

# Cabling Methods - Running and Securing Switchboard Cable

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# 1 . General

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- 1.1 Purpose** This practice provides the methods and procedures recommended for running and securing Central Office switchboard cables.
- 1.2 Filing Instructions** Remove and discard Issue 5, and file this issue in its place in your GTE Telephone Operations practices set.
- 1.3 Supersedures** This practice supersedes:
- All local practices, policies, procedures, general instructions, letters, and memoranda which address this subject.
  - Any document which provides information contrary to the information contained in this practice.
- 1.4 Reason for Reissuing** This practice has been updated to clarify DC power cable separation, fiber optic cable placement guidelines and add general cable running guidelines in support of installation quality procedures. Information for HF cable butting and separating loose wires was also added.
- 1.5 Copyright and Responsibility** This practice was published by the GTE Telephone Operations Administrative Services Department. For more information about this practice contact the Headquarters COE Construction Department.
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- 1.6 Disclaimer** This practice was prepared solely for the use of GTE Telephone Operations. It must be used only by its employees, contractors, customers and end users, when installing, operating, maintaining, and repairing GTE Telephone Operations' equipment, facilities and services. Any other use of this practice is forbidden. The information contained in this practice may not be applicable in all circumstances and is subject to change without notice. By using this practice the user agrees that GTE Telephone Operations will have no liability (to the extent permitted by applicable law) for any consequential, incidental, special, or punitive damages that may result.

## 2. Overview

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- 2.1 Introduction** This practice provides the methods and procedures recommended for running and securing switchboard cables to all types of switchboard cables.
- Cable installation planning, safeguards, and precautions are covered in GTE Telephone Operations Practice 256-050-203 and should be reviewed concurrently with this practice.
- 2.2 Tools and Materials** The cable installation tools and materials required to complete the central office switchboard cabling procedures referenced in this practice are covered in GTE Telephone Operations Practice 256-050-203 and/or the COE Installation Standard Tools and Test Equipment Handbook.

## 2. Overview, continued

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### 2.3 References

Refer to the following GTE Telephone Operations practices before running switchboard cables.

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<b>See GTE Telephone Operations Practice...</b>	<b>For Information Regarding...</b>
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075-170-100	Cable and Support Ties -- Description and Use.
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256-050-203	Cabling Methods -- installation Planning and Safeguards.
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256-050-205	Butting, Stripping, and Fanning Cable.
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256-050-206	Cabling Methods Power Cable -- Running and Securing.
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256-050-216	Shielded and Coaxial Cables.
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256-150-201	Distributing Frame Cabling.
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795-805-071	Central Office Grounding Systems -- Engineering Applications.
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795-805-072	AC Service Grounding Engineering Applications.
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795-805-073	Central Office Grounding Systems -- Transmission.
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835-000-071	T1 PCM Repeatered Line -- Transmission Considerations for Engineering.
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938-624-000	Optical Fiber Cable General Outside Plant Design Considerations
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<b>See AG Communication Systems Practice...</b>	<b>For Information Regarding...</b>
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256-224-216	Cabling Methods - GTD-5 EAX
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## 3. Cable Running

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### 3.1 Planning

Careful planning of the Central Office switchboard cable process is required to determine:

- The specific order in which the cables are run.
- Where cable separation/zoning requirements exist.
- When and where paired cables or maximum or minimum length cables are required.

### 3.2 General Guidelines

The following considerations are primary and should be observed in advance of starting the actual cable running:

- When running cables from one piece of equipment to another, whenever possible:
  - 1 Run the larger, longer cables first.
  - 2 Follow these cables with any successive large uniform switchboard cables.
  - 3 And, finally, run the smaller, shorter cables.

**NOTE: This will minimize potential damage by positioning the smaller, lighter weight cables on top of the stack.**

- Depending on the site floor plan layout, and when possible, run digital cables within a lineup to the frames closest to the Time Switch and Peripheral Control Unit Frame (TCUF) in the same lineup first, etc., out to both ends of the lineup. In this way, cables will not go through other cables to drop down the frames.
- Cables are to be run parallel in horizontal cable runs.

If it becomes necessary to cross cable or cables from one side of the trough or runway, make the crossover gradually when cable separation requirements do not exist. Minimize cable crossover when making vertical drop-offs from the runway or trough by planning ahead.

**NOTE: Avoid unnecessary pileup or twisting of the cables.**

- If cables require zoning or separation, they are to cross at 90-degree angles while maintaining the minimum cable radius bends. Different cables requiring separation (such as GTD-5 EAX; see AGCS Practice 256-224-216) must not run parallel to each other outside the rack/trough/grid unless the minimum cable separation requirements are maintained.
- P-wire runs are not to be intermixed with sheath cables. They are to be run on goal post, p-wire rings, or loosely secured with cable ties underneath the cable racks.

**NOTE: Do not tie, wrap, or bundle different cable types together in the same bundles, e.g., power and ground, signal transmission, loose wires, etc.**

- At the intersection of trough or cable runway, plan the cable run so that a group of cables running in the same direction will cross over at one time.

**NOTE: This will limit the interweaving of cables.**

- Stack the cables in such a manner that future cables will not be blocked. Leave room for miscellaneous cables on the runway.
- If the working space available in the troughs or runway is limited, and if it is difficult to make long, straight cable runs when shorthanded, use the pulley method outlined in GTE Telephone Operations Practice 256-050-203.

### 3. Cable Running, continued

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#### 3.2 General Guidelines, continued

- Do not let any of the cables sag (through the slots) below the bottom plane of the cable runway sidebars.
- Do not let any of the cables drop over or extend more than one full cable diameter over the side of the runway.
- In existing offices, make sure service affecting cables are run during the maintenance window.
- Make sure each cable in the bottom layer parallels the adjacent cables with a maximum separation between cables of one-half inch at each supporting slat.
- Make sure no excess cable length can be seen (to the extent possible) when an observer looks up the cable runway.
- Make sure no gaps exist (to the extent possible) that allow an observer to look through the center of a group of cables and see the ceiling.
- Make sure all sharp edges of the runway, trough, threaded rods, etc., are protected from accidental wire or cable cutting when running and housing the wire and cable. Use threaded rod covers and material covered in GTE Telephone Operations Practice 256-050-203.

**CAUTION:** Use caution when running cable on central office cable rack and grid. Never step, sit, or kneel on cables as the direct pressure could cause damage to the cable conductors.

If you must enter into a cable area, use plywood or other supportive materials to distribute any weight. Be aware that cables may be dislodged or damaged when contact is made with cables.

#### 3.3 Running Distributing Frame Cables

Review GTE Telephone Operations Practice 256-150-201 before running cables to the distributing frame.

#### 3.4 Cable Separation

General Switchboard Cable minimum separation guidelines are as follows:

- From DC power cables: normally ten to twelve inches, but could be three inches when the switchboard cables and power cables must be run on the same cable rack because of site restrictions. Refer to GTE Telephone Operations Practice 256-050-206.
- From ground cables (except lightning protection ground [LPG]): one to two inches.
- From LPG cables: five to six inches.

See Section 2.3 for information regarding associated practices.

Depending on the type of transmission shielded cable ordered, and the engineering configuration, a minimum cable separation of six inches may be required. Refer to GTE Telephone Operations Practice 835-000-071, T1 PCM Repeated Line Transmission Considerations for Engineering. Additional transmission cable information is covered in GTE Telephone Operations Practice 795-805-073, Section 3.3.

## 3. Cable Running, continued

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### 3.5 Running Cables with Drop Offs

The following guidelines apply when running cables with drop-offs:

- individual cables and bundles of cables which drop off of a runway must be dressed as compactly as possible to prevent scattered cables.
- The bottom layer of the runs with drop-offs do not have to be composed of individual cables that are parallel to each other and do not have to be laced to the runway, but the cables must run in the same general direction.
- Bundle together from frame/file terminated cables running from the runway to the top file; route and secure them directly to the outside part of the cable runway sidebar.
- Route all rear frame/file terminated cables down through the runway.

### 3.6 Running Cables on Grid

In general, cables should be run and secured on grid as they are on runway. The following covers specifics:

- On full grid offices, cables can be run point to point provided that the zoning and separation, when required, and minimum radius bend rules covered in Section 3.7 are followed.
- Cables may be run down lineups over aisle space, rather than over frames, to prevent blocking airflow and to maintain zoning requirements.
- No cables should sag below channel braces that support the grid or over the edge of the outside perimeter of the grid.
- Do not route the rear cables into the aisle before dropping into the backplane or cable rings.
- Excess cable (slack) rolls or runs must also comply with minimum radius and separation rules.
- When zoning or separation is required, cables in one zone should be placed on the grid toward the front of frames in one lineup, and toward the back of frames in the next lineup. Other zone cables should be placed on the grid opposite the first zone cables. Using this method, cable quantities will not build up, and heat problems will be minimized.
- Should additional zoning/separation requirements exist, run cables on goalposts as is the method for cable runway.

### 3.7 Cable Radius Minimum Bend Requirements

Switchboard and coaxial cables in central offices must maintain specific radii when bending. The following chart gives the minimum radius for different cable conductor groups.

Cable Conductors	Minimum Radius
1 - 6	1/2 inch
a-44	1 inch
50 - 102	3 inches
103 - 402	6 inches
Coaxial	6 inches
Fiber Optic	10 times the cable diameter when the cable is not under tension; 20 times the cable diameter when the cable is under tension.

**NOTE:** All cable bends are measured as the inside radius of the bend. Avoid sharp bends.

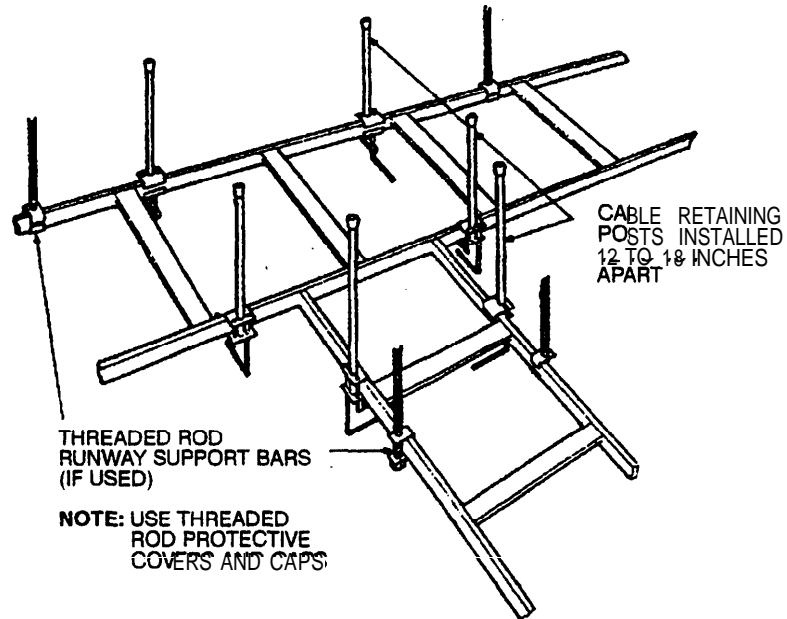
## 4. Cable Securing Procedures

### 4.1 General Guidelines

The following covers cable securing requirements:

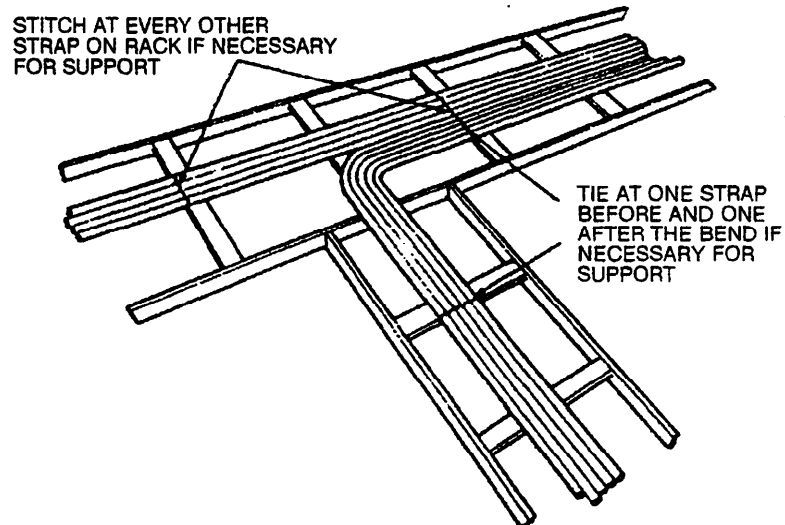
- Do not secure the cables when using horizontal cable trough or cable runway with retaining posts.
- Place cable retaining posts about 12 to 18 inches apart, consistently and uniformly throughout. Exhibit 1 below shows a typical cable runway with retaining posts.

**NOTE:** Whenever possible, the goalpost clips (edge size) should face into the cable rack.



**Exhibit 1 - Cable Runway**

- Cables must be secured in the center of the bend if the cable is not supported by runway slats (as shown in Exhibit 5) for break-offs. See Exhibit 2 for cable securing locations where the cable rack has not been converted to trough.



**Exhibit 2 - Cable Stitching on Cable Runway**

## 4. Cable Securing Procedures, continued

### 4.1 General Guidelines, continued

- For appearance, all cable ties must oriented in the same direction on runway slats, distributing frame uprights, etc., and should be consistent in their placement wherever possible.
- Cable ties must be secured with enough tension (equal tension among similar applications) to securely hold the cable(s) without pinching the cable(s) unnecessarily.
- Use cable ties in an "H-stitch" configuration to prevent movement of a cable bundle.
- Ensure that cable ties are cut off flush, without leaving a sharp flashing. Refer to GTE Telephone Operations Practice 075-170-100.
- If cables are added to an already cable-tied bundle, add a cable tie to the outside of the bundle and remove the existing cable tie. Only use/leave one cable tie per bundle.
- Cables must be cable tied between the point where they break off of a runway or grid and me point where they enter a cableway or ring.

### 4.2 HF/Transmission/ Optical Fiber Cable Securing

Do not lace High Frequency (HF) shielded cable to the cable rack or grid runway. If securing is necessary, loosely tie the stitches or pull the cable ties so that indentations are not made in the cable.

**NOTE: Tightly laced stitches or cable ties can alter the capacitance of the cable. Each tie/stitch will change the cable diameter and slope loss at high frequency.**

**Avoid sharp ends of hardware where the likelihood of crushing and bending of HF cable should cause problems.**

Butt HF/transmission cables as close to the termination point as possible to avoid leaving the wires exposed without the protective sheathing.

Optical fiber cables may be routed with high frequency (CXR) cable.

Do not use the power cable runway/zone to support optical fiber/HF cables. Take care to avoid a route that would stack future cables (in excess of 150 pounds) on top of fiber cables.

When placing optical fiber cable within the confines of a CO, put the cable inside a fire retardant conduit (ridged or flexible). Refer to GTE Telephone Operations Practice 938-624-000.

### 4.3 Securing on a Break-Off to Vertical Rack

Switchboard cables break off from the cable runway/trough or grid onto a vertical cable rack for the purpose of cable distribution to other locations or other floors. The following requirements are necessary to secure cables on a vertical rack.

For...	Action
The cables at all horizontal straps	Sew with lacing twine.
Large diameter cables (at least 5/8 inches diameter)	Lace only one cable under each stitch.
Small diameter cables (less than 5/8 inches diameter)	Lace two or three cables under a single stitch depending upon the cable diameter and holding capabilities.

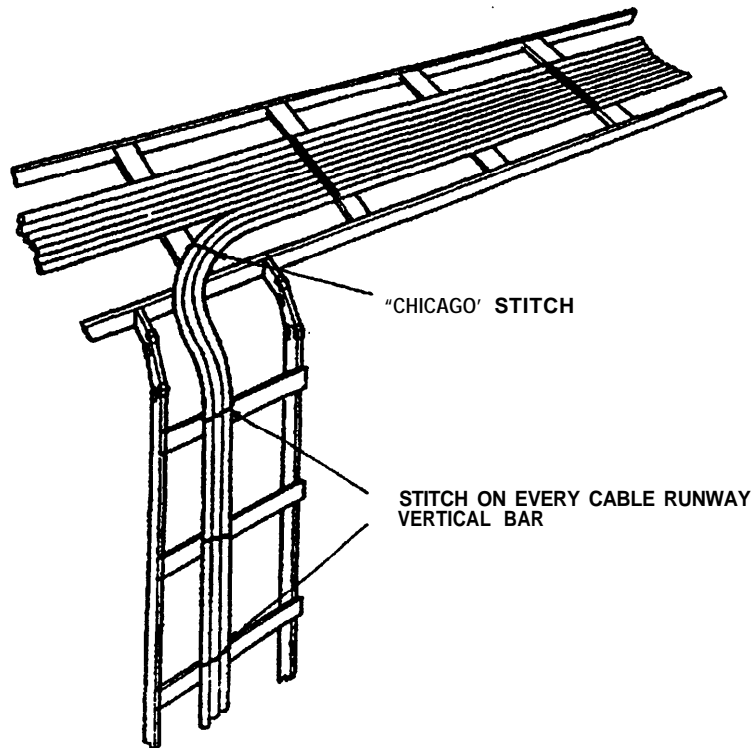
Refer to Exhibit 3 for a sample of stitching cables on vertical break offs.



## 4. Cable Securing Procedures, continued

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### 4.3 Securing on a Break-Off to Vertical Rack, continued



**Exhibit 3 - Stitching Cables on Vertical Break-Offs**

### 4.4 Securing on Break Offs to Equipment

Note the following when securing switchboard cables which break off the cable runway/trough or grid into equipment racks:

- Stitch or cable tie the cables in a group at the top strap of the appropriate rack.
- Band or cable tie each cable no greater than 12 inches apart.
- Dress individual cables in cable runs with drop-offs compactly to prevent cables that appear scattered.
- Bundle together front cables running from the runway to the top frame file. Route and secure them directly to the inside part of the cable runway sidebar.
- Route frame rear cables through runway either down the left or right side of the frame depending on the terminating point proximity.

Refer to GTE Telephone Operations Practice 256-050-205 for cable butting, stripping and fanning. Refer to the information in Section 4.2 of this practice for HF/transmission cable securing.

Exhibits 4 and 5 show the method for securing cables on a break-off to equipment.

## 4. Cable Securing Procedures, continued

### 4.4 Securing on Break Offs to Equipment, continued

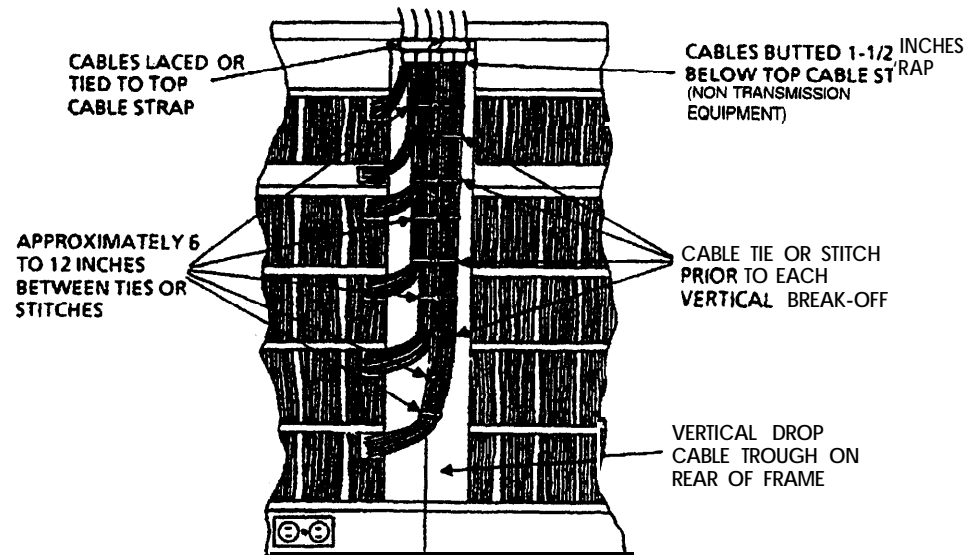


Exhibit 4 - Cable Break-Off to Equipment (Matrix Type Frame)

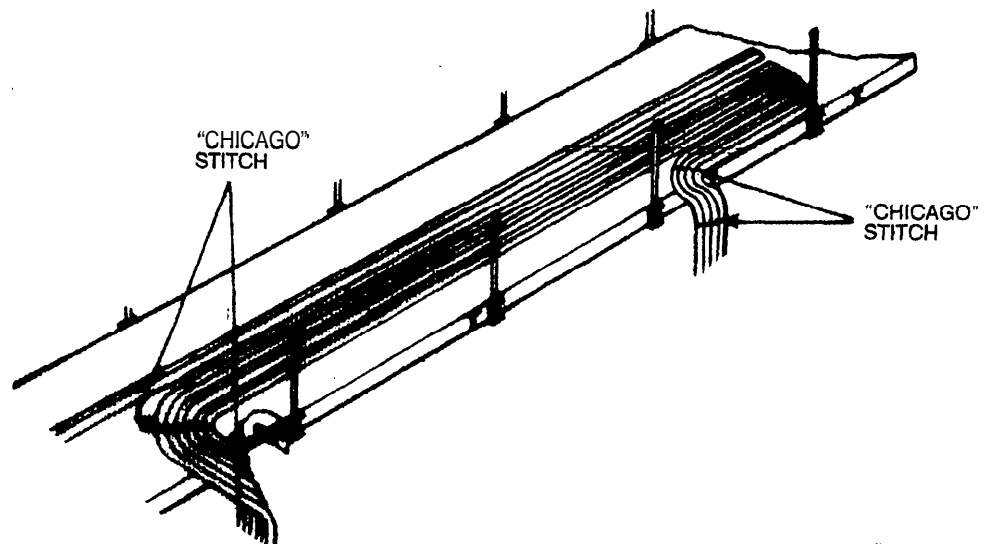


Exhibit 5 - Typical Cable Run Showing Break-Offs and  
Stitching at Break-Offs

## 4. Cable Securing Procedures, continued

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### 4.5 Plug-Ended Cable Slack

Electronic installations use two types of plug-ended cables to interconnect the common control equipment:

- Plug-ended on both ends.
- Plug-ended on one end only.

The cables with the double plug end will allow a natural slack length that cannot be avoided. This slack must be distributed evenly in runway or cableway so that this type of cable is snug in the vertical drop, allowing a three- to five-inch maintenance loop at its connector where it branches off the vertical drop from the runway.

The type of cable that has a plug end on only one end is to be run from the mating connector end, allowing the three- to five-inch maintenance loop prior to the vertical run. The cable is then run without leaving slack on the trough for the horizontal run to the applicable vertical drop. The cable is butted, and all but the required maintenance loop slack at the respective terminal block is eliminated.

Refer to AGCS Practice 256-224-216 for detailed information recurring cables in GTE-5 installations.

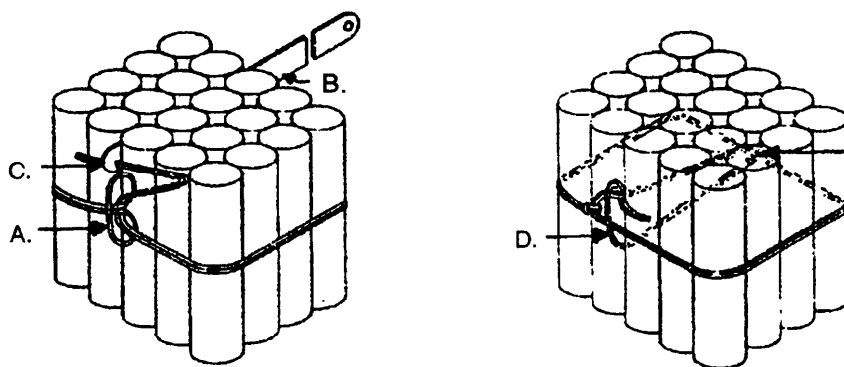
# 5. Lacing Twine Stitching and Lacing Methods

## 5.1 Methods of Tying the "Chicago" Stitch

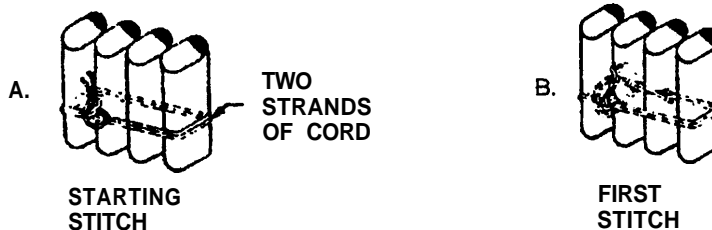
Use the following procedure to lace grouped or small cables to the slats using the "Chicago" stitch.

### Using the "Chicago" Stitch to Lace Grouped or Small Cables to the Slats

- | Step | Using the "Chicago" Stitch to Lace Grouped or Small Cables to the Slats   |
|------|---|
| 1    | <p>A. Make a starting stitch around cables.</p> <p>B. Pass the twine between the cables using a "Chicago" needle.</p> <p>C. Hook the end of lacing twine with the sewing needle.</p> <p>D. When passing the twine between cables, leave enough slack on both sides to make it easy to grasp the twine when tightening the stitch.</p> |



GROUPED OR SMALL CABLES



PULL ALL STITCHES TIGHT

VERTICAL FLAT CABLES

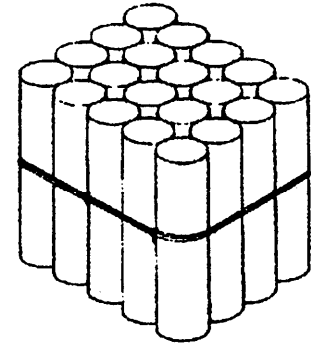
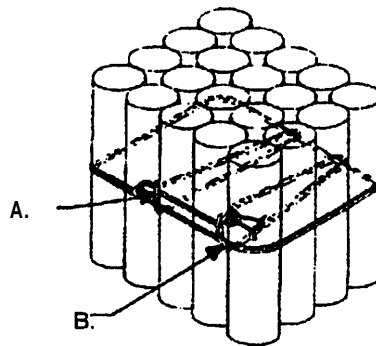
(continued)

## 5. Lacing Twine Stitching and Lacing Methods, continued

### 5.1 Methods of Tying the "Chicago" Stitch, continued

#### Using the "Chicago" Stitch to Lace Grouped or Small Cables to the Slats

- Step 2
- A. Pull out the slack before starting the next stitch.
  - B. Make the last stitch. Tighten stitch and dead-end with a square knot.



REAR VIEW OF  
COMPLETED STITCH

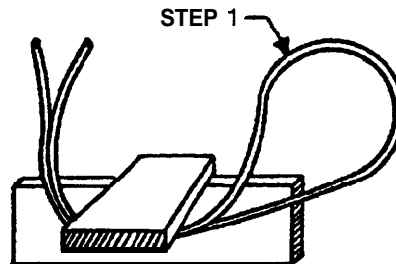
GROUPED OR SMALL CABLES

### 5.2 Starting Stitch Procedure

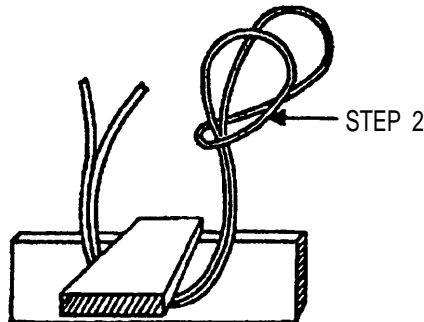
Use the following procedure to make a starting stitch.

#### Step Making a Starting Stitch

- 1 Double a length of lacing twine. Even up the ends, and pass under the last slat.



- 2 Double loop end back on itself.



(continued)

## 5. Lacing Twine Stitching and Lacing Methods, continued

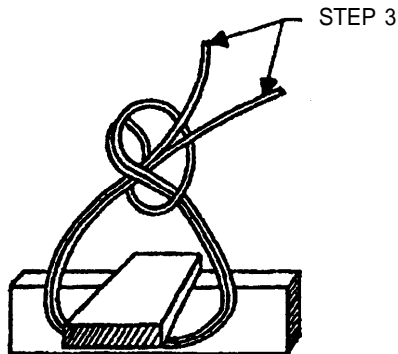
### 5.2 Starting Stitch Procedure, continued

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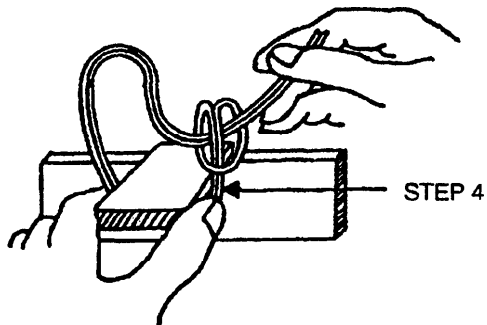
Step	Making a Starting Stitch
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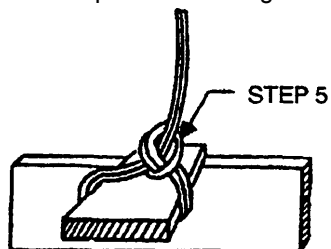
- 3 Place free ends through loop.



- 4 Hold in position and pull out slack. Avoid crossed stitches under slat.



- 5 Complete stitch. Tighten securely on slat.



## 5. Lacing Twine Stitching and Lacing Methods, continued

### 5.3 Lacing Cables, "Kansas City" Method

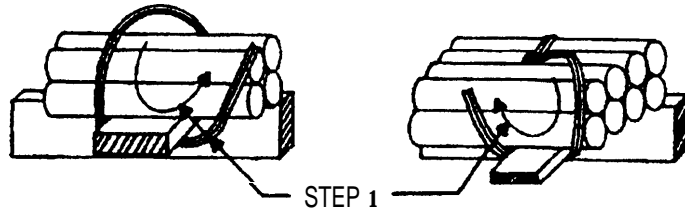
Use the following procedure when lacing cables using the "Kansas City" method.

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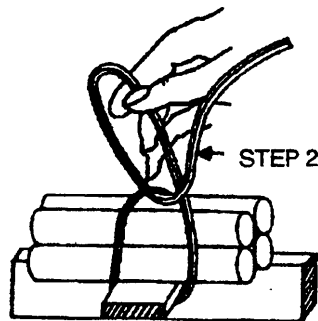
#### Step Using the "Kansas City" Method to Lace Cables

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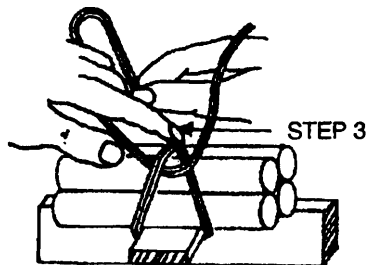
- 1 Place free ends under slat. Reverse the direction under the slat on alternate stitches.



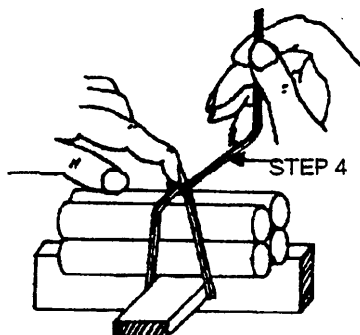
- 2 Place free ends over twine and back through the loop.



- 3 Tighten stitch under the slat and hold with finger. Avoid crossed stitches under the slat.



- 4 Remove slack by pulling up and to the right. Keep loop on top of cable.



(continued)

## 5. Lacing Twine Stitching and Lacing Methods, continued

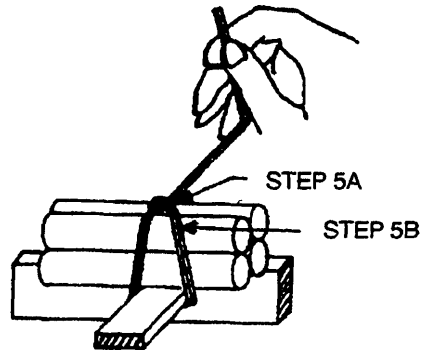
### 5.3 Lacing Cables, "Kansas City" Method, continued

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Step	Using the "Kansas City" Method to Lace Cables
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- |   |  |
|---|--|
| 5 | A. Tighten stitch pulling to right and drawing loop to top front of cable. Remove slack and tighten with a steady, even pull.<br>B. Stitch will tighten more when each succeeding stitch is tightened. |
|---|--|



### 5.4 Lacing a Second Layer of Cable

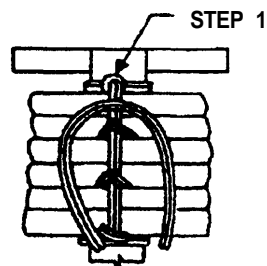
Use the following procedure when lacing a second layer of cable.

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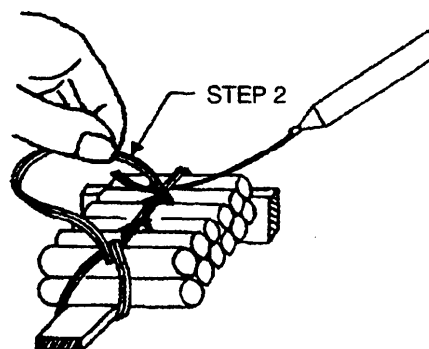
Step	Lacing a Second Layer-of Cable
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- |   |  |
|---|--|
| 1 | Keep stitches in straight line in center of strap. |
|---|--|



- |   |  |
|---|--|
| 2 | Pull end of twine under first stitch with an Evans needle. |
|---|--|



(continued)



## 5. Lacing Twine Stitching and Lacing Methods, continued

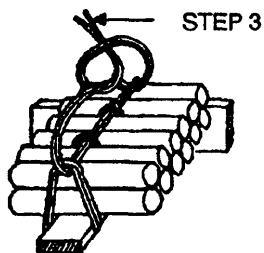
### 5.4 Lacing a Second Layer of Cable, continued

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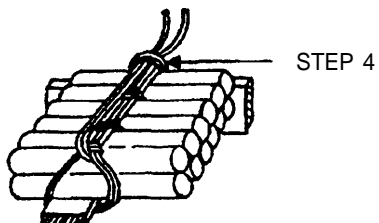
Step	Lacing a Second Layer of Cable
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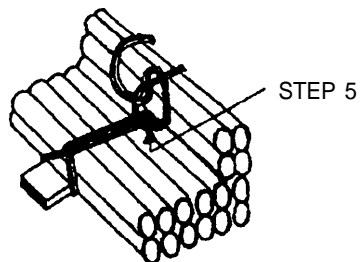
- 3 Loop end over twine and back through loop.



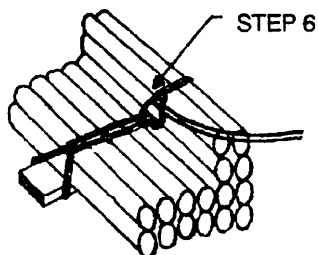
- 4 Tighten knot over top outside edge of cable.



- 5 Make "Kansas City" stitch through the first bottom stitch as shown below.



- 6 Tighten knot in preparation for sewing next group of cables or dead-end as shown below.



## 5. Lacing Twine Stitching and Lacing Methods, continued

### 5.5 Dead-Ending Cable Stitches

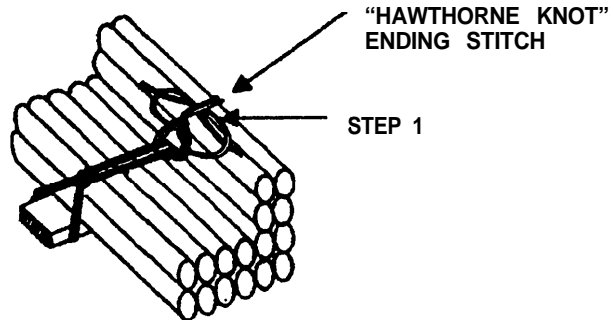
Use the following procedure when dead-ending cable switches.

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Step	Dead-Ending Cable Stitches
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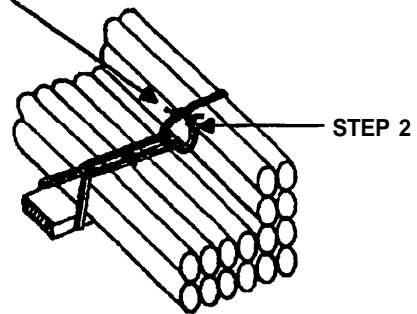
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- 1 Form knot as shown below.



- 2 Tighten knots securely and cut off ends of twine as shown below.

"HAWTHORNE KNOT"  
ENDING STITCH

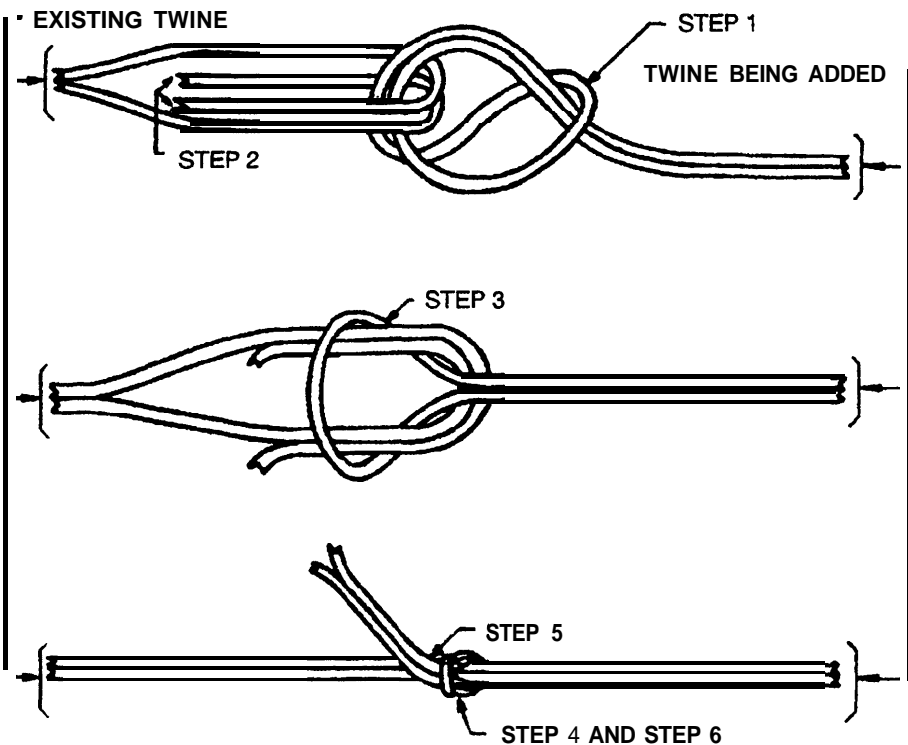


## 5. Lacing Twine Stitching and Lacing Methods, continued

### 5.6 Splicing Double-Strand Lacing Twine

Use the following procedure when splicing double-strand lacing twine.

Step	Splicing Double-Strand Lacing Twine
1	Make loop for starting stitch in twine being added.
2	Place existing twine ends through starting stitch loop in opposite direction.
3	Slide loop of starting stitch back over existing twine.
4	Tighten knot.
5	Cut off excess twine after tightening.
6	When lacing cable, place the knot as close to cable being laced as possible so it will not interfere with lacing the succeeding cables.



## 5. Lacing Twine Stitching and Lacing Methods, continued

### 5.7 Splicing Double-Strand Cord

Use the following procedure when splicing double-strand lacing cord.

**NOTE:** locate the splice where it will not interfere with the making of stitches.

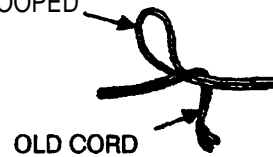
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Step	Splicing Double-Strand Lacing Cord
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- 1 Loop the new cord and pass the old cord.

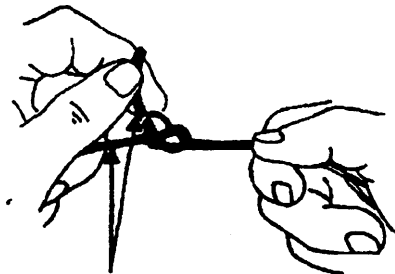
NEW CORD LOOPED



- 2 Pass ends of old cord through loop of new cord.

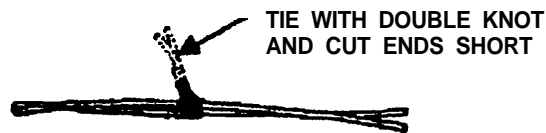


- 3 While pulling new cord, hold as shown.



HOLD HERE WHILE  
PULLING NEW CORD

- 4 Tie with double knot and cut ends short.



## 5. Lacing Twine Stitching and Lacing Methods, continued

### 5.8 Splicing Single- Strand Lacing Twine

Use the following procedure when splicing single-strand lacing twine.

Step	Splicing Single-Strand Lacing Twine
1	Make a starting loop on the end of the twine being added.
2	Place the end of the existing twine "A" through the loop and wrap around loop "B" two turns.
3	Return end "A" through loop "B"
4	Tighten the knot by pulling both ends.
5	Cut off excess twine after tightening the knot.

