leads are not connected at unequipped positions (other than tip of form) and rigidity is required, a PVC should be secured to the detail.	3.814	
4.46	Partially equipped fuse and lamp panel forms supported midway between butt and tip. Additional support required at tip when unequipped.	3.82	
4.47	Use brackets to support forms serving relays, resistances, and similar strip mounted apparatus where distance between apparatus positions or butt of form exceeds 15".	3.822	13

No arrows due to extensive changes.

[Indicates requirement.

Engineering Planning Manager
(Installation)

SECURING CABLE AND WIRE

BASIC INFORMATION

CONTENTS

- | | | | |
|------|--|------|---|
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| 1.1 | Scope of Section | 5.1 | On Cable Racks |
| 1.2 | General Information Pertaining to Arrangement of Tools, Precautions, Verifications, Specs and Drawings and Figures | 5.2 | At Turns From Cable Racks |
| 2. | INSTALLING EQUIPMENT | 5.3 | Radii of Cable Bends |
| 2.11 | Tools | 6. | VERIFICATIONS |
| 2.12 | Supplies | 6.1 | Arrangement of Switchboard Cable and Wire on Racks |
| 3. | PRELIMINARY PLANNING FOR THE SECURING OF CABLES | 6.11 | Regular Runs |
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| 4.2 | Ladder-Type Cable Rack | | |
| 4.3 | Ladder-Type Cable Rack with Snap-On Brackets | | |

- | | | | |
|------|---|-----------|--|
| 1. | <u>GENERAL</u> | 2.11 | <u>Tools</u> |
| 1.1 | <u>Scope of Section</u> | R-2195 | Pliers, Side Cutting 8" (See Note 1) |
| 1.11 | This section covers the basic information concerning the securing of cable and wire to all types of cable racks. For detailed information, see other sections of this handbook. | R-2542 | Remover, Clip, Cable |
| 1.2 | <u>General Information Pertaining to Arrangement of Tools, Precautions, Verification, Specs and Drawings and Figures</u> | R-3208 | Screwdriver, Cabinet, 3" (See Note 2) |
| 1.21 | Refer to Section 1 of this handbook for information pertaining to these items. | R-2118 | Strap, Trunk |
| 2. | <u>INSTALLING EQUIPMENT</u> | R-6443 | Cutter, Diagonal |
| 2.1 | The tools and supplies generally used for operations covered in the 300 Series are as follows: | R-3209 | Needle, Insulated, Cable Sewing |
| | | R-2712 | Strap, Web. |
| | | NOTE 1: | For cutting excess from clips when disposing of projecting ends. |
| | | NOTE 2: | For mounting anchor clips. |
| | | 2.12 | <u>Supplies</u> |
| | | R-2916 | Twine |
| | | R-3359 | Tape, Gray Plastic Adhesive, 1/2" |
| | | R-3428 | Tape, Gray Plastic Adhesive, 3/4" |
| | | RM-583101 | Fiber Sheet, Gray, 1/64" |
| | | P-409474 | Protection Detail, Fiber Gray (See Note) |
| | | KS-5370 | Cable Clips |

This section includes material from BSP's 800-614-152 and 800-614-158
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NOTICE: NOT FOR USE OR DISCLOSURE OUTSIDE THE BELL
SYSTEM EXCEPT UNDER WRITTEN AGREEMENT

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A-1 Anchor Clips
 SA-S Start Clips
 SD-S Start Clips
 RA-S Regular Clips
 RB-S Regular Clips

NOTE: Gray fiber details P-409474 are furnished on equipment. If necessary, these details may be made of 1/64" gray fiber, RM-591862, or requisitioned from Installation Stock-keeping.

Purchase: Strap Iron for supporting cables,
 Locally 1/8" x 1" per Figure 8, Section 320.

Purchase: Carpenter's Aprons (See Note)
 Locally

NOTE: Aprons used to carry clips, clip remover, bolts, nuts and similar items.

3. PRELIMINARY PLANNING FOR THE SECURING OF CABLES

3.1 General

3.11 Plans for securing of cable must be made before cables are run so that anchor clips or cable retaining brackets may be assembled on the racks.

→ 3.2 Cable Clip (KS-5370)

3.21 Cable Clips per KS-5370 are to be obtained prior to the Installation start date.

→ 3.211 Cable Clips can be obtained from Installation Stockkeeping by forwarding an Installer's Requisition.

→ 3.22

The Installer will be responsible for ordering cable clips for existing office additions and new offices.

NOTE: The Installer is required to provide cable clips for securing vertical cable runs in systems designed to have unsecured cable runs (No. 5 Crossbar, etc.).

3.23

The Installer can obtain the required amount of cable clips in either of two ways:

- (a) Kit 86 contains enough clips to secure 120,000 feet of cable.
- (b) When the quantity of cable to be secured does not require a complete 86 Kit or exceeds 120,000 feet, the Installer can compute the approximate amount of cable clips needed by referring to Table A, B, C, and D.

TABLE A

Width Cable Rack	No. of A-1 Anchor Clips Required Per Stock Length of Cable Rack	
	Horizontal	Vertical
5	15	24
10	27	44
12	31	53
15	34	63
20	50	84
25	60	101
30	70	121

TABLE B

RA-S, RD-S CLIP		
NUMBER OF FEET	CLIPS FOR OLD CABLE RACK	CLIPS FOR NEW CABLE RACK
1 to 4,000	100	100
5,000	200	200
12,000	200	200
13,000	200	300
17,000	200	300
18,000	300	400
22,000	300	400
23,000	400	500
27,000	400	500
28,000	400	600
29,000	400	600
30,000	500	600
32,000	500	600
33,000	500	700
35,000	500	700
36,000	600	700
37,000	600	700
38,000	600	800
42,000	600	800
43,000	700	900
46,000	700	900
47,000	700	1,000
49,000	700	1,000
50,000	800	1,000

TABLE B (Cont'd)

RA-S, RB-S CLIP		
NUMBER OF FEET	CLIPS FOR OLD CABLE RACK	CLIPS FOR NEW CABLE RACK
52,000	800	1,000
53,000	800	1,100
57,000	800	1,100
58,000	900	1,200
62,000	900	1,200
63,000	1,000	1,300
67,000	1,000	1,300
68,000	1,000	1,400
69,000	1,000	1,400
70,000	1,100	1,400
72,000	1,100	1,400
73,000	1,100	1,500
74,000	1,100	1,500
75,000	1,200	1,500
76,000	1,200	1,600
77,000	1,200	1,600
82,000	1,200	1,600
83,000	1,300	1,700
87,000	1,300	1,700
88,000	1,300	1,800
92,000	1,300	1,800
93,000	1,500	1,900
95,000	1,500	2,000

TABLE C

SA-S CLIP		
NUMBER OF FEET	CLIPS FOR OLD CABLE RACK	CLIPS FOR NEW CABLE RACK
1 to 9,000	100	100
10,000	100	200
16,000	100	200
17,000	200	200
18,000	200	300
25,000	200	300
26,000	200	400
27,000	200	400
28,000	300	400
33,000	300	400
34,000	300	500
38,000	300	500
39,000	400	500
42,000	400	500
43,000	400	600
49,000	400	600
50,000	500	700
57,000	500	700
58,000	500	800
60,000	500	800
61,000	600	800
65,000	600	800
66,000	600	900
72,000	600	900
73,000	700	900
74,000	700	1,000
81,000	700	1,000
82,000	700	1,100
83,000	700	1,100
84,000	800	1,100
88,000	800	1,100
89,000	800	1,200
94,000	800	1,200
95,000	900	1,200
96,000	900	1,300

TABLE D

SB-S CLIP		
NUMBER OF FEET	CLIPS FOR OLD CABLE RACK	CLIPS FOR NEW CABLE RACK
1 to 14,000	100	100
15,000	100	200
19,000	100	200
20,000	200	200
24,000	200	200
25,000	200	300
34,000	200	300
35,000	200	400
39,000	200	400
40,000	300	400
44,000	300	400
45,000	300	500
54,000	300	500
55,000	300	600
57,000	300	600
58,000	400	600
64,000	400	600
65,000	400	700
74,000	400	700
75,000	500	800
84,000	500	800
85,000	500	900
89,000	500	900
90,000	600	900
94,000	600	900
95,000	600	1,000

4. SECURING CABLE AND WIRE

4.1 Bar-Type and Modified Ladder Type Cable Racks

4.11 The cable on Bar-Type, modified ladder type (P33B202), and wide cable rack (841210065), is unsecured and shall be placed in an orderly manner so there will be adequate capacity for all cables. The cables will lie reasonably flat and shall not be pulled to one side of the rack at turns or bends.

4.12 The wires run with unsecured cable shall be banded with two strands of twine approximately every 36 inches.

4.2 Ladder-Type Cable Rack

4.21 Cables are secured to ladder-type cable racks usually by clipping. See Section 310 for details covering clipping.

4.22 There are several conditions where cable is secured to ladder-type cable rack by sewing. See Section 320 in this handbook for details covering sewing.

4.3 Ladder-Type Cable Rack with Snap-On Cable Brackets

4.31 The high and low level transmission leads in carrier systems shall not be secured except to help the cable lay reasonably flat on the rack or at turn off points.

4.32 See Section 140 of this handbook covering detailed information concerning cable rack brackets.

4.33 A more detailed description of the various cable rack types can be found in Handbook 30.

5. CABLE ARRANGEMENTS

5.1 On Cable Racks

5.11 The arrangement of the cables on the cable racks will have been predetermined and the cable located in their proper relative position when run in.

5.12 Cables in regular runs are given a predetermined arrangement in the cross-sectional views on the job cabling plan drawings.

5.121 Place oval and flat cables on edge or flat depending on their position as indicated in the cross-sectional views on the cabling drawings. Oval cables will normally be placed on edge unless they terminate in switch-board or desks.

5.13 Cables in miscellaneous runs are not ordinarily given a predetermined arrangement on the job drawing. They are installed in complete layers across the width of the cable rack, except when other arrangements are indicated on the drawings.

5.14 On No. 5 Crossbar break off cables from the cross-aisle racks through both the cross-aisle and over-frame cable rack to the frame upright. Where the cross-aisle racks are continuous as shown in Section 13A, Handbook 30, it is not permissible to run cables on the over-frame racks under the cross-aisle racks as they would interfere with the cables breaking through the over-frame racks.

5.2 At Turns From Cable Racks

5.21 The turning of cables from the cable rack, either through or off the side, is determined when the cables are run, as covered in other sections of this handbook.

5.22 Cables are turned through the cable racks when, under certain specific conditions, the racks are directly over the frames. Figure 1 illustrates the method of arranging and grouping cables brought from the cable rack in this manner.

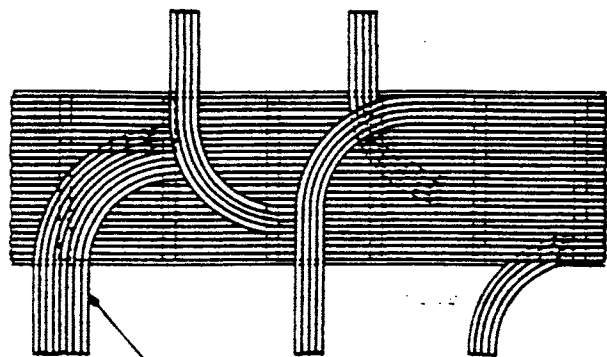
5.23 Cables turned off the side of the cable rack are to be arranged as follows:

5.231 Make square turnoffs as illustrated in Figures 2 and 3. Square turnoffs as illustrated, result in a good appearance with minimum effort.

5.232 Taper the cables across the cable rack, as shown in Figure 4, where cables can be arranged to break off the rack in a uniform manner from the near side of the rack. Tapering the cables across the cable rack at turn-offs results in a good appearance, economical use of cables and a minimum of blocking.



FIG. 1 CABLES TURNED THROUGH CABLE RACK
(PAR. 5.22)



CABLES TURNING OFF THE RACK
FROM ANY GIVEN LAYER SHOULD PASS
OVER THE CABLES OF THE SAME
LAYER RATHER THAN UNDER THEM.

RP-11096

FIG. 2 CABLES TURNED OVER SIDE OF CABLE
RACK
(PAR. 5.231)

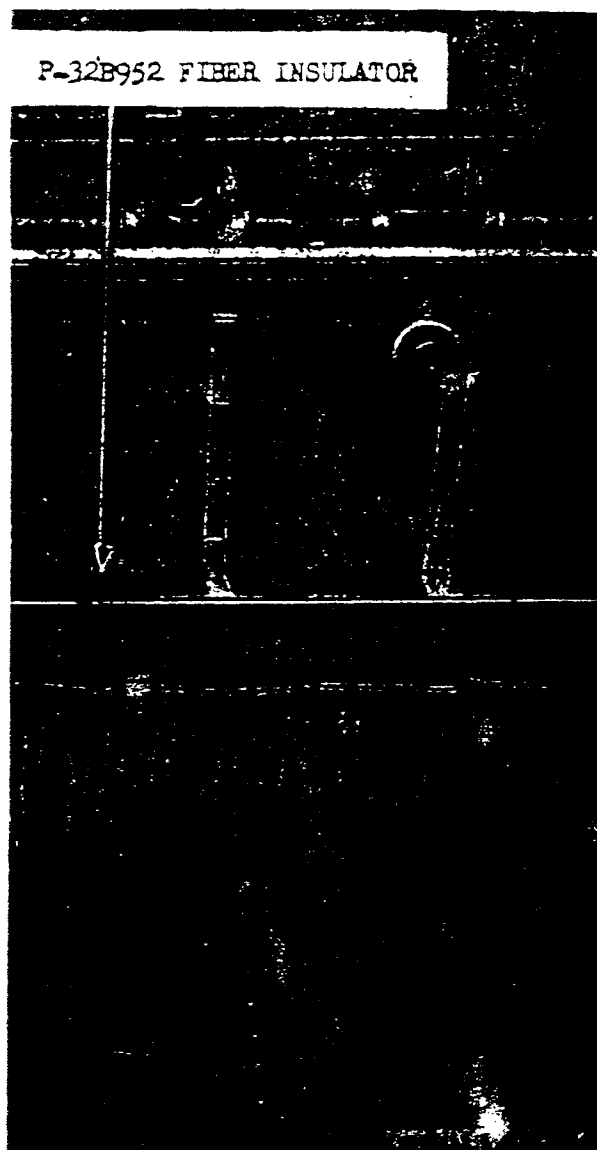
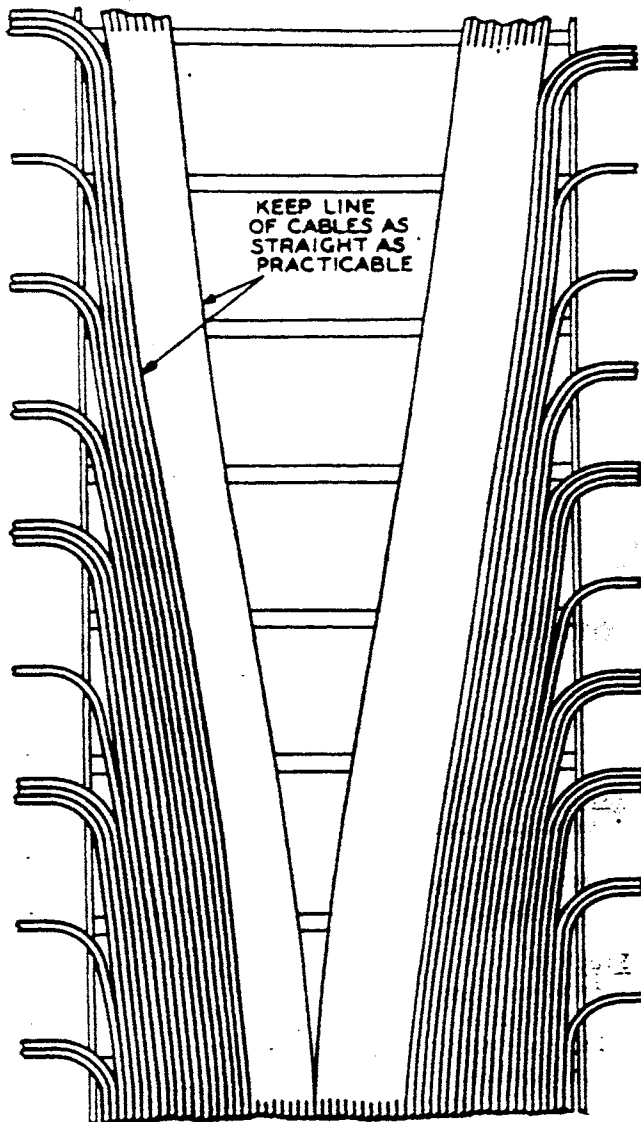


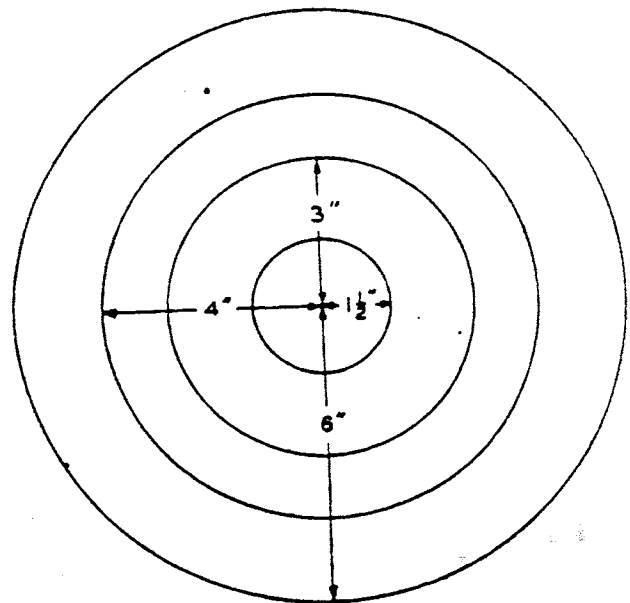
FIG. 3 CABLES TURNED FROM CABLE RACK AT
DISTRIBUTING FRAMES
(PAR. 5.231)



RP-9904

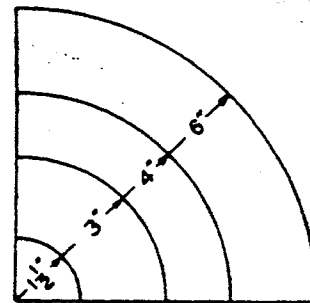
FIG. 4 TAPERED TURNOFF
(PARS. 5.231, 5.232)

- 5.24 Cables to be turned upward as they leave the cable rack are turned off horizontally and then up so as not to interfere with running other cables.
- 5.3 Radii of Cable Bends
- 5.31 Uniformity at all bends, turns and offsets is to be maintained.
- 5.32 Bends are to be formed gradually by hand so no excessive strain is placed on the cable at any one point.



RP-12420A-L

FIG. 5 TEMPLATE LAYOUT
(PAR. 5.3311)



RP-12400B-L

FIG. 6 TEMPLATE
(PAR. 5.3312)

5.33 Cable Bending Radii Template

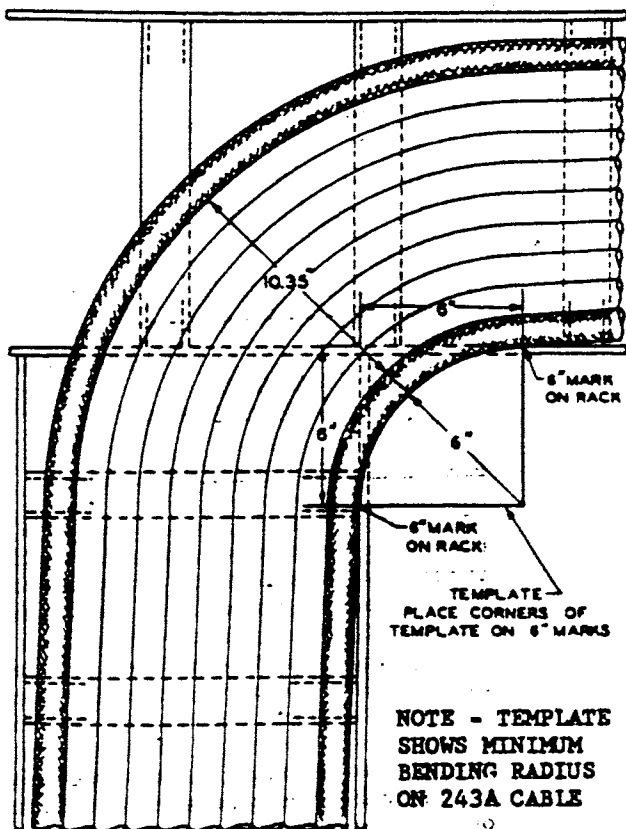
- 5.331 Too sharply bending or twisting a cable during a forming operation will injure the insulation. Install cables so that bends are made on radii that are equal to or greater than the minimum bending radii permitted. A template made of fiber or similar material, (cut to form a quadrant, a quarter of a circle, with its radius equal to the minimum bending radius requirements of the cable) may be used for laying out and measuring bends. Bend the in-

side cable of a run (or the cable having the sharpest bend) to conform to, or fall outside of, the curvature of the template.

- 5.3311 To make a template for 243A and smaller cable, cut out a circle with a 6" radius on a piece of fiber or cardboard, as illustrated in Figure 5. At the same time draw circles using the same center point with 4", 3" and 1-1/2" radii.

- 5.3312 Cut out one-quarter of the circle as illustrated in Figure 6.

- 5.3313 Now for example, if 243A cable is to be bent around a 90° turn, measure 6" each way from the corner junction point of the cable racks and mark the rack as shown in Figure 7. Then place the template in position, as shown, to form the arc which will be the radius of the cable at the bend.



RP-12419-L

FIG. 7 USING TEMPLATE TO CONTROL BENDING RADIUS
(PAR. 5.3313)

- 5.3314 Where the first cable to be laid is on the far side of the 90° angle, add to the minimum bending radius of one cable the width of the other cables which are to go on the rack. Thus if ten 243A cables are to be laid, each cable being 1.1" diameter, add 9 x 1.1" or 9.9" to the 6" template. This will give the location of the inside of the first cable on the far side of the turn.

- 5.34 All requirements are met when the bending radii shown in Table E are established. If necessary to use smaller radii, reference to Section 100 of this handbook may indicate some leeway on some codes of cables.

TYPE OF CABLE	DIAM	BENDING RADIUS
Round	Up to 1/2"	3"
	Over 1/2" to 1"	4"
	Over 1"	6"
Oval	Bend on Flat of Cable	2"
	Bend on Edge of Cable	3"
Flat	Bend on Flat of Cable	3"
	Bend on Edge of Cable	6"
	Less than 1"	8"
	1" to 1-1/2"	12"
	1-1/2" and Over	

TABLE E NORMAL BENDING RADII FOR SWITCHBOARD CABLES
(PAR. 5.34)

6. VERIFICATIONS

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS			REFERENCE	
			Par.No.	Fig.No.
6.1	<u>ARRANGEMENTS OF SWITCHBOARD CABLE AND WIRE ON RACKS</u>			
6.11	<u>Regular Runs</u>			
(P) 6.111	Cables arranged according to predetermined arrangement in cross-sectional views on job cabling drawings.		5.12	
(P) 6.112	Oval cables normally placed on edge unless they terminate in switchboards or desks.		5.121	
6.113	Cables on cross-aisle racks run over the over-frame cable rack.		5.14	
6.12	<u>Miscellaneous Runs</u>			
(P) 6.121	Installed in complete layers across width of rack, except when other arrangement is indicated on cable drawings.		5.13	
6.13	<u>Bending Radii</u>			
6.131	Proper bending radii used and uniformity maintained at all bends, turns and offsets.		5.31 5.32 5.34	8
6.2	<u>Securing of Switchboard Cable and Wire on Cable Racks</u>			
6.21	<u>Bar Type and Modified Ladder Type Cable Rack</u>			
6.211	Wires run with unsecured cable are banded with two strands of R-2916 Twine every 36 inches.		4.12	

→ Indicates new or changed information

[Vertical line at side of paragraphs indicates requirements.

Engineering Planning Manager
(Installation)

Reason for Reissue:

Change to reflect Installer furnishing
all cable clips.

SECURING CABLE AND WIRE
MANNER OF SECURING CABLE AND WIRE

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 - 1.1 Scope of Section
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 - 3.2 Clipping on Vertical or Inverted Cable Racks
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 - 3.4 Securing Switchboard Cable in Power Rooms
 - 3.5 Securing Cable Splices
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 - 4.1 Clamping on Spiral Turns
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 - 8.1 Along Transverse Arms With R-4265 Cable Ties
 - 8.2 Under Transverse Arms With U Clips
9. MANNER OF SECURING WIRES RUN WITH SWITCHBOARD CABLE
10. VERIFICATION

1. GENERAL

1.1 Scope of Section

1.11 This section contains general basic information, requirements and methods, and reference to the complete information, concerning the manner of securing switchboard cable and wire on cable racks by clipping or sewing.

1.12 All cables on ladder type cable racks, except short multiple cables in switchboards and desks and cables supported by fanning rings or distributing rings, shall be adequately secured to supports, either by means of cable clips or twine.

1.2 General Information Pertaining To Arrangement of Tools, Precautions, Verification, Specs and Drawings and Figures

1.21 Refer to Section 1 of this handbook for information pertaining to these items.

2. INSTALLING EQUIPMENT

2.1 The tools and supplies normally required for the operations covered in this section are covered in Section 300 of this handbook.

3. MANNER OF SECURING CABLE

3.1 Clipping on Ladder Type Cable Rack

3.11 Secure cable on cable racks with adjustable flat type clips KS 5370-01 type when furnished, except where special methods of securing are specified.

3.12 Where it is uneconomical to clip because of irregular size of the cable or access to the cable rack is too limited to permit damage to the cable cover, sewing is permitted.

3.2 Clipping on Vertical or Inverted Cable Racks

3.21 Complete groups of cable on all new vertical or inverted racks are to be clipped. Arrange to obtain clips for these racks if they have not been furnished.

3.22 Incomplete groups, except the bottom layer, shall be securely fastened with approved twine.

3.23 Incomplete groups in the first layer of cable on new vertical racks must be clipped.

3.3 Sewing On Cable Racks

3.31 Cable shall be secured by sewing under the following conditions:

(a) On additions to runs previously sewed or clipped where the amount of cable to be added, the size, and length of the run or the formation of the present cables would make clipping uneconomical or result in a poor appearance of the finished run.

(b) On incompleted groups of cables in vertical and inverted horizontal runs except the layer resting against the cross strap.

(c) Where cables turn through the rack, cables are to be sewed to the last cable rack strap, except on clipped runs where this strap is a normal clip location.

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(d) Where cables are not at right angles to supports and the angle is such to make clipping impracticable.

(e) Where cables are fastened to the underside (Flange side) of the rack straps.

(f) At intersections of cable racks where cables meet or cross (sewing permits spreading and arranging cables to prevent excessive piling).

(g) Where no 0 or larger armored cables and runs containing various sizes of armored cables are fastened to the cable racks.

(h) where access to cable racks is considered too limited to permit installing clips with sufficient insurance against incorrect assembly and consequent possible damage to cables.

3.4 Securing Switchboard Cable in Power Rooms

3.41 Secure switchboard cable in power rooms by sewing.

3.42 In rooms containing combinations of Power Equipment Bays and Frames clipping is not permitted over such equipment where a service hazard exists. Using clips over generator set rectifiers with open tops, generator control bays, batteries etc. is considered hazardous to service. Consideration should be made for future power equipment; these cables should be sewed to reduce the possibility of service hazard in the future.

3.5 Securing Cable Splices

3.51 On the portion of cable runs where present or future cable splices are specified sewing is required.

3.6 Securing Cable To Spiral Turns

3.61 Sewing is required on all spiral and 90-degree double turns.

4. CLAMPING ON CABLE RACKS

4.1 Clamping on Spiral Turns

4.11 Clamps per ED-91987-30 should be provided for spiral cable runs as follows.

4.12 If the vertical cable run turns to a horizontal position near the ceiling of the floor below the one on which the spiral is located in Figure 1, View A, one clamp should be placed immediately above the spiral.

4.13 If the vertical cable run turns to a horizontal position immediately above the spiral the clamp should be placed below the spiral as shown in Figure 1, View B.

4.14 If the spiral is placed in a straight vertical run, so that the run continues the distance between two adjacent floor lines or more beyond the spiral in both directions, a clamp should be placed directly above and below the spiral as shown in Figure 1, View C.

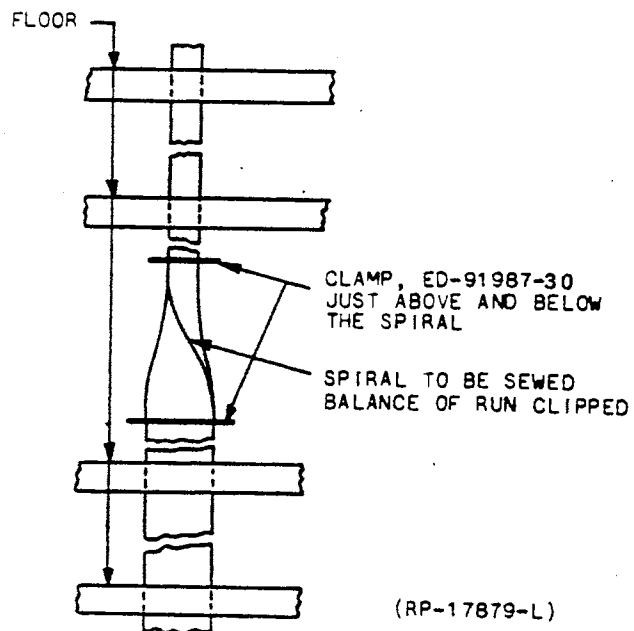
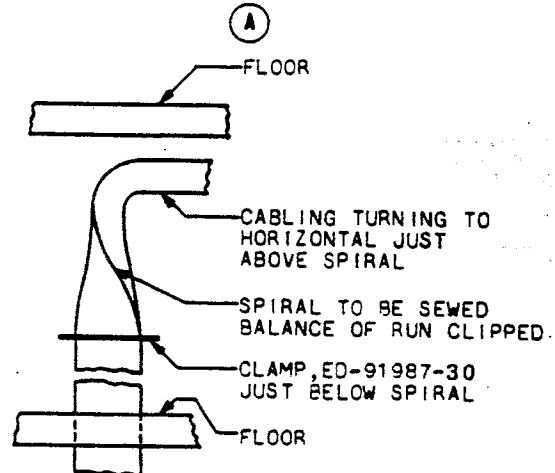
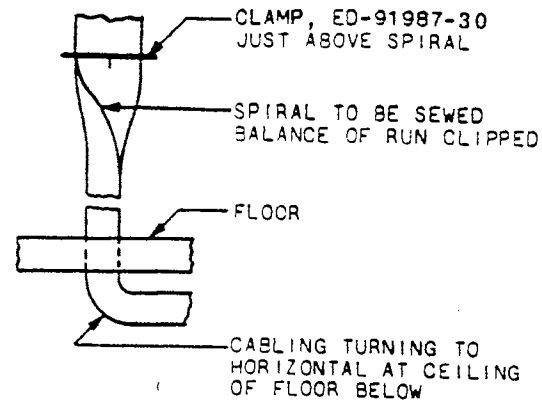


FIG. 1 ARRANGEMENT OF CLAMPS ON SPIRAL CABLE (PARS. 4.11 to 4.14)

1.15 Supplementary clamps are not required on horizontal spirals or 90° double turns.

4.2 Inverted Horizontal Runs by Auxiliary Supports

4.21 Inverted horizontal cable runs are to be equipped with auxiliary supports as shown in Figure 2. These auxiliary supports are to clamp the cables firmly but should not be so tight as to distort the cables.

4.22 Place supports on all underhung sewed runs and on all underhung clipped runs or portions thereof which are three or more clips in depth.

4.23 Space the supports along the run at approximately 10'-0" intervals for runs less than 100 square inches in approximate cross-sectional area and at approximately 6'-0" intervals for larger runs.

4.3 Vertical Runs by Auxiliary Supports

4.31 Place auxiliary supports on vertical runs as indicated on cable plan drawings, when furnished in the job specifications. See Figure 2.

4.32 On additions to existing sewed vertical runs, clamps per ED-91987-30, when furnished in the job specification, should be added wherever the pileup including the addition exceeds approximately 4".

4.33 Inverted horizontal cable runs which are three or more clips in depth should be equipped with auxiliary supports.

5. ON CABLE RACKS WITH CABLE RETAINING BRACKETS

5.1 Cables are secured with cable retaining brackets on horizontal cable racks only when called for in the job specifications. Cables placed in cable retaining brackets are not to be otherwise secured except in certain locations such as at turns and intersections where they are to be sewed. See Section 330 of this handbook.

6. BETWEEN CABLE RACK AND BUTT LOCATION

6.1 Cables between the cable rack and the butt location, are to be secured to the supports at frames, bays, racks and switchboards. See Section 340 of this handbook for detail information.

7. AT VERTICAL SIDE OF DISTRIBUTING FRAMES

7.1 Cables on the vertical side of all distributing frames are to be secured with R-4265 Nylon Cable Ties.

8. AT HORIZONTAL SIDE OF DISTRIBUTING FRAMES WITH NYLON CABLE TIES AND U CLIPS

8.1 Along Transverse Arms With R-4265 Nylon Cable Ties

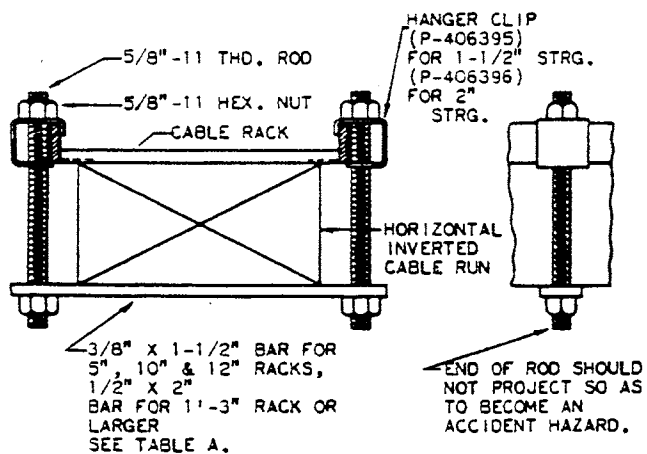
8.11 Cables passing from the vertical side of distributing frames to the terminal strips on the horizontal side are, ordinarily, to be secured to and along the transverse arms with R-4265 Nylon Cable Ties. Refer to Section 340 of this handbook.

8.2 Under Transverse Arms With U Clips

8.21 Cables passing along the horizontal side of distributing frames are, ordinarily, to be secured under the transverse arms with U clips. Refer to Section 340 of this handbook.

9. MANNER OF SECURING WIRES RUN WITH SWITCHBOARD CABLES

9.1 Secure wires run with switchboard cables in the same manner as the switchboard cable with which they are run.



SIZE OF RACK	PIECE PART NUMBER
10"	P-401760
12"	P-411735
1'-3"	P-401761
1'-8"	P-401762
2'-1"	P-401763

TABLE A

FIG. 2 AUXILIARY SUPPORTS
(PARS. 4.2, 4.3)

10. VERIFICATION

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS	REFERENCE	
	PAR. NO.	FIG. NO.
10.01 Incomplete groups on vertical and inverted horizontal runs secured with approved twine (except bottom layer)	3.22	
10.02 Incompleted groups on the bottom layer of vertical and inverted horizontal runs secured with clips in regular manner using start or regular clips ascending to the size of the group.	3.23	
10.03 Cables at splices are to be secured with twine.	3.5	
10.04 Sewing is required on all spiral and 90° double turns.	3.6	
10.05 If the vertical cable run turns to a horizontal position near the ceiling of the flow below the one on which the spiral is located one clamp should be placed immediately above the spiral.	4.12	1A
10.06 If the vertical cable run turns to a horizontal position immediately above the spiral the clamp should be placed below the spiral.	4.13	1B
10.07 If the spiral is placed in a straight vertical run, so that the run continues the distance between two adjacent floor lines or more beyond the spiral in both directions a clamp should be placed directly above and below the spiral.	4.14	1C
10.08 On inverted horizontal runs equipped with supports cables will be firmly clamped but not distorted.	4.21	
10.09 Supports will be placed on all underhung sewed or clipped runs three clips or more in depth.	4.22	
10.10 Supports will be placed at 10 feet intervals for runs less than 100 square inches in cross-sectional area and at 6 feet intervals for longer runs.		
10.11 Auxiliary supports on vertical runs will be placed as indicated on cable plan drawings.	4.31	2
10.12 On additions to existing sewed vertical runs, clamps will be added whenever pile up including addition exceeds approximately 4".	4.32	
10.13 Inverted horizontal cable runs three or more clips in depth will be equipped with auxiliary supports	4.33	
10.14 Cables are secured with cable retaining brackets on horizontal cable racks only when called for in the job specifications.	5.1	
10.15 Cables between the cable rack and the butt location are to be secured to the supports at frames, bays, racks and switchboards.	6.1	
10.16 Cables on the vertical side of all distributing frames are to be secured with R-4265 Nylon Cable Ties.	7.1	

→ Arrowed lines indicate new or changed information.

[Vertical line at side of paragraphs indicates requirements.

Assistant Manager
Common Installation Engineering

Reason for Reissue:
Extensive change

SECURING CABLE AND WIRE SEWING

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|---|---|

-
- | | |
|--|---|
| <ul style="list-style-type: none">1. <u>GENERAL</u>1.1 <u>Scope of Section</u>1.11 This section covers the securing of switchboard cable and wire on cable racks by sewing with twine.1.111 "Wire" or "wires" as used in this section cover all codes of bulk wire ordered in installers cable running lists including flexible cordage such as KS-15141 and KS-15143.1.12 Sewing is an approved method for securing cables when cable clips or cable rack brackets are not specified or where the use of clips or cable rack brackets is not practicable. Sewing is also used where cables in retaining brackets will not otherwise retain their position and where clipping is not permitted as covered in Section 301 of this handbook.1.2 <u>General Information Pertaining to the Arrangement of Tools, Precautions, Verifications, Specs and Drawings and Figures</u>1.21 Refer to Section 1 of this handbook for information pertaining to these items. | <ul style="list-style-type: none">1.3 <u>Specific Precautions</u>1.31 Sewing twine may break if given a quick jerk or if one strand is pulled tighter than the other.1.32 Particular care should be taken to avoid eye injuries due to the breakage of twine when sewing cables which are located at or slightly above eye level and especially when performing this operation in congested places. Safety glasses are to be worn at all times. See Handbook O for details.1.33 Avoid cuts and bruises by tightening with a steady pull. Protect hands as necessary using a 1" compress, piece of adhesive tape, or R-4248 Fingerless Leather Gloves.1.34 Avoid placing tools, material or other objects on cable racks, ladders or scaffolding where they may be accidentally pushed off or fall on those below. Keep tools in cases provided for them.1.35 Observe the condition of the cable and wire as it is being grouped and secured and repair any damaged insulation. See Section 140 of this handbook. |
|--|---|

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SYSTEM EXCEPT UNDER WRITTEN AGREEMENT

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2. INSTALLING EQUIPMENT

2.1 The tools and supplies generally used for operations covered by in this section are covered in Section 300 of this handbook.

3. ARRANGEMENT AND GROUPING OF SWITCH-BOARD CABLES

3.1 Place the maximum number of cables under a stitch, space the stitches and use the number of strands of twine as shown in Figure 1.

3.2 Not placing the maximum number of cables under a stitch or the securing of cables to cable rack cross straps more often than specified does not necessarily improve the quality of the job but may cause additional work on subsequent additions.

4. SECURING BY SEWING

4.1 Starting Stitch

4.11 Make the starting stitch on cable rack as shown in Figure 2 when securing the first group of cables. Place the stitch approximately 3/4" from the outer edge of the cable rack stringer. The knot should be in the center of the strap when the stitch is tightened.

4.2 "Kansas City" Stitch

4.21 The "Kansas City" Stitch is used when sewing cable to cable rack straps, cable brackets, or to supports. This stitch is made as a continuation of a starting stitch.

4.22 Use the method shown in Figure 3 to make the Kansas City stitch.

4.23 Determine the number of cables to be placed under the stitch from Figure 1.

4.24 After completing each stitch, place the ends of the twine so that they will not interfere with running in additional cables. Keep the line of the stitches straight on the center line of the cross strap as shown in Figure 4.

4.25 To sew a succeeding layer to a lower layer of cables, loop the twine back across the cables in the lower layer and continue according to the method shown in Figure 5.

4.3 Ending Stitch

4.31 Two methods of ending the Kansas City stitch when sewing cables to cable rack straps, cable supports or cable brackets are illustrated in Figure 6. Use the Hawthorne knot except where a small group of cables requires a more secure fastening than can be obtained by this knot, in which case a square knot should be used.

4.4 Sewing on Additions

4.41 When cables are added to an existing run sewed at every strap, sew the additional cables in accordance with the requirements of this section. Where existing cables are sewed at every other strap, the added cables are to be sewed in the same manner as the existing cables. Fasten the starting stitch to the stitches holding the last cable of the present run, looping the starting stitch around the old stitch.

4.42 To sew additional cables to runs previously wire clipped, secure starting stitch under wire clips.

4.5 Sewing Miscellaneous Runs of Cable

4.51 Arrange the stitches in miscellaneous runs as illustrated in Figure 7.

4.511 When sewing the first layer, place the number of cables under a stitch according to the table in Figure 1 and loop the stitches the same as when sewing regular runs as illustrated in Figure 3.

4.512 When sewing the second layer, place the number of cables under a stitch according to Figure 1. One of two conditions will be found in making the loop at the end of each stitch. Make the loop of each stitch as described for the condition at that point.

4.5121 One condition is where the loop falls at a point such as at (A) in Figure 7 where the stitch of the first layer loops under the cross strap. Loop the twine through the stitch of the first layer as illustrated at (A) in Figure 7.

4.5122 The second condition is where the loop falls at a point such as at (B) in Figure 7, where the stitch of the first layer does not pass under the cross strap. Loop the twine through the first layer and under the cross strap as indicated at (B) in Figure 7.

4.513 When sewing layers above the second layer, arrange the length of each stitch so the twine at the end of the stitch will loop through the stitch of the preceding layer in line with a loop or a series of loops the first of which passes under the cross strap as at (A) in Figure 7. Form and end the stitches and loops in the same manner as when sewing a regular cable run as illustrated in Figure 6.

SWITCHBOARD CABLES TO BE SEWED UNDER 1 STITCH

Type	Cable Size	Horizontal Resting Runs			Vertical or Inverted Horiz. Runs (See Note 1)			No. of Cables Under 1 Stitch	Sew at Every Strap	Sew at Every 3rd Strap
		Round	On Edge	On Flat	Round	On Edge	On Flat			
Round	Up to 1/2"	X						6		X
	Over 1/2" to 3/4"	X						5		X
	" 3/4" to 1"	X						3		X
	" 1"	X						2		X
	Up to 1/2"				X			5	X	
	Over 1/2" to 3/4"				X			2	X	
	" 3/4"				X			1	X	
Oval	All		X					6		X
	All 2 Cables Wide			X				10		X
	All					X		(See Note 3) 3	X	
	All 1 Cable Wide						X	5	X	
Flat	All 1 Cable Wide		X	X				5		X
	All 1 Cable Wide					X	X	5	X	
Misc.	Mixed	The number of cables under one stitch should be the maximum shown above for the largest size cable under each stitch. For oval cables use the largest dimension to determine the number of cables to be included under a stitch.								

NOTE 1: Applies only to small installations, where due to the limited number of cables, flat type clips are not provided.

All new vertical or inverted horizontal runs except as covered above are to be clipped as covered in Section 312. Arrange to secure clips for these runs if they have not been furnished.

On additions when the pileup (including the added cables) exceed 4" the run should be equipped with clamps per ED-91987-01 when called for in the job specification.

NOTE 2: Use 2 strands of twine for sewing all horizontal and vertical runs.

Use 2 strands of twine for sewing inverted horizontal runs when the ultimate depth is less than 8". Use 4 strands when the ultimate depth is 8" or more.

NOTE 3: Where it is difficult to hold ten cables in place and sew them under one stitch, it is permissible to split the group of cables and sew them four or six cables under a stitch.

FIG. 1 SWITCHBOARD CABLE SEWING REQUIREMENTS
(PARS. 3.1, 4.23, 4.511, 4.512)

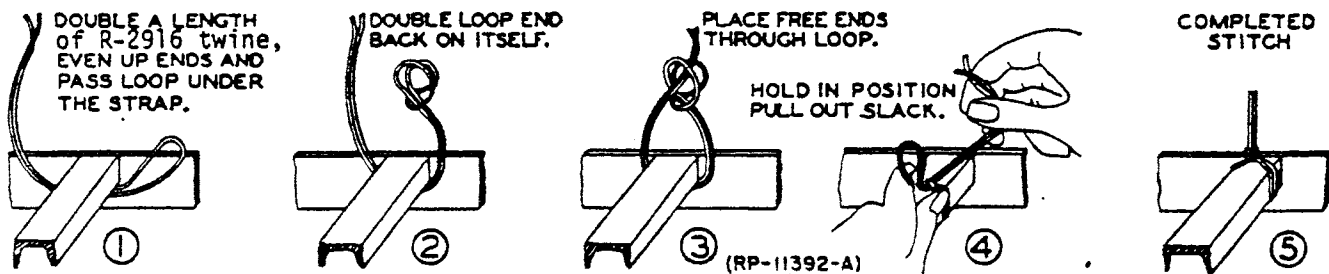


FIG. 2 STARTING STITCH
(PAR. 4.11)

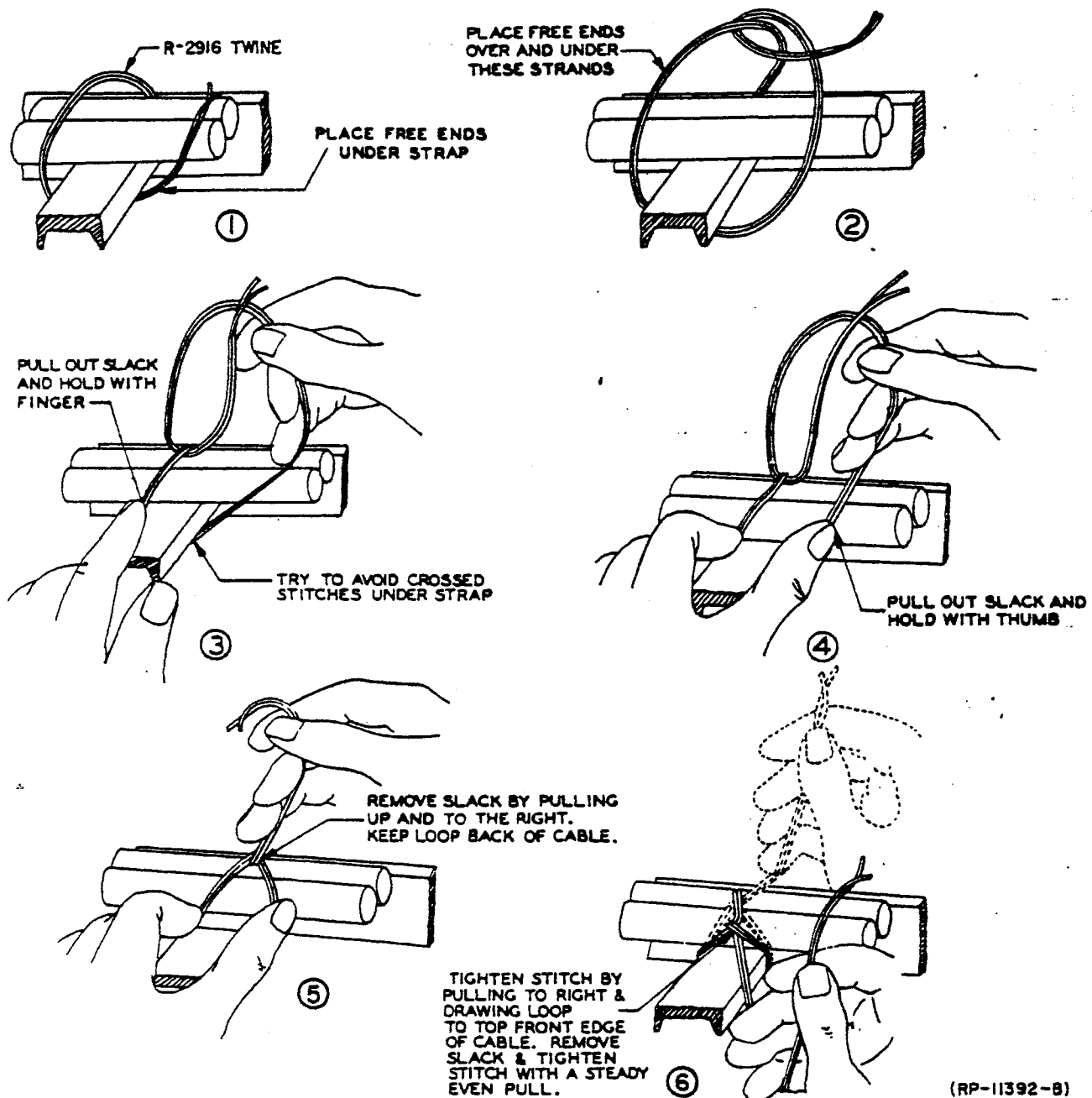


FIG. 3 KANSAS CITY STITCH
(PARS. 4.21, 4.511)

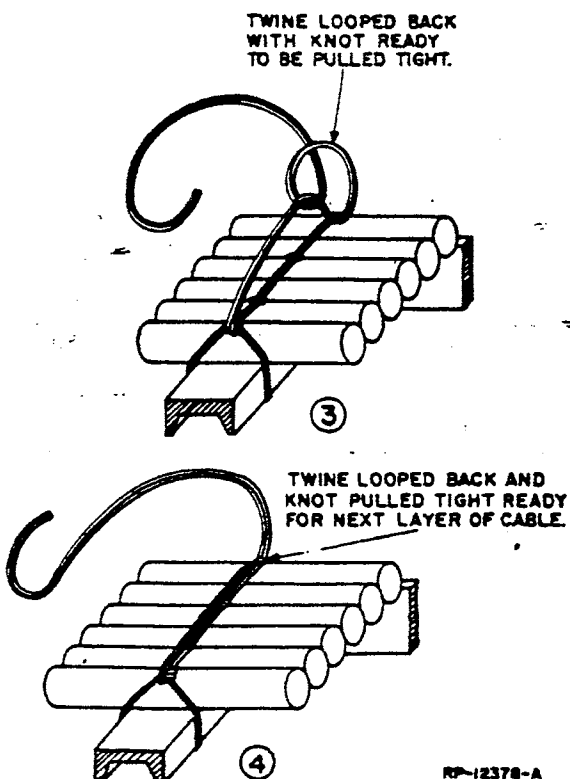
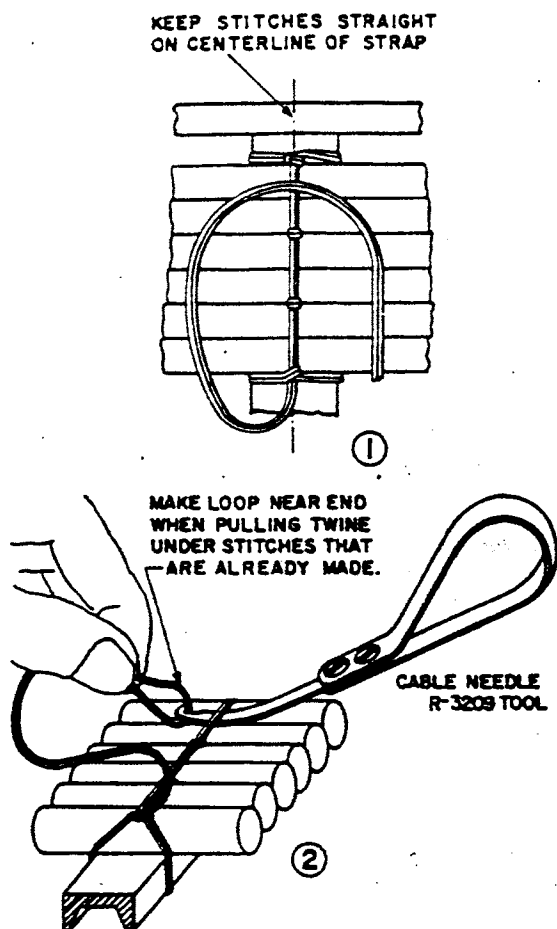


FIG. 4 FIRST LAYER
(PAR. 4.24)

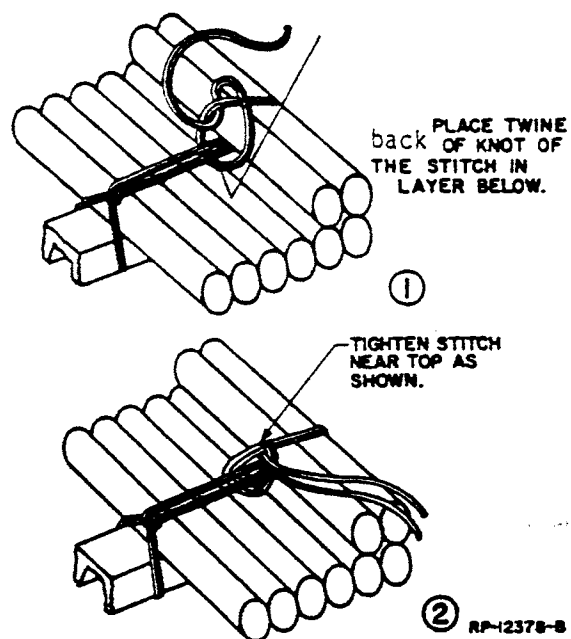


FIG. 5 SECOND LAYER
(PAR. 4.25)

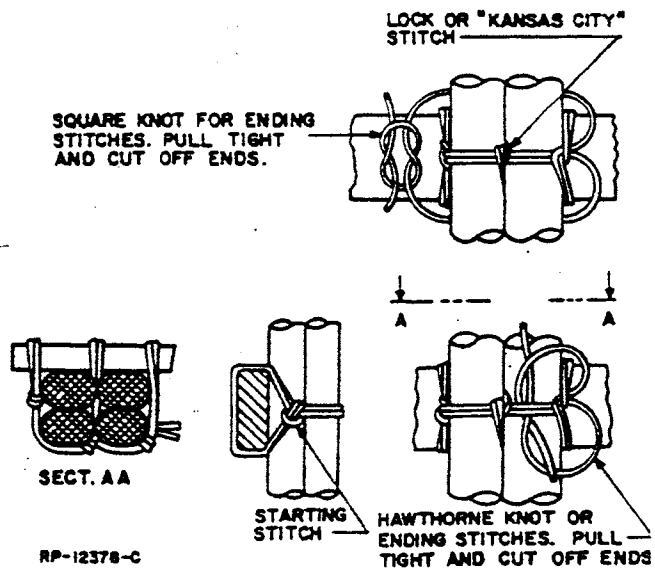


FIG. 6 METHOD OF ENDING STITCHES
(PAR. 4.31, 4.513)

4.6 Securing Cable at Turning Points

4.61 Sew cables to supports provided at turns in the same manner in which they are sewed to cable rack cross straps. See Figure 8.

4.62 Cables on horizontal runs will in general be sewed at every third strap. On turns in the same plane, sew cables at straps adjacent to start and completion of turn and at such intervals in turn as will insure the cables retaining their proper position.

4.63 Where cables turn off of cable racks and the last cross strap before the turn is not a normal sewing location (See Figure 1), sew cables to this strap to insure cables being secured at the last cross strap before the turn off.

4.631 On layers other than the bottom layer secure cables to several adjacent cables at the position of the cross strap before the turn with a hand of two strands of R-2916 Twine made with a starting stitch and ended in a square knot.

4.632 Stitches or bands placed at turn off points need not be continued above the layer where the last cables turn off.

4.64 Where cables turn through the rack and the last cross strap is not a normal sewing location, sew the cables to this strap.

4.641 Stitches on these straps need not be continued above the layer where the last cables turn through the rack.

4.7 Sewing Wire Run With Cable, Shielded and Rubber Covered Wire and Local Power Cable Forms

4.71 Secure wires run with switchboard cable in the same manner as the switchboard cables with which they are associated.

4.72 Place wires between cables, as far as practicable, so they will be protected by the regular cables with which they are associated.

4.73 Sewed local power cables, which are run separately, should be installed in the same manner as switchboard cables of a similar size.

4.74 Sew shielded wire in the same manner as switchboard cable.

4.75 When sewing all rubber covered wire such as KS-15141 and KS-15143 flexible cordage, place pieces of fiber cut from P-409474 or 1/64 gray sheet fiber RM-583101 around the wire and locate it centrally under the stitch to prevent the twine cutting into the insulation. Use R-3428 gray plastic tape if fiber is not available.

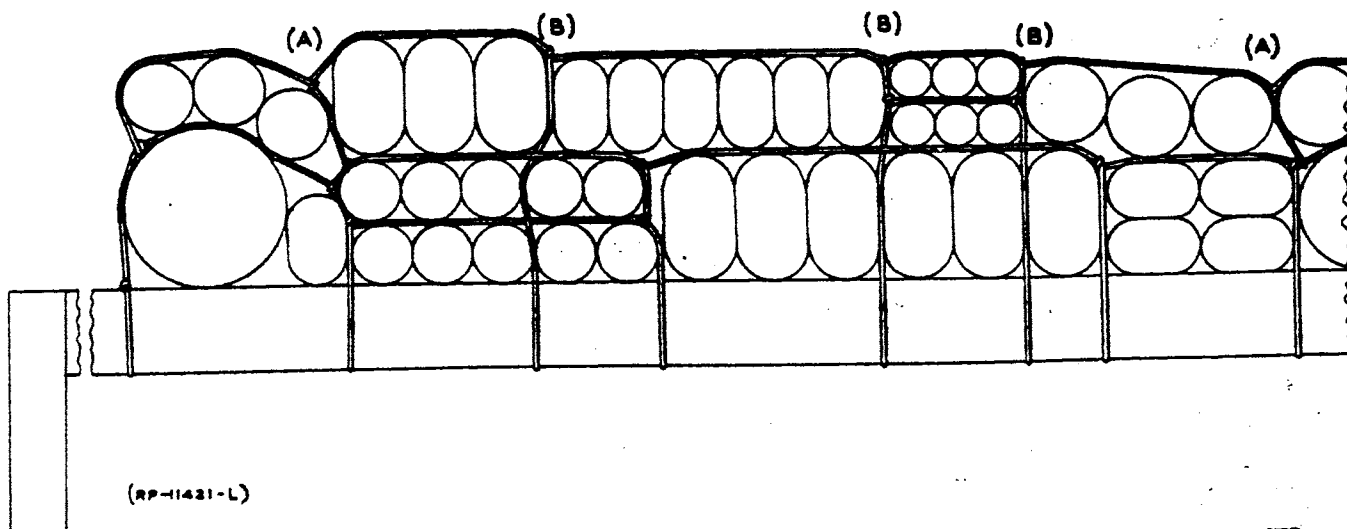


FIG. 7 METHOD OF SEWING RUNS OF MISCELLANEOUS CABLE
(PARS. 4.51, 4.5121, 4.5122, 4.513)

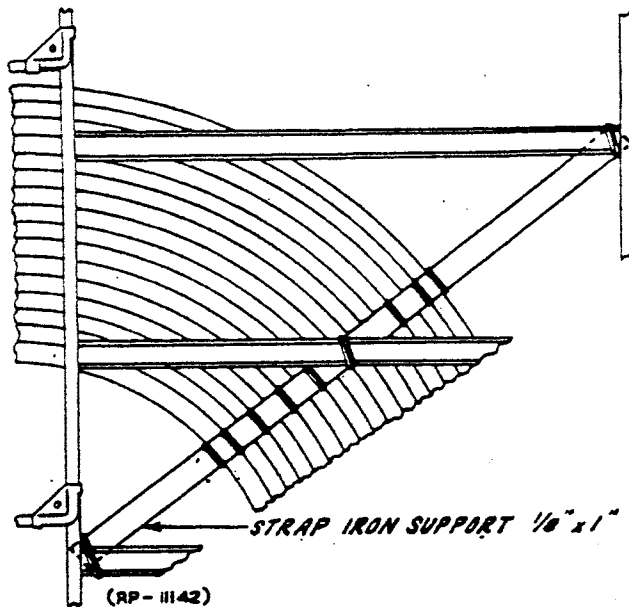


FIG. 8 SEWING CABLE TO SUPPORTS AT TURNS
(PARS. 4.61)

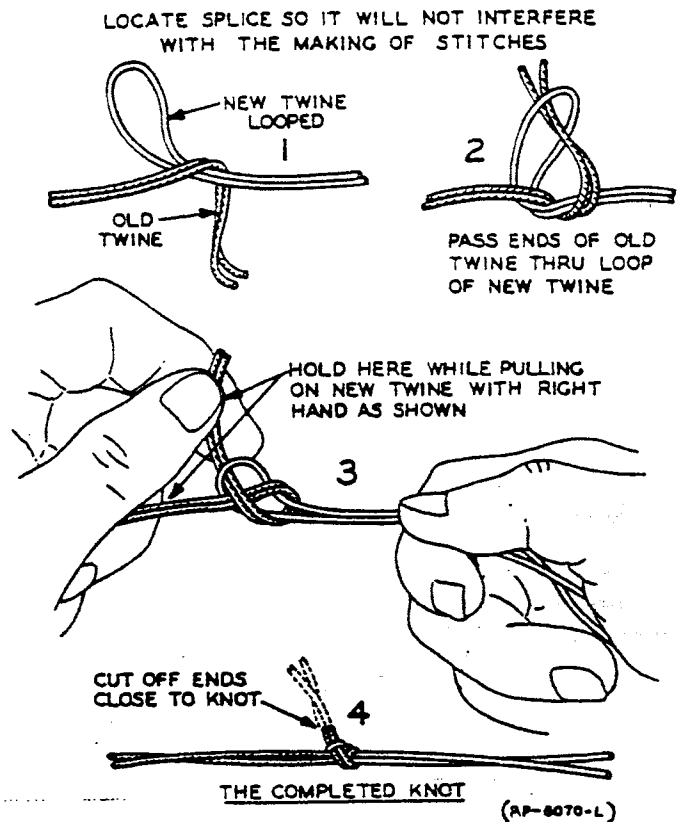


FIG. 9 SPLICING DOUBLE STRANDS OF TWINE
(PAR. 4.81)

4.8 Splicing Twine

4.81 Splice twine as shown in Figure 9 whenever it is too short or when it breaks. If possible, make the splice where it will not be seen and where it will not interfere with the making of stitches.

5. VERIFICATION

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS			REFERENCE	
			Par. No.	Fig. No.
5.1	<u>Sewing</u>			
(P) 5.101	Starting stitch properly made.		4.11	2
(P) 5.102	Starting stitch approximately 3/4" from edge of cable rack and knot centered.		4.11	
(P) 5.103	Kansas City Stitch properly made.		4.21	3
5.104	Proper number of cables under stitches.		4.23, 3.1	1
(P) 5.105	Miscellaneous runs properly sewed.		4.511 to 4.513	7
(P) 5.106	For first layer, proper number of cables under a stitch according to Figure 1.		4.511	1 & 3

5. VERIFICATION (Cont'd)

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS		REFERENCE	
		Par. No.	Fig. No.
5.1	<u>Sewing</u> (Cont'd)		
(P) 5.107	For second layer, proper number of cables under a stitch according to Figure 1.	4.512	1
5.108	When the loop falls at a point, as at point (A) in Figure 7 and the stitch of the first layer loops under the cross strap, loop the twine through the stitch of the first layer as illustrated at (A) in Figure 7.	4.5121	7
5.109	When the loop falls at a point, such as at (B) in Figure 7 and the stitch of the first layer does not pass under the cross strap, loop the twine through the first layer and under the cross strap as indicated in Figure 7 at (B).	4.5122	7
5.110	Layers above the second layer sewed so that the twine at the end of the stitch will loop through the stitch of the preceding layer in line with a loop or series of loops, the first of which passes under the cross strap as at (A) in Figure 7.	4.513	6, 7
5.111	Cables at turning points secured as follows:		
5.112	Cables sewed to supports provided at turns in same manner used to sew at cross straps.	4.61	8
5.113	Cables at turns secured at start and completion of turn and at such intervals in turn to insure cables retaining their proper position.	4.62	
5.114	Cables which turn off or turn through the rack sewed to last cross strap before turn where this strap is not a normal sewing location.	4.63 or 4.841	
5.115	Shielded wire sewed in same manner as switchboard cable.	4.74	
5.116	Protect rubber covered wire such as KS-15141 and KS-15143 flexible cordage with 1/64" fiber at all sewing points.	4.75	
5.117	Twine spliced properly.	4.81	9
(P) 5.118	Splice placed where it does not interfere with stitches; concealed if possible.	4.81	9

[Vertical lines at side of paragraphs indicates requirements.

Engineering Planning Manager
(Installation)

Reason for Reissue:

Removed reference to lead covered cable and No. 12 Twine.

SECURING CABLE AND WIRE
FROM RACK TO BUTT LOCATION

CONTENTS

- | | |
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| 1.1 Scope of Section | 5.4 Securing Switchboard Cable to Brackets at Crossbar Single Sided IDF and TRDF by Sewing |
| 1.2 General Information Pertaining to Arrangement of Tools Precautions, Verification, Specification, Drawings, and Figures | 5.5 Securing Switchboard Cable Running Under and Perpendicular to Transverse Arms at the Horizontal Side of Distributing Frames |
| 2. INSTALLING EQUIPMENT | 5.6 Securing Switchboard Cable and Wire Along Transverse Arms and Similar Supports |
| 2.1 Tools and Supplies | 6. VERIFICATION |
| 3. SPECIFIC PRECAUTIONS | 6.1 Arrangement of Cable and Wire From Rack to Butt Location |
| 4. CABLE ARRANGEMENT | 6.2 Securing Switchboard Cable and Wire On Racks, Frames, Bays, and in Switchboards |
| 4.1 Cable Arrangement from Cable Rack to Cable Butt Location | |
| 5. SECURING SWITCHBOARD CABLE AND WIRE FROM THE CABLE RACK TO THE BUTT LOCATION | |
| 5.1 General | |
| 5.2 Securing Switchboard Cable at Frames, Bays, Racks, and in Switchboards | |

1. GENERAL

1.1 Scope of Section

1.11 This section covers the securing of cable and wire from the cable rack to the butt location, to supports at distributing frames, bays, racks, and switchboards.

1.111 The term "Frames" as used in the text of this section refers to frames other than distributing frames. When reference is made to distributing frames, they will be shown as "Distributing Frames".

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

1.12 The arrangement of cables passing along through the various equipment is shown on the cable plan drawing covering the particular equipment.

1.2 General Information Pertaining to Arrangement of Tools, Precautions, Verification, Specification, Drawings, and Figures

1.21 Refer to Section 1 of this handbook for information pertaining to these items.

2. INSTALLING EQUIPMENT

2.1 Tools

R-4266 Tool, Fastening, Cable Tie
R-4827 Tool, Fastening, Cable Tie ←

This section includes material from BSP's 800-614-152 and 800-612-153
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SYSTEM EXCEPT UNDER WRITTEN AGREEMENT

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2.2 Supplies.

→ R-2916 Twine
 RM-583101 Fiber Sheet, Gray, 1/64"
 R-4265 Cable Tie, Nylon
 List 2 for 2" Max Cables Diameter
 List 3 for 3" Max Cables Diameter
 List 4 for 4" Max Cables Diameter

3. SPECIFIC PRECAUTIONS

3.1 Precautions which are not specific to a particular operation but which are to be observed in connection with the various operations performed, as covered in this section, are:

3.11 Avoid using clip-on cable rack brackets installed on cable racks as a support. They may be dislodged by a pull or jerk.

3.12 Sewing twine may break if given a quick jerk or if one strand is pulled tighter than the others.

3.13 Avoid cuts and bruises by tightening stitches and knots with a steady pull of the twine.

3.14 Avoid placing tools or other objects on ladders or scaffolding where they may be accidentally pushed off or fall on those below. Keep tools in case provided for them.

3.15 Handle cable and wire carefully so the shape and condition of the cable and wire will not be altered.

3.16 Exercise the greatest care at all times in working offices to guard against fuse service hazards as blowing fuses, breaking off wires, and crossing terminals on equipment in service.

3.161 Shielded wire must be handled with extra precaution at the rear of fuse panels as the grounded shield is a potential service hazard at such points.

NOTE: Ensure that the ends of all cables and wires in the vicinity of live equipment are taped when securing from the cable rack to the butt location. See Section 200 for applying tape to the ends of the cable.

3.162 Take extra care at frames with exposed wiring and switches to prevent cables and wires from damaging the equipment or wiring.

3.2 Provide adequate protection as covered in Section 131 of this handbook, at corners, uprights, and sharp edges of ironwork so that the insulation of switchboard cables and loose wires is not damaged.

3.3 Observe the condition of the insulation of cable and wire as it is being grouped and secured and repair any damaged insulation. Refer to Section 160 of this handbook.

3.4 The practice of waxing cable forms has been discontinued by the Installation Organization. Older types of cables which have untreated textile insulated conductors (6000 Type, etc.) shall be recabled rather than rewaxed. Should it be necessary to replace existing waxed cables, the Installer shall inform the Telephone Company of this condition and request authorization for the replacement of the cables involved.

→ 3.5 All R-4265 Cable Ties must be secured with an R-4266 or R-4827 Cable Tie Fastening Tool.

→ 3.51 Excess "tie ends" protruding through the "tie head" of R-4265 Cable Tie shall never be cut off by any cutting instrument other than R-4266 or R-4827 Cable Tie Fastening Tool.

3.52 After cut off with the tool, the tail of the tie should, in general, be flush or slightly below the head. In no case shall the tail extend more than 1/32" beyond the head.

3.53 See Handbook 9 for proper use of R-4266 and R-4827 Tool.

4. CABLE ARRANGEMENT4.1 Cable Arrangement from Cable Rack to Cable Butt Location

4.11 The arrangement of cables between the cable rack and cable butts shall agree with the cable plan drawings for that type of equipment.

- 4.111 When necessary to bend cable, refer to Section 300 of this handbook for bending radii.
- 4.1111 Conduit or 2" x 4" lumber with edges rounded placed at cable break-off points as a temporary support will serve as an aid in maintaining the proper radius and uniformity of the cable bends at verticals of distributing frames.
- 4.112 Arrange cables so as to permit the installation of the cables for the ultimate equipment.
- 4.12 Secure cables to new frames, bays, racks, switchboards, and verticals of distributing frames in accordance with the information shown on the equipment cabling plan drawings.
- 4.121 Cabling plan drawings required may not always be ordered by the Engineer on Telephone Company, or on additions to Western Electric engineered jobs. The following list of cabling plan drawings for the more commonly encountered types of equipment is provided for convenience in ordering the required drawings in these cases.

Distributing Frames

- | | |
|----------------|--|
| ED-26990-12 | No. 5 XBAR Arrangement for Protector Mountings |
| ED-10233-01 | Step-by-Step Wall Type MDF |
| ED-91236-01 | Common Systems Arranged for Protector or Jack Mtgs |
| ED-92879-11 | Common Systems-MDF |
| ED-10537-12 | Manual Switchboard |
| ED-90290-10 | Common Double Sided Protector Frame |
| ED-30731-01 | Step-by-Step Single Sided Protector Frame |
| ED-61059-01 | Toll Test Protector Frame and IDF |
| ED-10422-10 | Manual Switchboard IDF |
| ED-20524-01 | Panel IDF |
| ED-20838-01,02 | Panel and Step-by-Step IDF |
| ED-30333-01 | Step-by-Step CDF |
| ED-61893-10,11 | Toll CDF |
| ED-66573-10,11 | 701B and 711B PBX CDF |
| ED-65286-10 | Common PBX Distributing Frame |
| ED-65776-01 | 740E PBX Distributing Frame |
| ED-30140-01 | Step-by-Step Double Sided TRDF |
| ED-31218-10 | Step-by-Step Single Sided TRDF |
| ED-25341-10,11 | No. 1 Crossbar LDF and TRDF |
| ED-26337-10 | No. 1 Crossbar MRDF (Arranged for AMA) |
| ED-68654-10 | Toll TRDF |
| ED-25256-10 | No. 1 Crossbar District Junctor Grouping Frame |

Fuse Boards

- | | |
|----------------|--|
| ED-90798-02,11 | Relay Rack Mounted and Bus Arrangement I Beam and Channel Type Relay Racks |
| ED-91203-01 | Relay Rack Mounted Bulb Angle Relay Racks |
| ED-26589-12,13 | No. 5 Crossbar PRTD |
| ED-95171-01,10 | Typical Fuse Board Cabling |
| Ed-92137-10 | Duct Type Fuse Board |

Relay Racks

- | | |
|----------------|--|
| ED-3C085-10 | Duct Type, Unequal Flange |
| ED-92224-10,11 | Bulb Angle Type-Typical Cabling |
| ED-26629-10 | Crossbar Relay Racks |
| ED-90976-10,11 | Channel or I Beam Type-Direct Cabling to Units or Individual Mounting Plates |
| ED-10537-12 | Manual Systems No. 11 Switchboard, MDF to Relay Rack and Misc. |

Register Racks

- | | | |
|----------------|----------------|------------|
| ED-26232-01 | No. 5 Crossbar | MR Frame |
| ED-90587-10 | Common Systems | MR Frame |
| ED-30113-02 | Step-by-Step | TR Rack |
| ED-91432-01 | Common Systems | TR Cabinet |
| ED-26498-10,11 | No. 5 Crossbar | TR Frame |
| | & | 12 |

Step-By-Step

- | | |
|-------------|----------------------|
| ED-30791-10 | Step-by-Step Systems |
|-------------|----------------------|

Switchboards

- | | |
|-------------|---|
| ED-91118-01 | Common Systems, Miscellaneous Cabling in Switchboards |
| ED-61651-01 | Running Box and Roof Cabling in 3B and 3C Toll Switchboards |

4.13 Cabling plan drawings are not ordinarily ordered by the Engineer for additions to existing frames, bays, racks, switchboards, and verticals for distributing frames. In such cases, where practicable, the present cabling arrangement should be followed as a guide for the method of cabling. However, the current requirements should be met, such as bending radii, protection of cables at points where they break sharply over the edge of the cables rack structure, method of securing, etc., irrespective of any such deviation in the existing cables. If there is any question as to the advisability of following the existing cabling arrangement, refer to the drawings. Order drawings through the regular channels.

4.14 Cable brackets furnished but not used to support cables in partially equipped bays should be left as a permanent part of the frame or rack. Brackets which are bolted on should be installed in the specified location. It is preferable to install unused clip type brackets in partially equipped bays at the top of the upright. If, however, this would result in the clips being covered with cables to such an extent as to make their removal difficult when needed, they may be installed at a point just below the cables.

4.15 Secure switchboard cables leaving cable racks and entering switchboards, frames, racks, and other equipment so that there will be no appreciable sag in the cabling.

4.151 Cables shall not be unsupported except at distributing frames for a distance greater than 2'-0" measured along the shortest cable between the last support on the cable rack and the first support on the switchboard, frame, bay, or rack.

4.152 When cabling at duct type bays, the point where the cables enter the duct at the top of the bay is considered a point of support. The unsupported distance of cables between this point on the bay and the cable rack will not exceed 2'-0".

4.153 Where cabling to a distributing frame passes through a floor slot immediately under the frame, an unsupported length of not more than 4'-0" measured along the shortest cable is permissible. In the case of cabling entering a distributing frame from a cable rack at the top of the frame, the cables may be unsupported at the turn for a distance not exceeding 3'-0".

4.154 Secure groups of cables midway between the cable rack and the first support when the distance between these points or the fan arrangement is such that the cables tend to spread apart and result in a poor appearance, as follows.

4.1541 Where the cables are the same size and break off from a regular run, when the bundle of cables is four (4) inches in diameter or less, use an R-4265 Nylon Tie, or a band of twine; over four (4) inches in diameter, secure with Chicago stitch as shown in Figure 1 and Figure 2.

4.1542 Where the cables are of different size and break off a miscellaneous run, when the bundle of cables is (4) four inches in diameter or less, use R-4265 Nylon Tie or band of twine; over (4) four inches in diameter, secure them with a modified Chicago stitch using only one pass through the cables

with twine as shown in Figure 3. Split the cables into two equal groups when coming from one direction. When cables feed from both directions, split cables in two groups according to the direction from which the cables are run.

4.16 Maintain sufficient slack where necessary to provide space for placing future cables in their proper location.



FIG. 1 CABLES FROM REGULAR RUN SECURED TOGETHER BETWEEN RACK AND FIRST SUPPORT WITH CHICAGO STITCH (PAR. 4.1541)

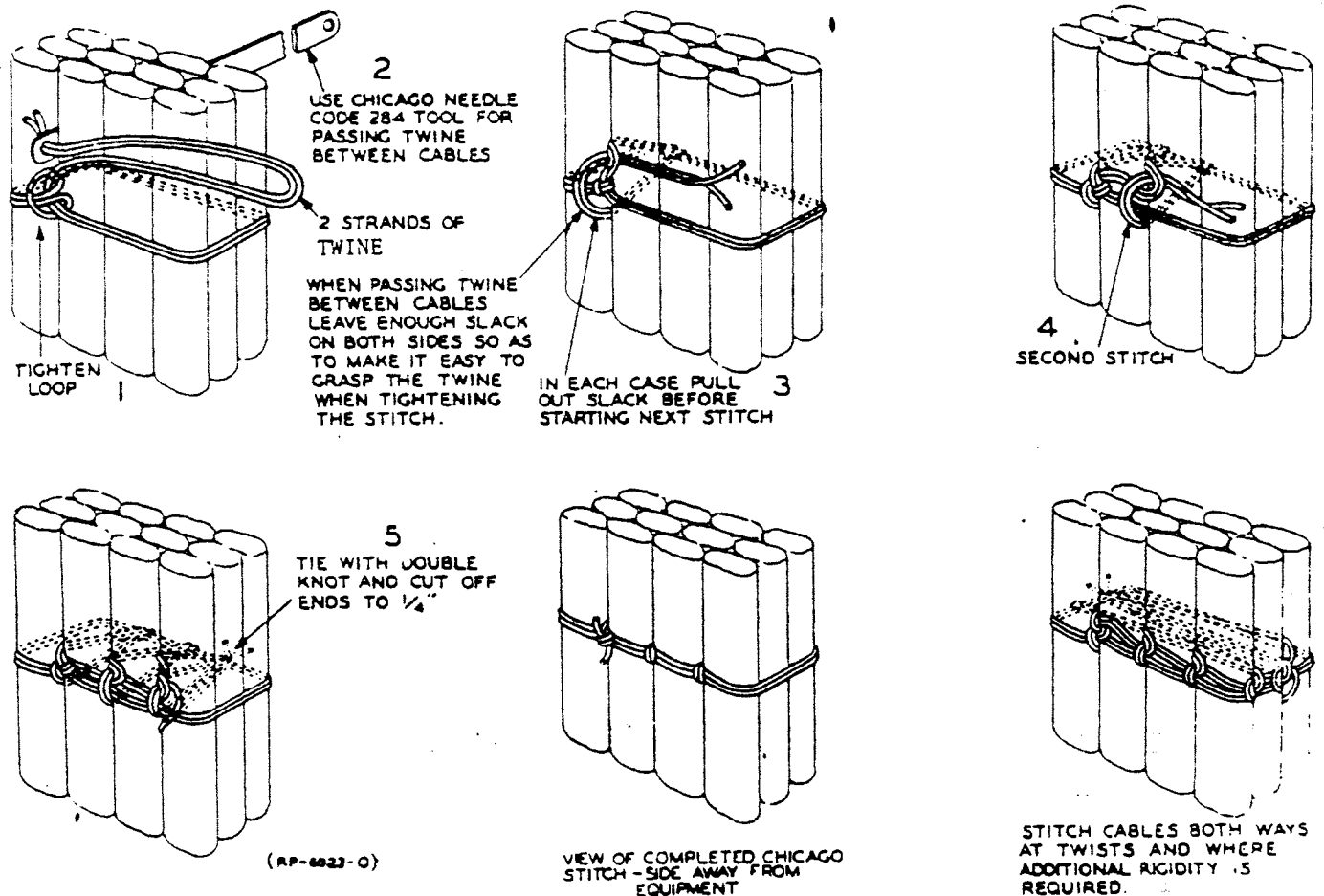


FIG. 2 CHICAGO STITCH USED TO SEW CABLES TOGETHER
(PAR. 4.1541)

5. SECURING SWITCHBOARD CABLE AND WIRE FROM THE CABLE RACK TO THE BUTT LOCATION

5.1 General

5.11 When securing cables with R-4265 Nylon Ties, the locking head of the tie shall not appear between layers of cable.

5.12 R-4265 Nylon Ties shall not be placed directly over the heads of other nylon ties.

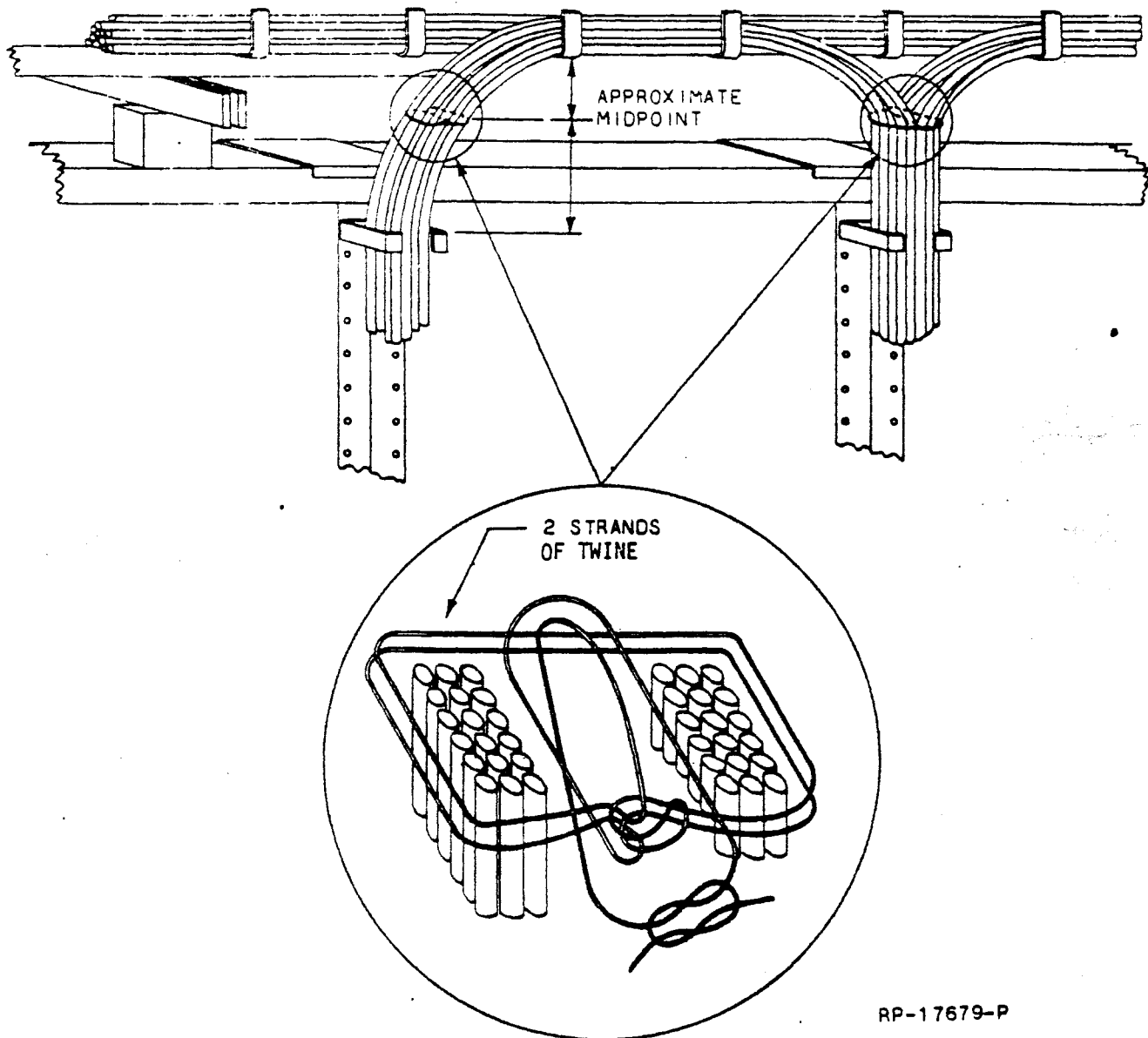
5.13 Nylon ties shall not be used for securing coaxial cable to cable brackets, towel bars, etc., unless the coaxial cables can be completely embedded in the center of the cable form.

5.14 R-4265 Nylon Cable Ties shall not be used for securing vertically run switchboard cables totaling less than 1/2" in combined diameter to cable brackets or other wiring supports.

5.2 Securing Switchboard Cable at Frames, Bays, Racks, and in Switchboards

5.21 Secure all cables and wire to supports except short multiple in switchboards, desks; and cables passing through fanning rings. Refer to Section 221 of Handbook 9 for requirements pertaining to the protection of rubber and PE insulated wires when securing.

5.211 Secure cables to the top cable bracket of a frame with R-2916 Twine, using either the Kansas City or Chicago stitch as illustrated in Figure 6 of this section. See PAR 5.214 for exception.



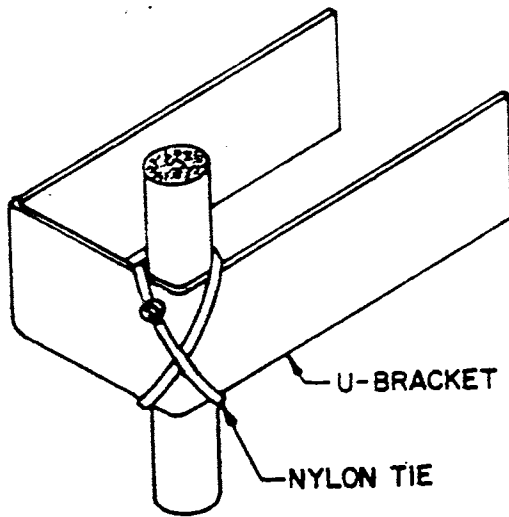
RP-17679-P

FIG. 3 CABLES FROM MISCELLANEOUS RUN SECURED TOGETHER BETWEEN
RACK AND FIRST SUPPORT WITH A MODIFIED CHICAGO STITCH
(PAR. 4.1542)

5.212 When securing switchboard cable butts at equipment frames, the cable butt will be secured to the cable bracket with R-2916 Twine, regardless of the location of the frame. See PAR 5.214 for exception.

5.213 Secure cables to equipment frame brackets (except cable butts and at the top bracket) using R-4265 Nylon Ties as shown in Figures 4 and 5 or R-2916 Twine as shown in Figure 6. See PAR 5.214 for exception.)

5.214 When securing additional cables to a bracket that already contains secured cables, the added cables shall be anchored to the bracket if possible. Where it is not possible to anchor the added cables to the bracket due to cable build-up, they may be banded to previously secured cables. Twine shall be used for banding in the vicinity of the top bracket (first cable support) and at cable butt locations. At other cable support locations, the R-4265 Nylon Cable Ties are acceptable.



RP-0071 RM-1

FIG. 4 SECURING CABLE TO THE INSIDE OF U
TYPE BRACKET
(PAR. 5.213)

5.215 When securing at equipment frame supports, the maximum number of cables placed under an R-4265 Nylon Tie or R-2916 Twine Stitch shall be in accordance with Table "A" of this section.

5.22 When securing on a frame, the last support adjacent to the butt should be withheld until the cable has been stripped and the stripper placed in position for the fanning or forming operation.

5.23 Where the butt location of cables is between cable brackets, below the lowest bracket, or above the uppermost bracket on the frame, secure the cables to other cables passing the butting point to provide additional support.

5.231 When the butt is located in excess of 2 inches below the uppermost or an intermediate cable bracket:

- (a) Secure a single cable to one or two large cables or several smaller cables with a nylon tie or band of twine placed approximately 1 inch above the butt.
- (b) Secure two or more cables together with a nylon tie or band of twine placed approximately 1 inch above the butts and include one or two large cables or several smaller cables.

5.232 When the butt is located below the lowest cable bracket, it is permissible to have a length of 10 inches between the butt and the bracket.

NOTE: If the butt is located at a point in excess of 10" below the lowest cable bracket, the butts are considered to be inadequately supported and such cases should be referred on a Route "C" J.I.M. as specified in the Service Division Instructions.

5.233 When the butt location is above the uppermost cable bracket on the frame or bay upright, the butted cable or cables should be secured to one or two large cables or several smaller cables passing the butt location. Place the nylon tie or band of twine approximately 1 inch above the butt location.

5.24 Secure cables compactly so they will not occupy a greater space than is provided for the particular runs.

NOTE: Secure cables in a compact and neat manner.

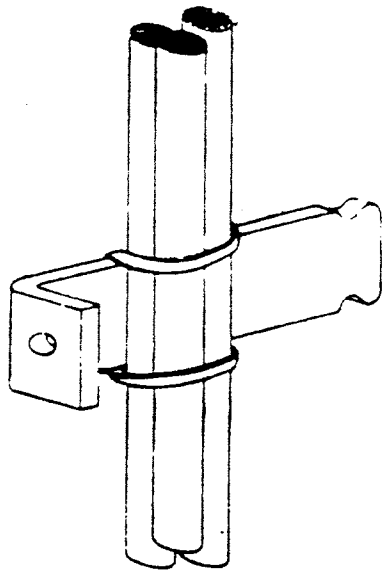
5.3 Securing Switchboard Cable and Wire at the Vertical Side of Distributing Frames

5.31 Secure cables to transverse arm with either twine or R-4265 Nylon Ties as shown in Figure 6, 7, or 8. Place the number of cables under an R-4265 Nylon Tie, or Twine Stitch, in accordance with Table "A" of this section.

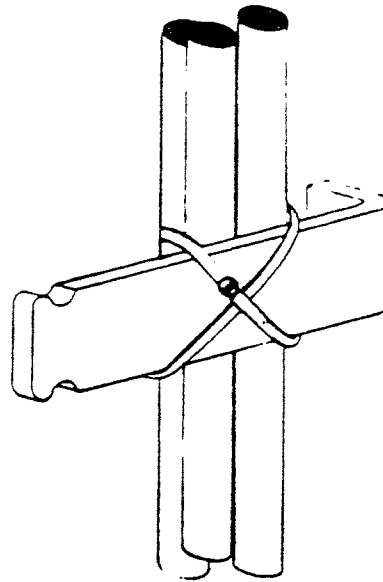
5.311 On distributing frames having transverse arms on 13 inch vertical centers, secure all cables at all transverse arms.

5.312 On distributing frames having transverse arms on less than 13 inch vertical centers, secure all cables at the first (top or bottom) transverse arm where cables enter the frame and at alternate arms, counting from the first arm. At other than alternate arms, secure only those cables which butt or turn off at these arms.

- 5.313 When fanning rings are used on the vertical side, the ring shall be considered as a means of securement for those cables within the ring.
- 5.32 Arrange the cables as shown on the cable plan drawings.
- 5.33 Secure cables terminating on the vertical terminal strips in each vertical in the following manner.
- 5.331 Secure the cables to the first transverse arm after determining the arm at which each cable will break off.
- 5.332 Stripping and butting the cables before securing them to the other transverse arms will facilitate the stripping and butting operation.
- 5.3321 An exception is where cables are arranged on multilayer basis with the bottom layers serving the terminal strips furthest away (lower or upper part of vertical) from the first arm. Securing the bottom layers partially down or up the vertical before stripping and butting the cables in these layers will facilitate the securing operation.
- 5.333 Secure cable butts to transverse arms including cables butting at the first arm with R-4265 Tie or Twine. Arrange the butts of the cables terminating on the vertical terminal strips so that they will be in vertical alignment.
- 5.3331 A dimension is generally shown on cable plan drawings between the rear side of the vertical terminal strips and the side of the vertical cable run adjacent to them. This fixes the position of the cable break-offs (cable butts) on the transverse arms. Generally, this dimension is shorter for the cables butting at the first arm.
- 5.3332 At transverse arms where fanning rings are used, place cable butts and as many cables adjacent to the butted cables as the ring will easily accommodate within the ring. Cable plan drawings show the application of fanning rings for this purpose.
- 5.34 Secure cables terminating on the horizontal terminal strips in each vertical as follows.
- 5.341 Secure the cables to the first transverse arm after determining the arm at which each cable will turn off.
- 5.342 Determine the arms to which cables will be secured.
- 5.3421 Generally, cables turn off from the side of the cable run next to the horizontal terminal strips with the cable turn offs in a vertical line.
- 5.3422 Some cable plan drawings fix the vertical cable line of turn off by reference to the face of the bay vertical angle as follows:
- (a) By a dimension between the line and the angle face for some verticals.
 - (b) By specifying the minimum bending radius for the cables involved between the line and the angle face for other verticals.
- 5.3423 Some cable plan drawings show cables turning off from the side of the vertical cable run away from the horizontal terminal strips but not in vertical alignment. Examples are Panel and Step-by-Step IDF's.
- 5.343 Pass cables through the frame and secure them to the transverse arms as in Figure 11 or 12.
- 5.35 Wires run with switchboard cable at the vertical side of distributing frames shall be secured to transverse arms in the same manner as switchboard cable.
- 5.4 Securing Switchboard Cable to Brackets at Crossbar Single Sided LDF and TRDF by Sewing
- 5.41 At the LDF and TRDF and grouping frames on crossbar installations, it will be necessary to take special precautions to insure maintaining the radius required in the cables at each location between cable rack and top bracket. Form cables over wood strips secured to the underside of the superstructure are so located as to maintain the proper radius and uniformity of the cable bends.



FRONT VIEW



REAR VIEW RP-0033 RM-1

FIG. 5 SECURING CABLE TO "L" TYPE BRACKET
(PAR. 5.213)

5.42 Install cable brackets loosely when cables are run into the frame. Tighten after cables are sewed to the rear of the bracket. See Figure 9.

5.43 Secure cables run on the rear (outside) of cable brackets by sewing, using the Kansas City or Chicago Stitches as shown in Figure 6 of this section. Use two strands of twine and place the number of cables under a stitch in accordance with Table "A". Secure cables at every bracket.

5.431 The hole in the end of the bracket may be used to secure the sewing twine when cables are located close to the end of the bracket.

5.44 To avoid sewing cable unnecessarily at the rear of brackets, place block relay and message register cables inside of brackets which are not occupied by cables from the line link frames to the horizontal terminal strips. This practice is shown in detail on the cable plan drawing for these frames.

5.5 Securing Switchboard Cable Running Under and Perpendicular to Transverse Arms at the Horizontal Side of Distributing Frames

5.51 Cables running perpendicular to the horizontal transverse arms shall be secured to the underside of the transverse arm with R-4265 Nylon Ties or R-2916 Twine.

5.52 Secure all cables at each transverse arm as shown in Figure 10 or Figure 6. Refer to Table "A" for number of cable per tie or stitch.

5.6 Securing Switchboard Cable and Wire Along Transverse Arms and Similar Supports

5.61 Secure cables along transverse arms of distributing frames by using cable ties (R-4265 List 2) as shown in Figure 11 or with twine as shown in Figure 12.

5.62 Cables should be butted and stripped at the horizontal side of the distributing frame prior to applying the last R-4265 tie or twine stitch adjacent to the butt. Care should be taken to insure correct placement of cable butts and to maintain proper radius and uniformity of cable bends.

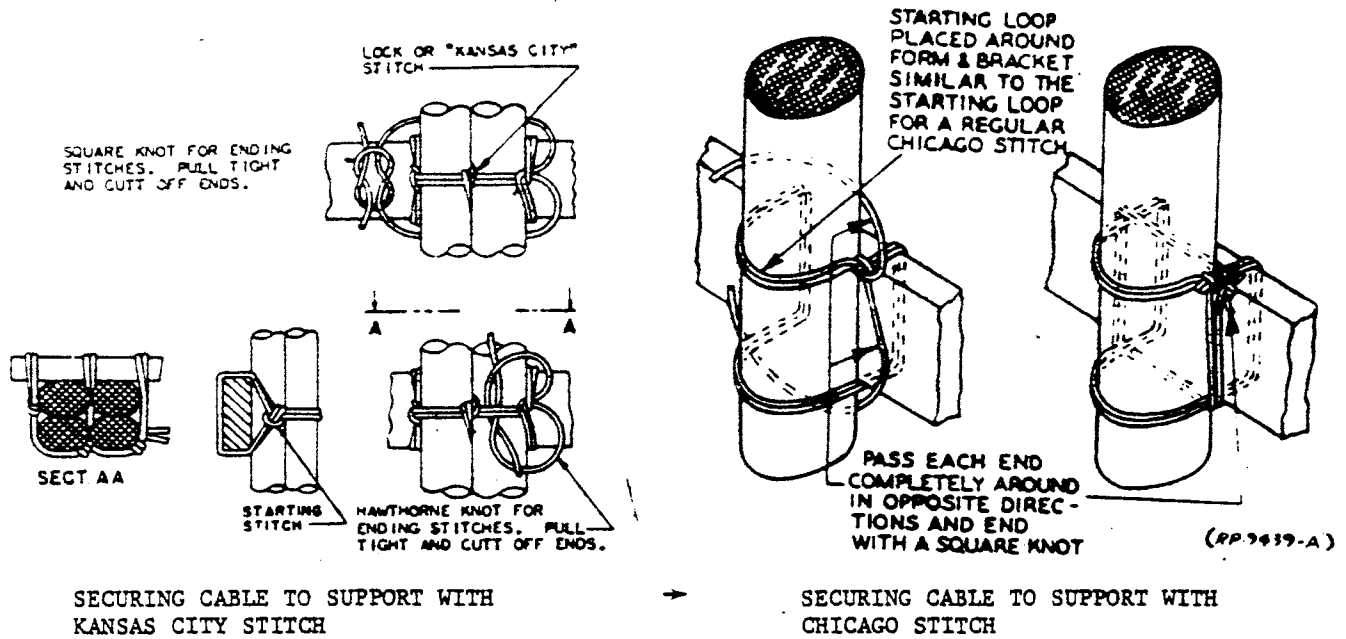


FIG. 6 SEWING CABLES TO CABLE BRACKETS AND DISTRIBUTING FRAME TRANSVERSE ARMS
(PAR. 5.211, 5.212, 5.213, 5.31, 5.43)

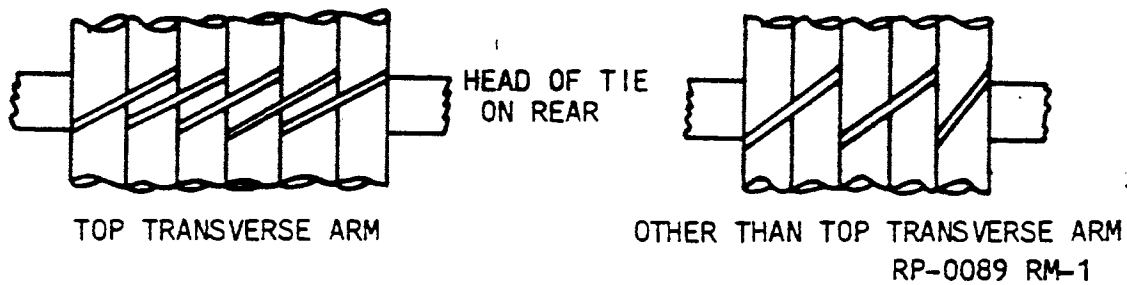


FIG. 7 SECURING FIRST LAYER OF CABLE ON VERTICAL SIDE OF DISTRIBUTING FRAME
(PAR. 5.31)

CABLE SIZE (DIAMETER)	MAXIMUM CABLE BUNDLE DIAMETER (OR EQUIVALENT)
LESS THAN 1/2"	1-1/2"
1/2" to 1"	2"
LARGER THAN 1"	2-1/2"

TABLE "A"

MAXIMUM CABLES PER R-4265 TIE OR TWINE
STITCH AT CABLE SUPPORTS
(PAR. 5.215, 5.31, 5.43, 5.52)

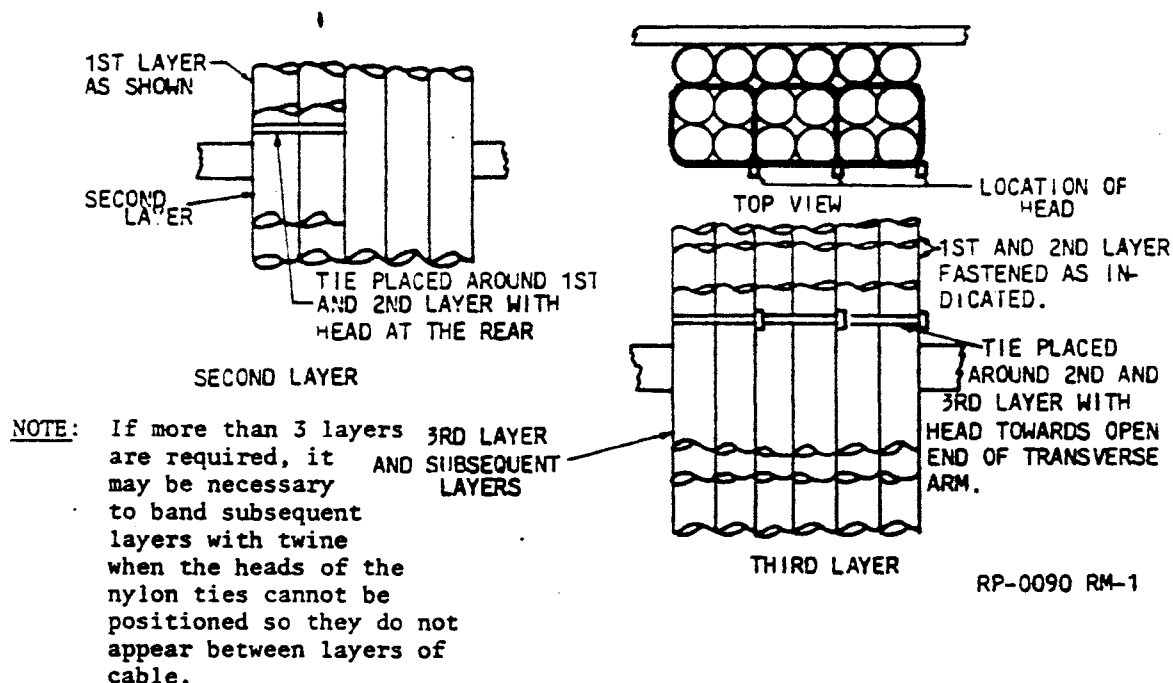


FIG. 8 SECURING SECOND AND SUBSEQUENT LAYERS OF CABLE ON VERTICAL SIDE OF DISTRIBUTING FRAMES (PAR. 5.31)

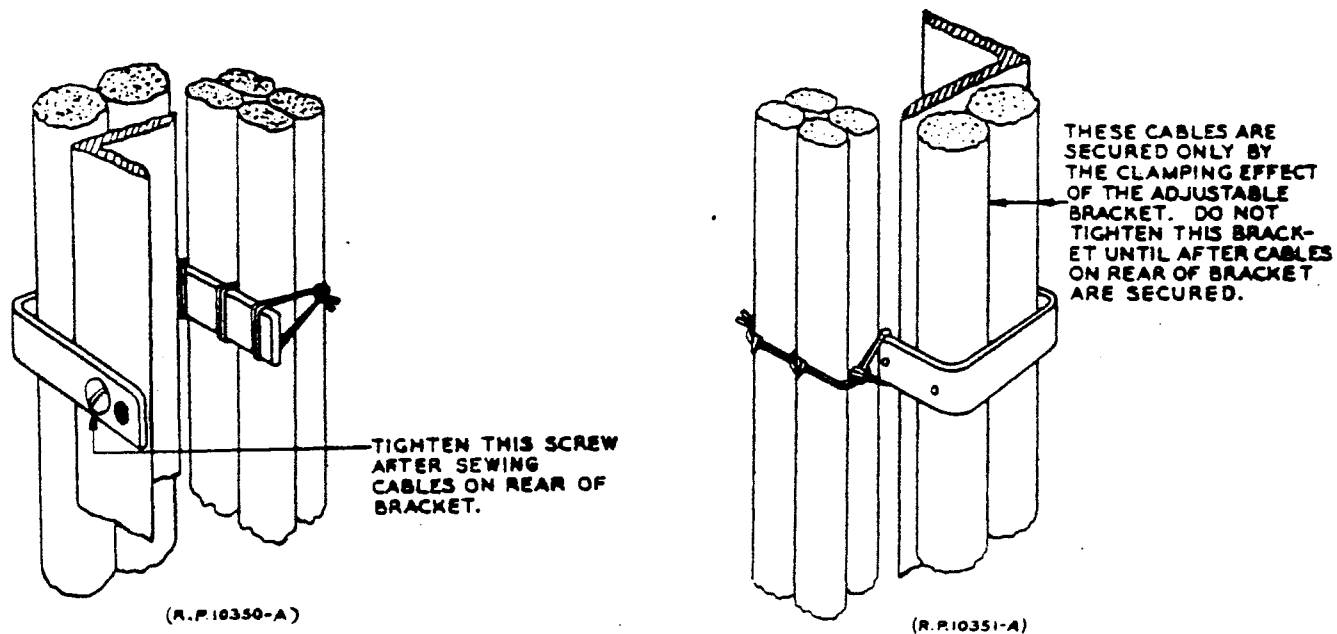


FIG. 9 SECURING CABLE TO BRACKETS AT SINGLE SIDED LDF AND TRDF BY SEWING (PAR. 5.42)

5.63 Cables which are run parallel to the transverse arms at the horizontal side of the distributing frames should be secured to the transverse arms with cable ties or twine as follows:

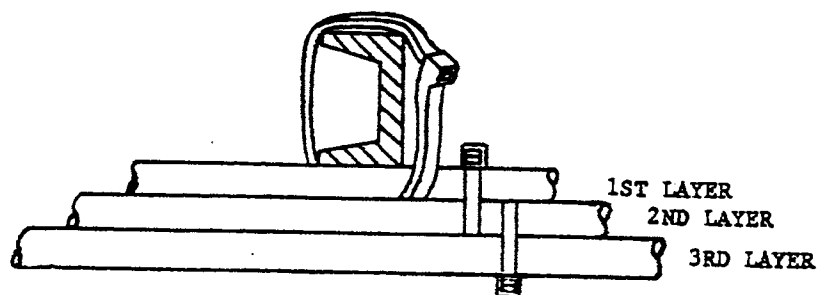
- (a) On arms 5" or less in length, place a tie at the cable butt. (Cable Sheathing side.)
- (b) On arms over 5" but less than 9" in length, place a tie midway between the butt and turn of the cable. Where fanning rings or distributing rings are not used, place additional ties at butt of cable as covered in PAR. 5.631.
- (c) On arms 9" to 1'-6" in length, place a tie as near to the turn of the cable as practicable and another uniformly close to the butt. Where fanning rings or distributing rings are not used, place the second tie at the butt of the cable as covered in PAR. 5.631.
- (d) On arms longer than 1'-6", place a tie as near to the turn of the cable as practicable, either on the horizontal or vertical side of the upright, a second tie midway between the butt and turn, and a third tie uniformly close to the butt. Where fanning rings or distributing rings are not used, place the third tie at the butt of the cable as covered in PAR. 5.631.

5.631 At the horizontal side of distributing frames, where cables are run parallel to the transverse arms and where fanning rings or distributing rings are not used at the cable butts, place a fiber detail, 449759 (or a piece of 1/64" fiber), between the cable butt and the transverse arm to prevent the wires at the cable butts from coming in contact with the metalwork. Secure the fiber detail in place by locating the tie (nylon or twine) at the cable butt (Cable Sheathing side) as shown in Figure 11 or 12.

5.64 Typical arrangements of nylon ties and cables secured with nylon ties are illustrated in Figure 11.

5.641 Be particularly careful not to apply ties so tight as to deform the cable covering.

5.65 Place wire run with cable between the cable and the transverse arm. Additional protection is unnecessary.



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FIG. 10 CABLES SECURED TO UNDER SIDE OF TRANSVERSE ARM
WITH R-4265 NYLON TIES
(PAR. 5.52)

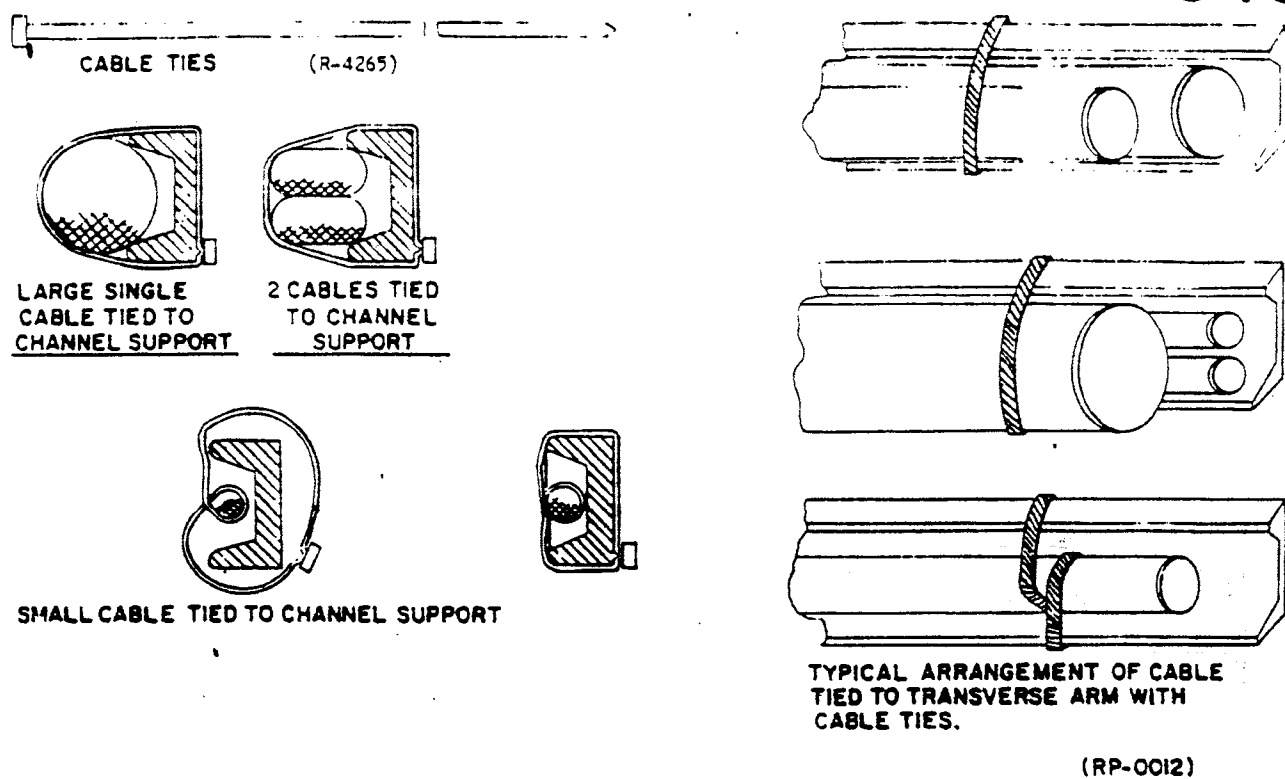


FIG. 11 CABLE SECURED ALONG TRANSVERSE ARM WITH R-4265 NYLON TIES
(PARS. 5.343, 5.61, 5.631, 5.64)

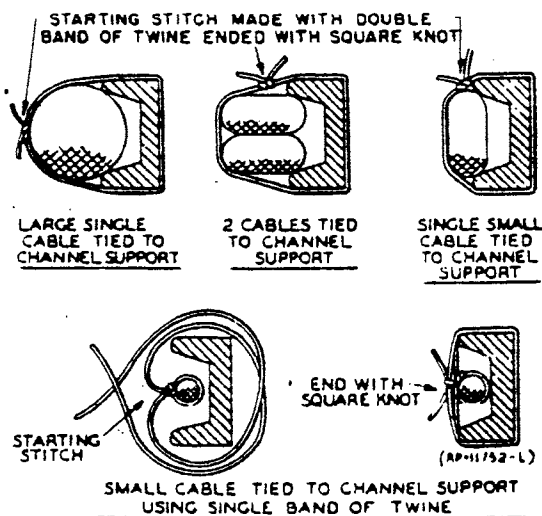


FIG. 12 TYPICAL METHOD OF SEWING CABLE AT HORIZONTAL TRANSVERSE ARM ON DISTRIBUTING FRAMES
(PARS. 5.61, 5.631, 5.343)

6. VERIFICATION

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS		REFERENCE	
		Paragraph Number	Figure Number
6.1	<u>Arrangement of Cable and Wire From Cable Rack to Butt Location</u>		
6.11	<u>Arrangement</u>		
6.111	Cables arranged as indicated on cable plan drawings for each type of equipment.	5.32 4.11	
6.112	Cables arranged to permit installation of ultimate equipment.	4.112	
6.2	<u>Securing Switchboard Cable and Wire on Rack, Frames, Bays, and in Switchboards</u>		
6.21	<u>General</u>		
6.2101	All cable and wire secured to supports at frames, bays, racks, and switchboards except short multiple in switchboards and desks and cables passing through fanning rings.	5.21	
6.2102	Cables secured to new frames, bays, relay racks, switchboards, and verticals of distributing frames as shown on cabling drawings.	4.12	
6.2103	Switchboard cables leaving racks and entering switchboards, frames, or other equipment secured so that there is no appreciable sag in the cable.	4.15	
6.2104	Cables between last support on cable rack and first support on frame (except distributing frames) not unsupported for a distance greater than 2'.	4.151	
6.2105	From top of duct type bays to cable rack, unsupported length of cable not more than 2'.	4.152	
6.2106	From distributing frames to cable slot in floor, unsupported length of cable not more than 4'.	4.153	
6.2107	Cable entering distributing frame from cable rack, unsupported length not to exceed 3'.	4.153	
6.2108	Cable groups secured midway between cable rack and first support where distance between these points is such that cables tend to spread apart.	4.154 4.1541	1,2
6.2109	Cables from miscellaneous runs secured together between rack and first support with nylon tie or band of twine for bundle 4" in diameter and under, over 4" in diameter with modified Chicago stitch.	4.1542	3
6.2110	Proper number of cables under stitches or nylon ties.	5.215 5.31 5.43 5.52	

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS (CONTINUED)		REFERENCE	
		Paragraph Number	Figure Number
6.2111	Nylon ties shall not be placed directly over the heads of other nylon ties.	5.12	
6.2112	Locking head of nylon tie shall not appear between cable.	5.11	
6.2113	Coaxial cable not secured to cable brackets, towel bars, etc., with R-4265 Nylon Ties unless completely embedded in the form.	5.13	
6.2114	Vertically run cables totaling less than 1/2" in combined diameter not secured to cable brackets or other wiring supports with nylon ties.	5.14	
6.2115	Cables secured to equipment frame brackets with R-4265 Nylon Ties (except at cable butt and top bracket), or twine.	5.213	4,5,6
6.2116	Cables secured to top bracket of equipment frame with twine.	5.211	
6.2117	Cable butts on equipment frames secured to brackets with twine.	5.212	
6.2118	Where cable butts appear above, below, or between equipment frame brackets, the butt will be secured to other cables passing the butting point.	5.24 5.241 5.242 5.243	
6.2119	R-4265 tail flush with head. Maximum protrusion 1/32".	3.52	
6.22	<u>Securing Cable and Wire at Vertical Side of Distributing Frames</u>		
6.221	Cables secured to every transverse arm on distributing frames having arms on 13" vertical centers.	5.311	
6.222	Cables secured to first transverse arm, to alternate arms, and at all arms where they butt or turn off on distributing frames having arms on less than 13" vertical centers.	5.312	
6.223	Fanning rings used on the vertical side considered a means of securement for cables within the ring.	5.313	
6.224	Secure butts of cable with R-4265 Tie or Twine. Arrange butts of cable to vertical terminal strip in vertical alignment.	5.333	
6.225	Wires run with switchboard cable secured to transverse arms in the same manner as switchboard cable.	5.35	
6.23	<u>Cables Running at Right Angles to Transverse Arms on Horizontal Side of Distributing Frames</u>		
6.231	Cables secured to underside of transverse arms with nylon ties or twine.	5.51	
6.232	Cables secured at every transverse arm unless otherwise specified.	5.52	10

VERIFICATION ITEMS AND BRIEF STATEMENT OF REQUIREMENTS (CONTINUED)		REFERENCE	
		Paragraph Number	Figure Number
6.24	<u>Cable Secured Along Transverse Arms and Similar Supports</u>		
6.241	Cables along transverse arm secured with R-4265 Cable Ties or twine.	5.61	11,12
6.242	Proper number of ties or stitches used according to length of transverse arm.	5.63	
6.243	Wires at cable butts on horizontal side of distributing frame protected with fiber detail P449759 when fanning rings or distributing rings are not used. (1/64" sheet fiber used when P449759 not available.)	5.631	
6.244	Nylon ties not applied so tight as to deform the cable covering.	5.641	
6.245	Wire run with cable placed between cable and transverse arm without additional protection.	5.65	

→ Indicates new or changed information.

[Vertical lines at side of paragraphs
indicates requirements.

Engineering Planning Manager
(Installation)

Reason for Reissue:
To modify Paragraph 5.333.