BONDING AND GROUNDING AERIAL PLANT

GENERAL

CONTENTS PAGE

1. GENERAL

1.01 This section summarizes the methods used to bond and ground telephone hardware in aerial plant. For more detailed information, refer to the appropriate sections in the Bell System Practices. Where there are differences in the methods covered in this section and in other sections, the methods described herein shall be used.

1.02 This section is revised to clarify the requirements for protective grounding when using the prelash method to place cable and strand. Revision arrows are used to emphasize the more significant changes.

1.03 ***It is the responsibility of the Outside Plant Engineer to specify on the work print the points where telephone hardware will be bonded and grounded and, if required, provide a detailed plan for the construction of an effective electrical ground.***

1.04 ***Bonding*** is electrically connecting two or more pieces of telephone hardware or connecting telephone hardware to hardware belonging to another utility to maintain a common electrical potential.

1.05 ***Grounding*** is electrically connecting telephone hardware to an ***effective electrical ground.*** An effective electrical ground can be a power system multigrounded neutral, a grounded neutral of a secondary power system with at least three customer services connected, a metallic water system, an extensive underground or buried cable system, or a specially constructed grounding network.

1.06 ***An effective electrical ground*** is a low resistance ground. Electrical connection to a low resistance ground must be made to prevent the buildup of hazardous voltages to ground on the telephone plant in the event of an electrical contact.

1.07 ***Electrical connections of aerial plant to anchor rods, ground rods, or down guys are not effective electrical grounds.*** These types of connections are high resistance grounds and are effective only in reducing induced voltages and maintaining a common electrical potential. A high resistance ground does not provide adequate protection against hazardous voltages resulting from power wires coming in contact with telephone plant.

1.08 The connection to a vertical grounding conductor of a power system multigrounded neutral is made in the telephone space on a pole by using an H connector as shown in Fig. 1.

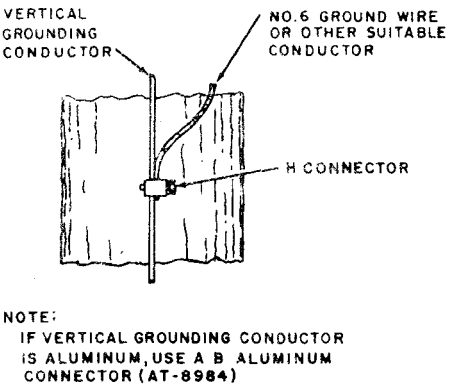


Fig. 1—Connecting to a Vertical Grounding Conductor

1.09 Bonding telephone company hardware to power company fixtures shall be done only when authorized by the power company, and all connections shall be made in accordance with locally established methods and procedures.

1.10 The connection to a guy or strand (except 25M) is made with a cable lashing clamp or strand ground clamp. For 25M, use only the strand ground clamp. See Fig. 2 and 3.

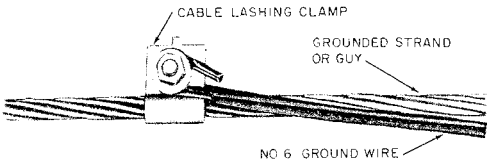


Fig. 2—Connecting to a Guy or Strand With Cable Lashing Clamp

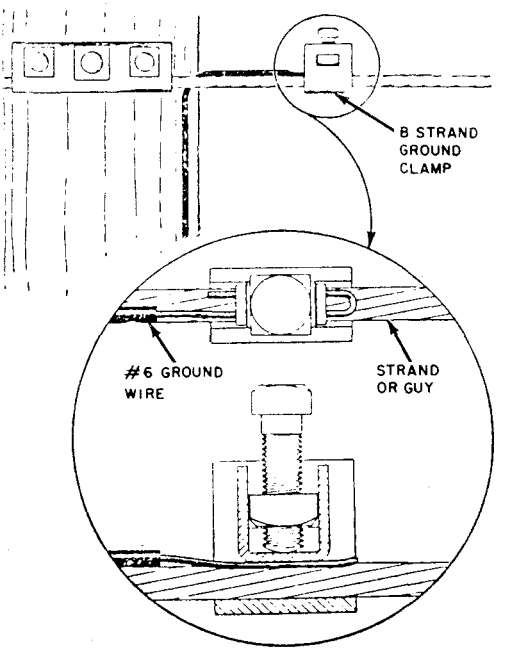


Fig. 3—Connecting to Guy or Strand With Strand Ground Clamp

1.11 The connection to jacketed (self-supporting cable) strand is made with C or D connectors as shown in Fig. 4.

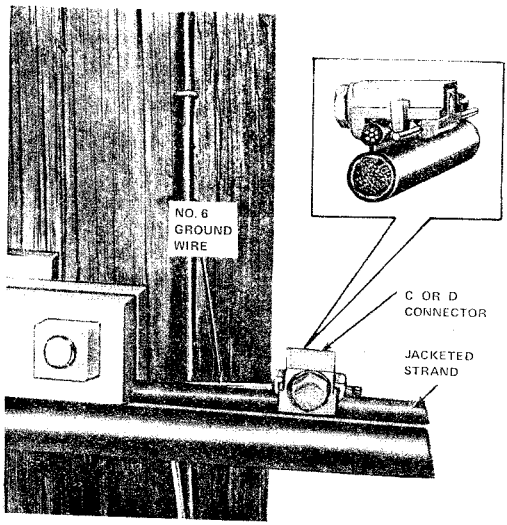


Fig. 4—Connecting to Jacketed Strand

1.12 Where the connection to the power system neutral must be made above the telephone space, estimate the length of wire that will be required, coil the wire, and attach it temporarily for later connection by a power company employee. See Fig. 5.

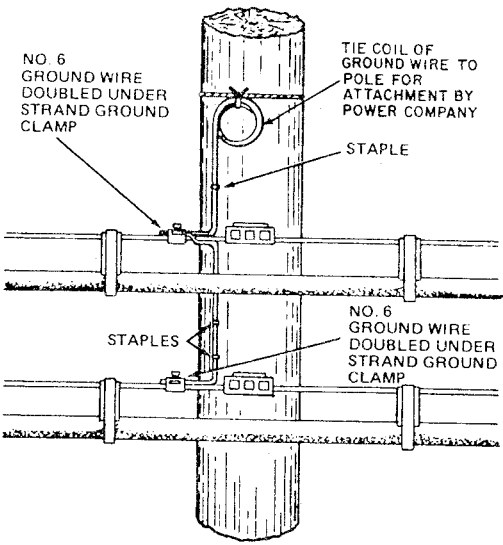


Fig. 5—Coiled Ground Wire Tied for Later Connection

2. PRECAUTIONS

2.01 Telephone workers shall not perform any work in or climb into the power company space on a pole. Ground connections may be made in or below telephone space where authorized by the power company.

2.02 A vertical ground conductor of a multigrounded neutral power system ***shall be tested with a 188A test set or a B voltage tester*** before a ground connection is made. The use of the 188A test set and the B voltage tester are covered in Sections 081-705-102 and 081-705-101, respectively.

2.03 Insulating gloves shall be worn when making or breaking a ground connection to the vertical ground of a multigrounded neutral power system. Insulating gloves shall be worn when placing and tensioning strand, self-supporting cable, and prelashed cable on joint use sections and on nonjoint sections involving power crossings.

3. GROUNDING GUYS

3.01 All guys are to be grounded or insulated (Section 621-405-201). Grounding is accomplished by electrically connecting the guys to an effectively grounded telephone cable suspension strand or by connecting the guy to the vertical ground of a multigrounded neutral power system. Where the guy and strand are attached to the same guy bolt or cable suspension bolt, they are electrically connected. Examples are shown in Fig. 6, 7, and 8.

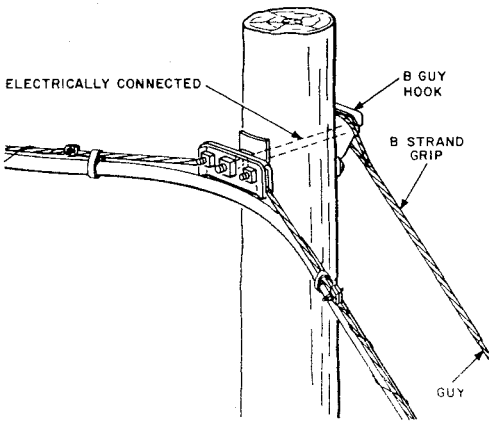


Fig. 6—Guy Grounded at Corner

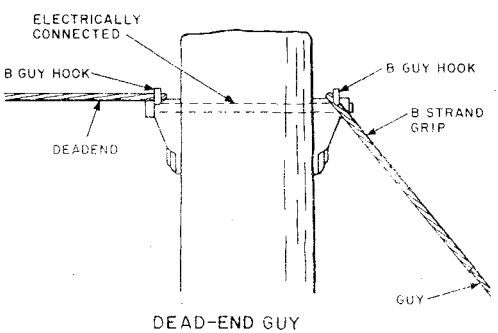


Fig. 7—Guy Grounded at Dead End

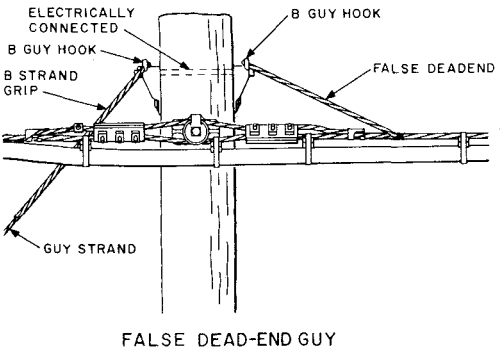


Fig. 8—Guy Grounded at False Dead End

3.02 Where self-supporting cable is involved, only guys connected to the same bolt as false dead ends and full dead ends are considered electrically connected.

3.03 Corner guys connected to bolts carrying self-supporting cable are not considered electrically connected. An electrical connection may be made using a length of No. 6 ground wire as shown in Fig. 9.

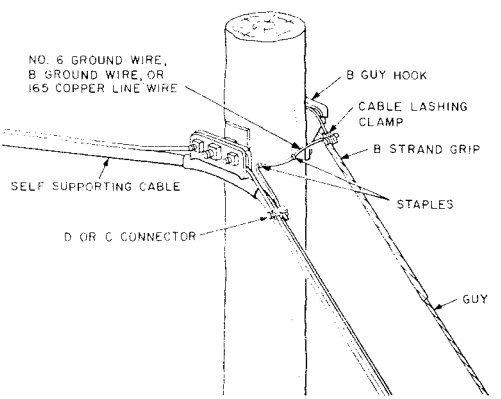


Fig. 9—Grounding Guy to Self-Supporting Strand

3.04 Do not connect the ground wire to a strandvise bail. When self-supporting cable is placed in a B or C sheave support, transfer the cable to a C cable clamp or an appropriate dead-end attachment. Connect ground wire to the guy with a cable lashing clamp or a strand ground clamp as shown in Fig. 10.

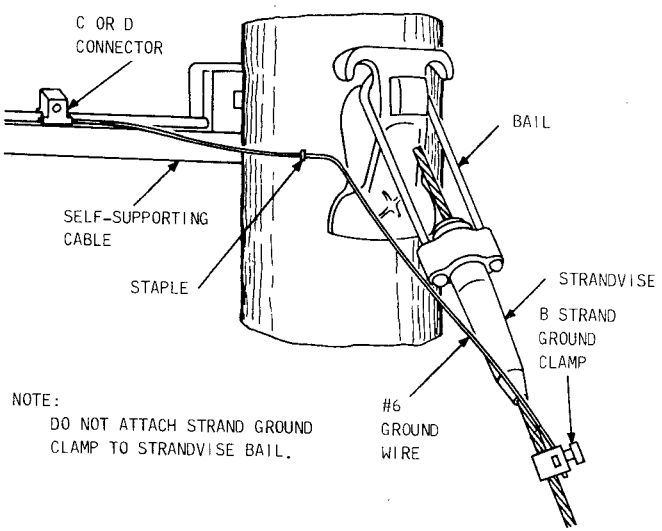


Fig. 10—Grounding Guy Where Strandvise Is Used

3.05 Where guys are not electrically connected through the guy bolt or cable suspension bolt, use a piece of No. 6 ground wire, B ground wire, or .165 copper line wire and two cable lashing clamps as shown in Fig. 11. With 25M strand, or with 2.2M strand not terminated with a B strand grip, use a B strand ground clamp. Double the wire back on itself for at least 1 inch when using the strand ground clamp on 2.2M strand. The connection to 2.2M strand may also be made by means of a one-bolt guy clamp with one half rotated so that the two sets of grooves are at right angles to each other. In all cases, the wire shall be stapled firmly to the pole. Staples should be 1 to 2 feet apart.

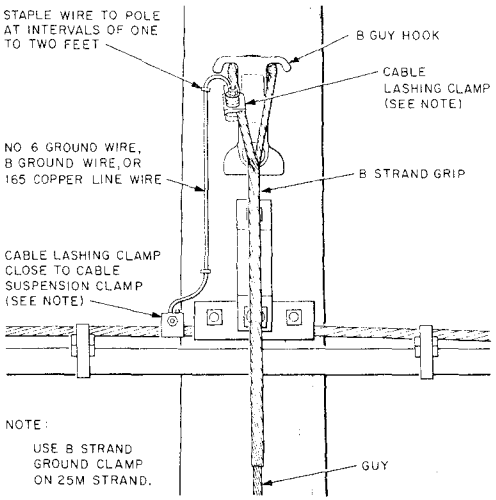


Fig. 11—Grounding Guy That Is Not Electrically Connected Through Guy Bolt

3.06 When the guy is either 6M, 6.6M or 2.2M strand, the connection may be made using the tail of the guy as shown. Do not attempt to use this method with the larger sizes of strand. The principal steps in this method are as follows:

(1) Assemble the upper part of the guy on the ground, leaving approximately 3 feet of extra strand as a tail.

(2) Bend the tail to its approximate final shape and tape it to the main part of the guy ***before*** raising it (Fig. 12).

(3) Secure the guy to the pole and the anchor ***before*** making the connection.

(4) Untape the tail and connect it to the suspension strand with a B strand ground clamp. Use a D or C connector on self-supporting cable strand.

(5) ***Caution: On joint-use poles, the length of the tail must not exceed 3 feet so it cannot accidentally whip up into the power wires.*** Staple the guy tail to the pole; space the staples from 1 to 2 feet apart.

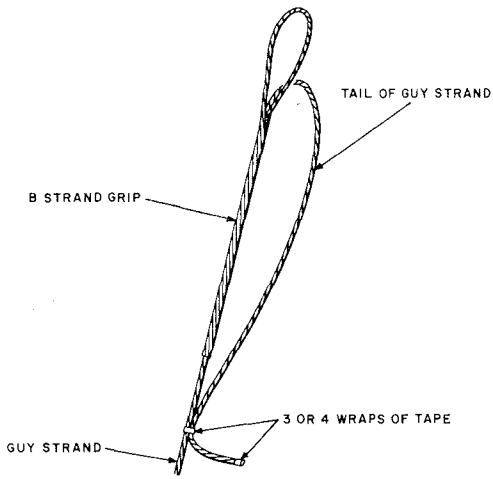


Fig. 12—Assembled Guy With Tail Secured

3.07 Connect the guy to the suspension strand as shown (Fig. 13) when using the tail of a guy to make the electrical connection between guy and strand for lashed or ring supported cable.

3.08 Connect the guy to the strand as shown (Fig. 14) when using the tail of a guy to make the electrical connection between guy and strand for self-supporting cable.

3.09 Where there is no telephone cable suspension strand, telephone guys are considered to be adequately grounded if they are connected to the same guy rod as a power guy that is connected to a multigrounded neutral as shown in Fig. 15. Placing a guy in this manner can be done only with proper authorization.

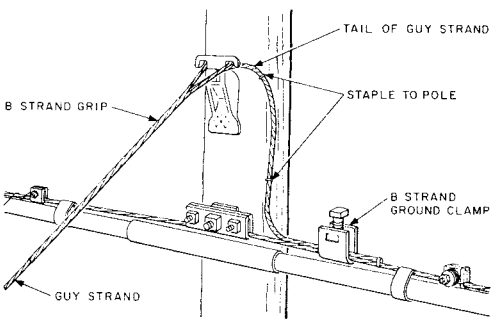


Fig. 13—Guy Tail Connected to Strand

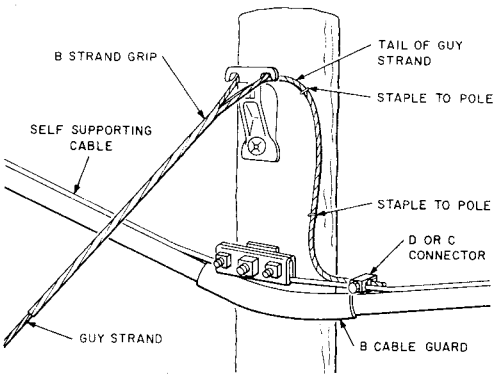


Fig. 14—Guy Tail Connected to Jacketed Strand

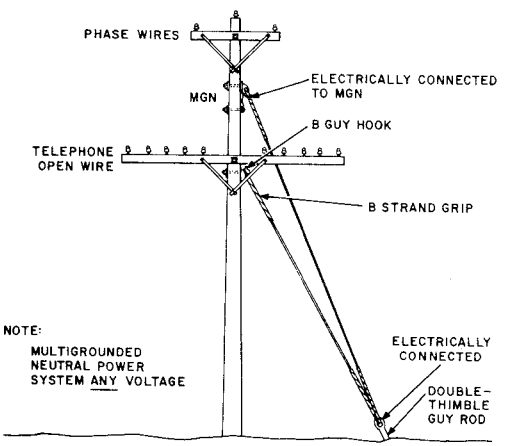
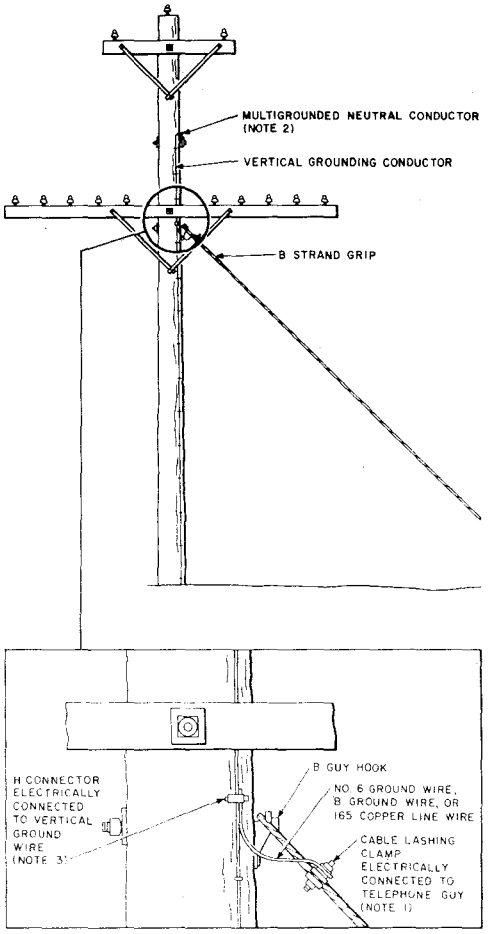


Fig. 15—Telephone Guy Connected to Power Company Guy

3.10 Where there is no telephone cable suspension strand and the guy cannot be connected to an effectively grounded power guy, connect the guy to an existing electric utility vertical ground wire as shown in Fig. 16. Test the ground wire with the 188A test set or the B voltage tester before attempting to make the connection. Use a suitable length of No. 6 ground wire, B ground wire, or .165 copper line wire and connect one end to the guy with a cable lashing clamp. Do this first. If the guy strand is 25M or 2.2M ***not*** equipped with a B strand grip, use a B strand ground clamp instead. Double the wire back on itself for about 1 inch when using the strand ground clamp on 2.2M strand. A one-bolt clamp may be used on 2.2M strand if the two halves of the clamp are rotated so the two sets of grooves are at right angles.

3.11 As an alternative for 6.6M, 6M, or 2.2M, the tail of the guy may be connected to the vertical ground wire. Use a B strand ground clamp, or for 2.2M guys a one-bolt guy clamp, to make the connection.

3.12 Where there is no power vertical ground wire present and proper arrangements have been made with the electric utility for the grounding of telephone guys to a neutral conductor, a piece of No. 6 ground wire, B ground wire, or .165 copper line wire of sufficient length to reach the neutral conductor should be attached to the guy, then coiled and secured to the pole in the telephone space as shown in Fig. 17. ***In no case shall a telephone company worker extend the wire into the power space.*** Extending the wire above the telephone space and connecting to the neutral conductor will be done by the electric utility.



NOTES:
1. USE STRAND GROUND CLAMP ON 25M STRAND.
2. MULTIGROUNDED NEUTRAL POWER SYSTEM ANY VOLTAGE.
3. IF VERTICAL GROUNDING CONDUCTOR IS ALUMINUM, USE A B ALUMINUM CONNECTOR.

Fig. 16—Grounding a Guy Where There Is No Suspension Strand and Vertical Ground Is Present

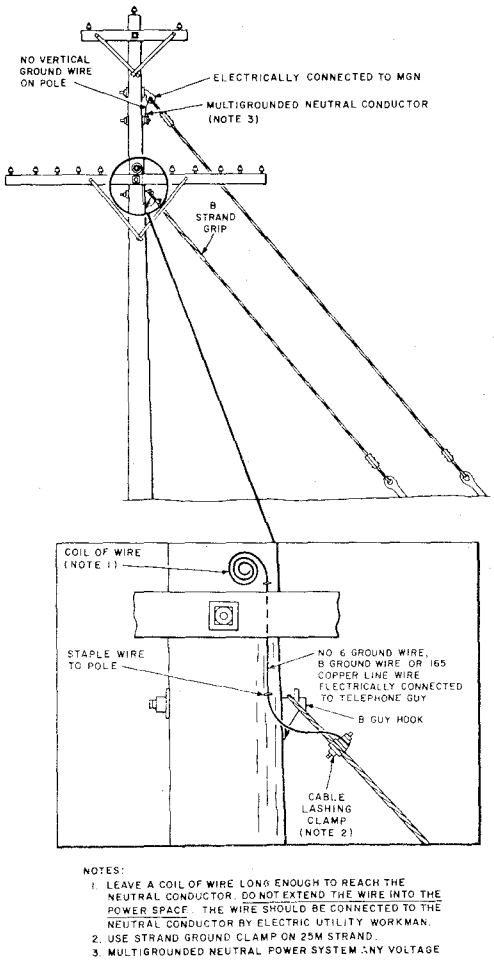


Fig. 17—Grounding a Guy Where There Is No Suspension Strand and No Vertical Is Present

3.13 If the work plans or other instructions require that an existing insulated guy be grounded, it will frequently be necessary to make the insulator ineffective. This is done by strapping it out as shown in Fig. 18. On 25M guys, it will be necessary to use B strand ground clamps instead of cable lashing clamps. Do not attempt to strap out insulators in guys belonging to the electric utility.

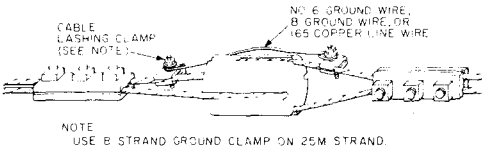


Fig. 18—Strapping Out an Insulator

4. BONDING AND GROUNDING STRAND

4.01 The grounding of suspension strand during placing shall not be considered as a substitute for the use of insulating gloves and other protective measures. Ground connections shall be made to an effective electrical ground.

4.02 When strand is placed from a stationary reel, use a B grounding roller as shown in Fig. 19. (The B grounding roller is covered in Section 081-410-106.) Place the rollers at intervals of 1500 feet or less and at power crossings.

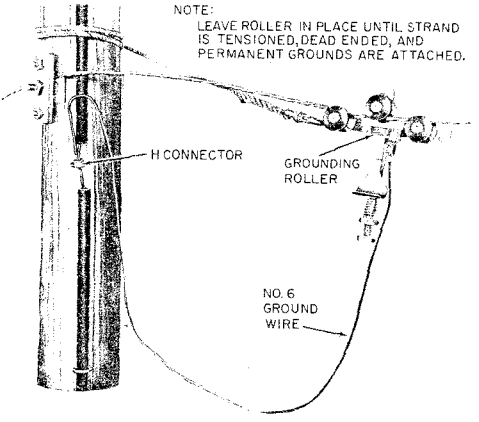


Fig. 19—Using a B Ground Roller With Stationary Reel

4.03 If suspension strand is to be placed using the moving reel method, start the placing operations from a point where the strand can be grounded. Dead end and ground the strand before moving the reel. Place the rollers at 1500 foot intervals or less and at power crossings. Place rollers as shown in Fig. 20.

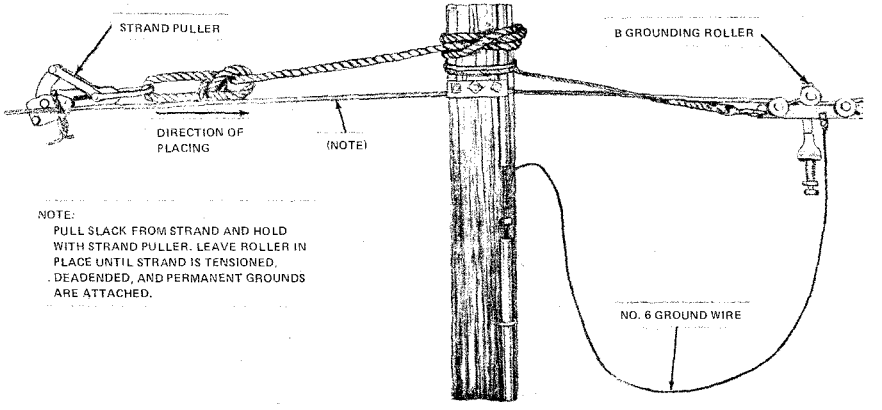


Fig. 20—Using a B Ground Roller With Moving Reel

4.04 During the placing operation, ground attachments along the line may be made as shown in Fig. 21 instead of using the B grounding roller.

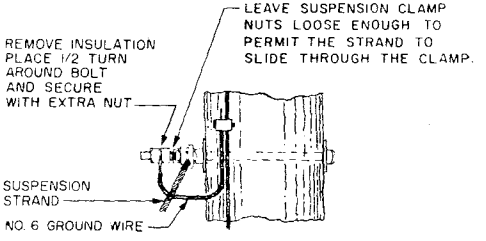


Fig. 21—Temporary Ground Attachment While Placing Strand

Note: During the placing of prelashed cable and strand, the strand shall be temporarily grounded at intervals of 1500 feet or less and at power crossings. For safety precautions pertaining to the operation of prelashing equipment, refer to Section 627-350-200.

4.05 When ***placing prelashed cable*** using the stationary reel method, on the vehicle at the ***payout end,*** install a B grounding roller at a point on the strand before the strand enters the lasher. The B grounding roller must be electrically connected to the vehicle chassis using as short a length of No. 2 wire as possible. In addition, the B grounding roller shall be connected to an effective electrical ground, also using a No. 2 wire. Since a B grounding roller cannot be used on the prelashed cable and strand, the length of cable that can be placed with the stationary reel method is limited to 1500 feet to comply with temporary grounding requirements. Place permanent grounds at locations indicated on the work print.

4.06 A winch truck must be used at the ***pulling end*** if a metallic pulling line is used. Install a B grounding roller on the pulling line at a point as close as possible to the pulling vehicle. The B grounding roller must be electrically connected to an effective electrical ground.

4.07 A power trailer may be used at the ***pulling end*** if a nonmetallic pulling line is used. A "B" grounding roller must be used on the pulling line in the same manner as if the line were metallic unless the pulling line is manufacturer certified as a valid dielectric.

4.08 When ***placing prelashed cable*** using the ***moving reel method,*** dead end and ground the strand at the starting pole. Since the B grounding roller cannot be used on prelashed cable and strand, the strand must be finally tensioned and grounded at intervals of no more than 1500 feet to comply with temporary grounding requirements. Place permanent grounds at locations indicated on the work print.

4.09 After the strand has been tensioned, make permanent ground attachments to the vertical ground of a power system multigrounded neutral as shown in Fig. 22. Points of attachment should be specified on the work print.

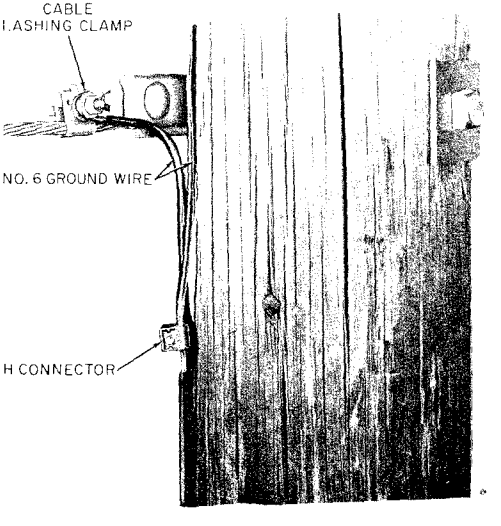


Fig. 22—Permanent Ground Attachment After Strand Is Tensioned

4.10 Continuity of suspension strand must be maintained. Any break in strand continuity shall be bridged with a permanent bond as shown in Fig. 23.

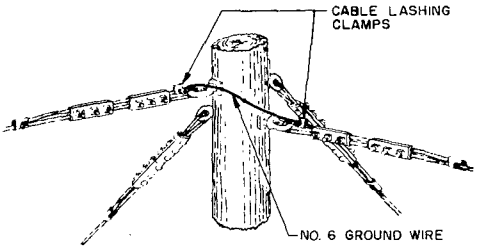


Fig. 23—Maintaining Strand Continuity at Corners

4.11 Branch strands shall be bonded to the main strand as shown in Fig. 24.

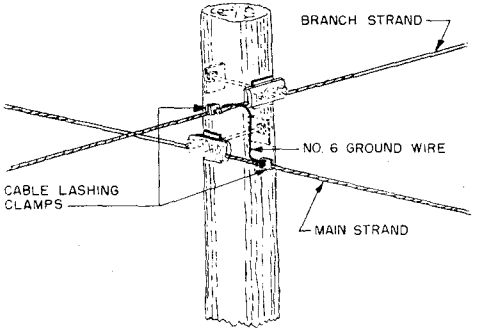


Fig. 24—Bonding Branch Strand to Main Strand

4.12 Parallel strands supported on separate suspension bolts shall be bonded as shown in Fig. 25. Parallel strands supported on the same suspension bolt are electrically connected through the suspension bolt and additional bonding is not required. Bond at points specified on the work print.

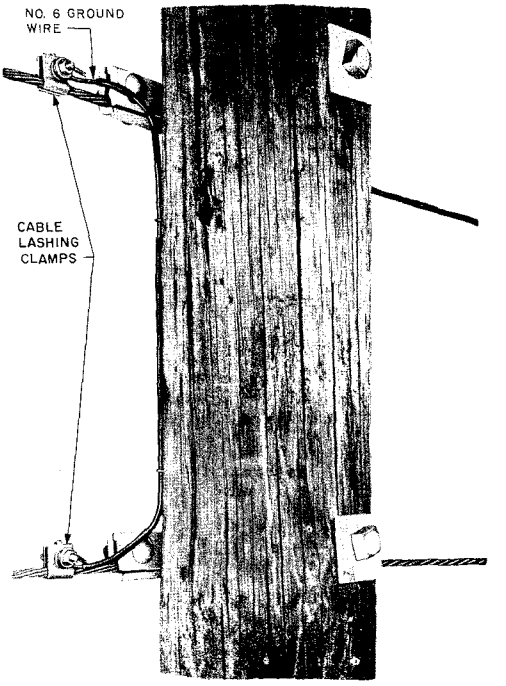


Fig. 25—Bonding Parallel Strands

4.13 When placing ***self-supporting cable*** from a ***stationary reel*** and using a plastic or manila rope for the pulling-in line, grounding the strand is not required.

4.14 When placing ***self-supporting cable*** from a ***stationary reel*** and using a metallic pulling line, insert a length of approximately 25 feet of B plastic rope or manila rope between the pulling line and the strand as an insulating joint. Use the B grounding roller on the pulling line.

The above method may be used only when a grounding conductor for the B grounding roller is available within two spans of the pulling vehicle and an E cable block with appropriate block frame is used at the pole nearest the pulling vehicle.

4.15 When placing ***self-supporting cable*** from a ***moving reel,*** dead end and ground the strand at the starting pole.

4.16 After self-supporting cable has been tensioned, make permanent ground attachments to the vertical ground of a power system multigrounded neutral as shown in Fig. 26. Points of attachment should be specified on the work print. Bridge any break in strand continuity with a permanent bond.

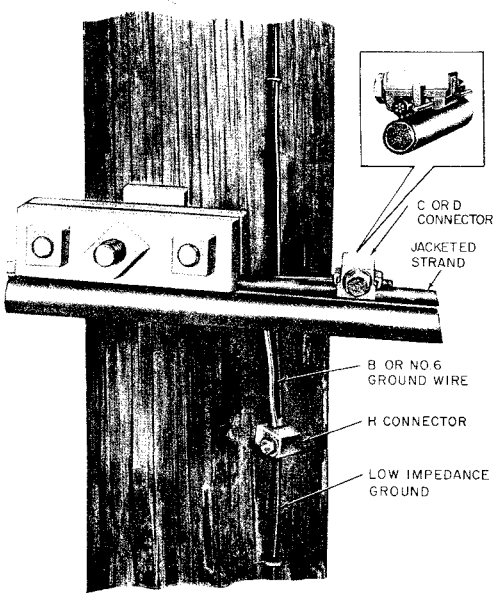


Fig. 26—Grounding Jacketed Strand

4.17 Self-supporting cable on separate suspension bolts must be bonded. Parallel strands of self-supporting cable supported on the same suspension bolt are not electrically connected and must be bonded. Use two C or D connectors and an appropriate length of No. 6 ground wire in the same manner as shown for bonding strand.

5. GROUNDING MULTIPLE LINE WIRE

5.01 When placing multiple line wire using the moving reel method on joint-use pole lines, near power lines, and at electric light or power crossings connect all conductors and the support wire to an effective ground and dead end the support wire before starting the placing operation. Use one of the methods shown in Fig. 27 or 28.

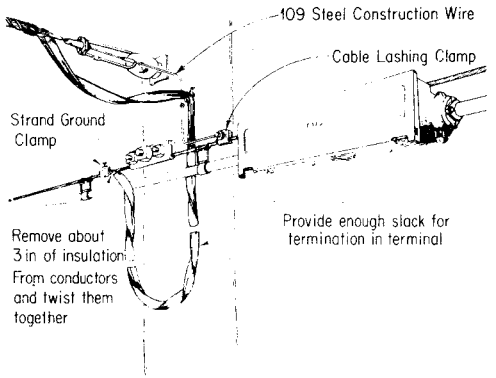


Fig. 27—Grounding to Strand When Placing From Moving Reel

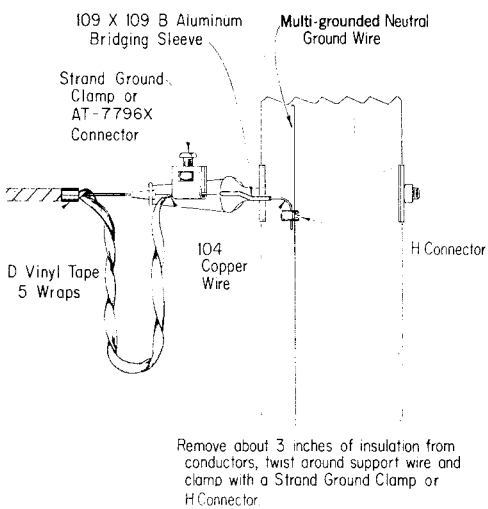


Fig. 28—Grounding to Vertical Ground Conductor When Placing From Moving Reel

5.02 Additional unspliced reel lengths shall be grounded as shown, or by connecting the conductors and the support wire to the previously placed grounded section with a strand ground clamp.

5.03 When the stationary reel method of placing is used, make the ground connection before tensioning the wire.

5.04 Where multiple wire is fed from aerial cable, connect the support wire to the strand as shown in Fig. 29 and 30. If fed from self-supporting cable, use a C or D connector on the strand instead of a cable lashing clamp.

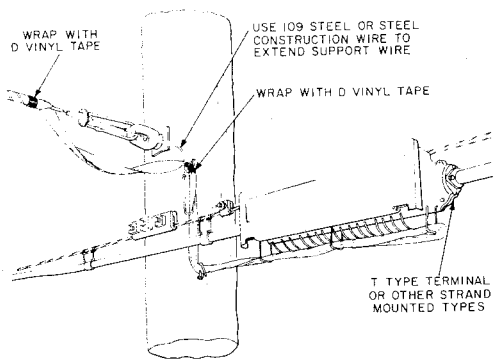


Fig. 29—Connecting Support Wire to Strand—Strand-Mounted Terminal

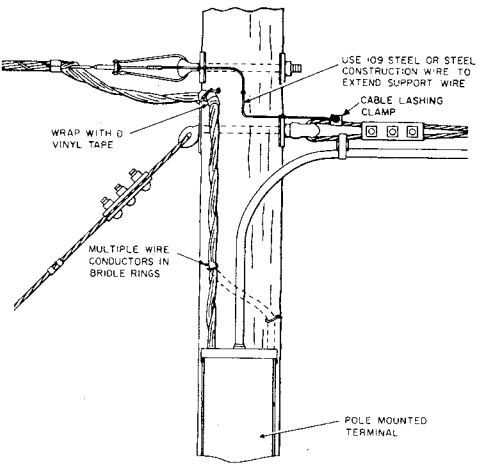


Fig. 30—Connecting Support Wire to Strand—Pole-Mounted Terminal

5.05 When multiple wire is fed from a buried cable, connect the support wire to the closure or terminal. See Fig. 31. All wire terminals, protected and nonprotected, shall be bonded to the steel support wire with a 109 steel wire run between the wire bracket and the outside grounding post on the terminal.

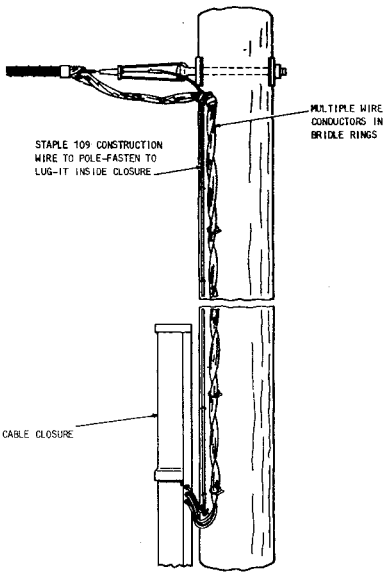


Fig. 31—Connecting Support Wire to Closure

5.06 Where the multiple line wire is supported in a B wire bracket, the support wire may be grounded by being connected to the vertical ground of a multigrounded neutral power system as shown in Fig. 32.

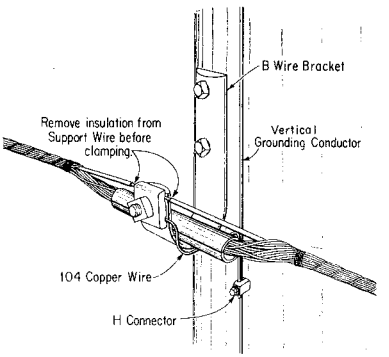


Fig. 32—Connecting Support Wire to Vertical Grounding Conductor

5.07 Where there is an existing telephone cable, the support wire may be connected to the cable suspension strand as shown in Fig. 33.

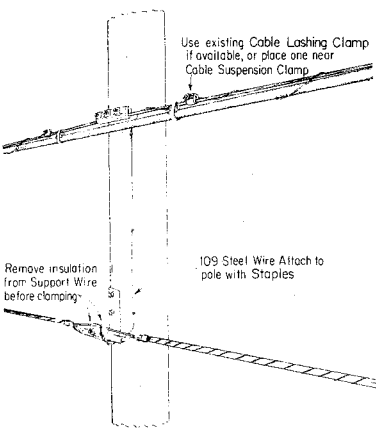


Fig. 33—Connecting Support Wire to Parallel Cable Suspension Strand

5.08 The steel support wire in multiple line wire shall be kept electrically continuous along the lead. Where the method of terminating the support wire results in an electrical separation between the ends, the gap shall be bridged with a length of 109 steel wire connected to the support wire by means of bridging sleeves.

5.09 Refer to Section 624-300-220 for methods of providing drainage for multiple wire circuits which are subject to induced voltages from adjacent power circuits.

6. GROUNDING MULTIPLE DROP WIRE

6.01 Connect support wire to strand as shown in Fig. 34. When fed from buried plant, bond support wire to terminal housing.

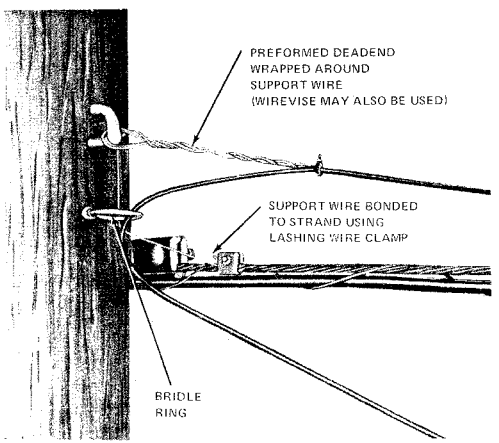


Fig. 34—Connecting Multiple Drop Support Wire to Strand

6.02 Support wire must be continuous at all intermediate attachments. At pole attachments, span clamps, and building attachments in building-to-building spans, rejoin the support wire with a bridging connector (Fig. 35) if cut. Terminate the support wire at the building first attachment (Fig. 36).

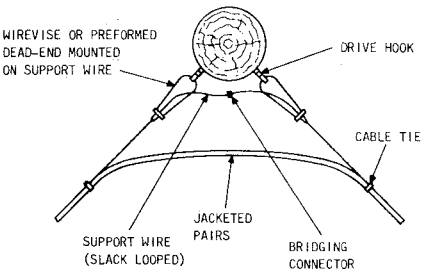


Fig. 35—Joining Support Wire With Bridging Connector

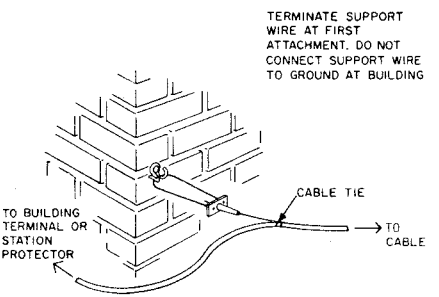


Fig. 36—Terminating Support Wire at First Attachment

7. GROUNDING NONWORKING OPEN WIRE

7.01 For grounding procedures to be observed when placing open wire, refer to Section 623-102-010. Grounding open wire that is in place but is not connected for service will reduce the effects of electrical induction and the effects of accidental contact with power conductors. Nonworking open wire may be grounded at terminal poles (Fig. 37), at protectors, or at vertical ground conductors (Fig. 38).

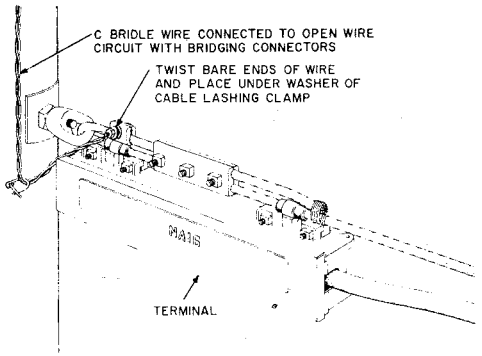


Fig. 37—Grounding Nonworking Wire at Terminal Pole

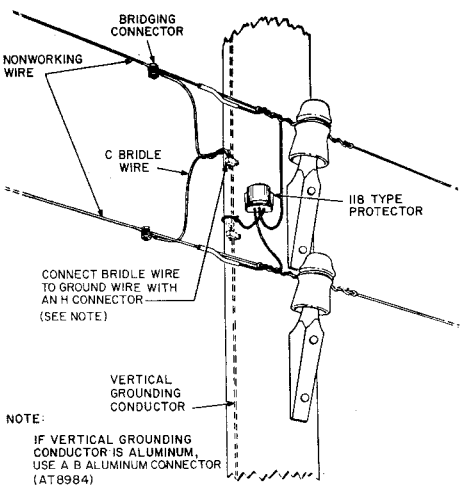


Fig. 38—Grounding Nonworking Wire at Vertical Ground

7.02 Where the telephone guy and power guy are attached to the same anchor and the power guy is connected to a multigrounded neutral, the telephone guy is adequately grounded and nonworking open wire may be grounded to the telephone guy (Fig. 39).

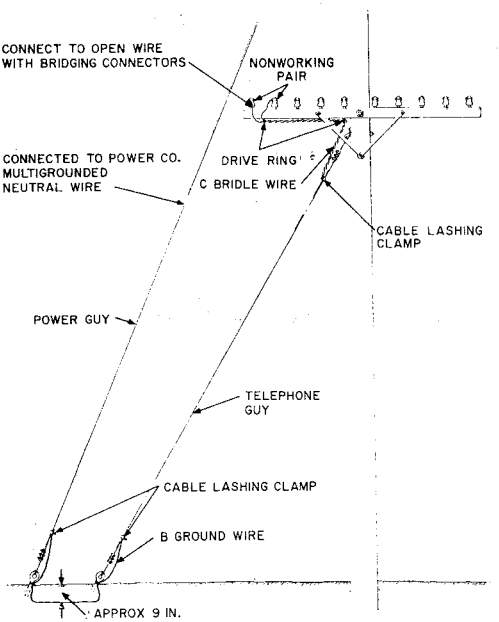


Fig. 39—Grounding Nonworking Wire at Telephone Anchor Guy

8. BONDING PLASTIC SHEATH CABLE FOR LIGHTNING PROTECTION

8.01 Where a single aerial plastic sheath cable is in an area subject to lightning, sheath to strand bonds at terminals and splices may be so far apart that additional sheath to strand bonds are required. The locations for any additional bonds will be specified on the work print.

8.02 ***Caution: Do not bond to the inner aluminum moisture barrier of ARPAP or ARPASP sheath cables.*** To place additional sheath to strand bonds, proceed as follows:

(a) Remove a portion of sheath as shown in Fig. 40. Clean corrugated steel shield with B cleaning fluid and wipe with a clean cloth. Aluminum shield does not need cleaning.

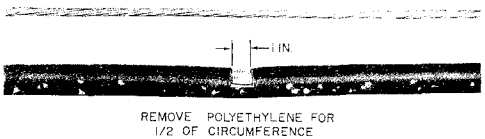


Fig. 40—Portion of Sheath Removed

(b) Scuff the polyethylene sheath with the carding brush. Place B paper tape collars on the sheath, and coat the enclosed area with C cement. Allow 3 to 5 minutes drying time in warm weather and 5 to 10 minutes in cold weather (Fig. 41).

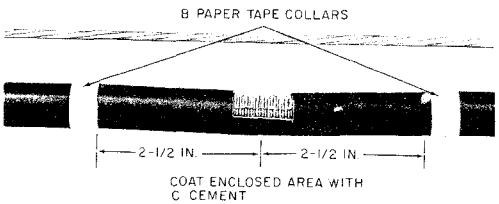


Fig. 41—Area Coated With Cement

(c) Cut a 3-inch long by 1-inch wide strip of B sealing tape. Lay this strip on the top of the cable sheath on the side of the opening where the bond will be made to the strand (Fig. 42).

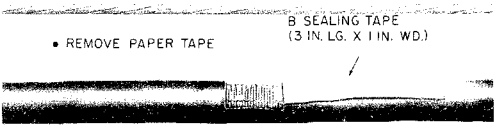


Fig. 42—B Sealing Tape in Place

(d) Cut a length of No. 6 ground wire or B ground wire and form a loop at each end of the wire. One end of the wire will be placed in contact with the metallic shield. The other end will be terminated on a cable lashing clamp. The finished length of the wire should be 2 to 3 inches longer than the actual distance between the exposed metallic shield and the cable lashing clamp. Form the wire end that will be in contact with the metallic shield as shown in Fig. 43.

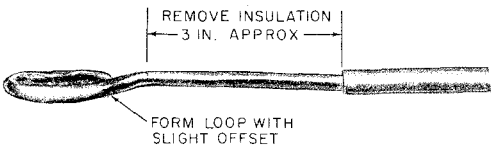


Fig. 43—Loop Formed at End of Ground Wire

(e) Place ground wire loop over sheath opening with wire centered on sealing tape. Tie the wire in place temporarily as shown in Fig. 44.

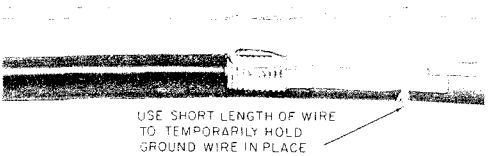


Fig. 44—Ground Wire Temporarily Held in Place

(f) Tightly wrap copper lashing wire over ground wire loop and exposed metallic shield as shown in Fig. 45.

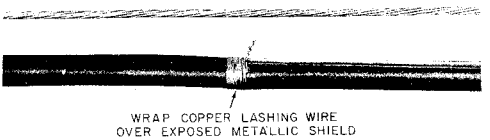


Fig. 45—Ground Wire Lashed in Place

(g) Remove the temporary tie and press the ground wire into the sealing tape. Cut a 4 inch long, 1-1/2 inch wide strip of B sealing tape. Lay this over the 1-inch wide strip with the extra length filling the sheath opening. Press the top strip firmly over the strip underneath until all crevices are filled and the edges are contoured to the surface of the cable as shown in Fig. 46.

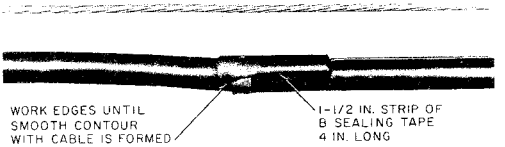


Fig. 46—Top Strip of B Sealing Tape in Place

(h) Apply two half-lapped layers of 3/4-inch DR tape over the cemented area and the B sealing tape. In applying the tape, it should be stretched to 5/8-inch width (Fig. 47).

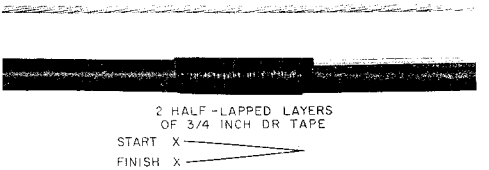


Fig. 47—DR Tape Placed Over Sealing Tape

(i) Apply a collar of three turns of 3-inch B aluminum tape on the DR tape. Iron the tape smoothly in place with the handle of dresser or carding brush. After smoothing, apply an additional 1-1/4 turns of 2-inch B aluminum tape extending beyond the exposed DR tape 1/2-inch at each end. Then iron smoothly in place. Figure 48 shows the two operations.

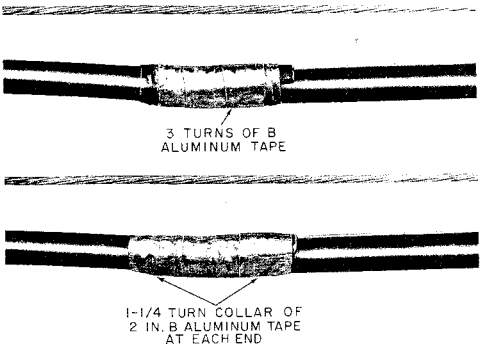


Fig. 48—Placing Aluminum Tape

(j) Apply two half-lapped layers of 3/4-inch friction tape, extending just beyond the edge of the aluminum tape. Cover the friction tape with a single half-lapped layer of D vinyl tape. The last turn should be applied free from all tension so the end of the tape will not ravel (Fig. 49).

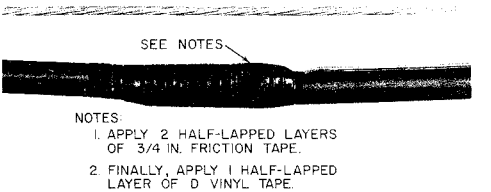


Fig. 49—Completing Cable Portion of Bond

(k) To complete the sheath to strand bond, terminate the free end of the ground wire in the cable lashing clamp. Form an "S" bend in the ground wire (Fig. 50).

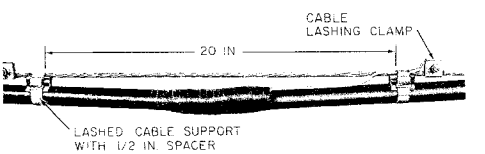


Fig. 50—Completed Bond