PRESSURE PLUGS
CLOSURE-INJECTION METHOD
CABLE PRESSURE SYSTEMS

CONTENTS PAGE

1. GENERAL

1.01 This section covers the closure-injection method (using J plug compound) for constructing a pressure plug in PIC and pulp cables (including screened cables).

1.02 This section is reissued to:

- Include the closure injection method for constructing a pressure plug in ICOT screened cable.
- Remove description and ordering information covering the J plug compound.
- Remove the sheath injection method for constructing a pressure plug. This method is no longer recommended.
- Omit the use of B sealing cord when placing closure over the sheath opening.

Revision arrows are used to emphasize the more significant changes.

1.03 The J plug compound, AT-8649, replaces both the C and F plug compounds, AT-7947 and AT-8470, respectively, and their associated hardware for use in plugging air core cables.

1.04 The J plug compound can be used for making plugs in both polyethylene and lead sheath air core cables of any size and type except single expanded LOCAP* cable and those cables containing coaxials, video pairs, disc-insulated spiral-four quads, or waterproof cable.

2. PRECAUTIONS

2.01 Observe the following danger and instructions to ensure maximum protection.

2.02 ***DANGER: The J plug compound contains chemicals to which some individuals are sensitive. Contact of these chemicals with the skin can cause an irritation or reaction. Eye and lung irritations may result from the vapors of this compound in poorly ventilated areas. Therefore, it is imperative that this compound be used only in well-ventilated areas. In addition, it is necessary that the employee adhere to the Danger statement regarding the safety precautions that appears on the compound cartridge bag.***

2.03 Before handling the plugging compound or any of the tools that come in contact with these materials, disposable plastic gloves (Section 081-856-101) must be worn to avoid skin contact with the compound.

*Trademark

2.04 To ensure eye protection, ***WEAR SAFETY GOGGLES*** while mixing the compound in the cartridges and while injecting the compound into the cable.

2.05 When the work is finished and the tools are cleaned, wash the exposed skin areas thoroughly with soap and water.

> ***Note:*** If water is not readily available, Bell System waterless hand cleaner may be used to clean the hands. However, DO NOT USE BELL SYSTEM WATERLESS HAND CLEANER ON THE FACE OR NECK.

2.06 Good personal hygiene and good housekeeping are essential in protecting against the possibility of skin irritation. Waste cloths, paper towels, empty compound cartridges, etc, which have been used during the plugging operations should be set aside in a bag or box for disposal each day. This precaution is of importance for the protection of both the public and the employee.

3. CONSTRUCTING PRESSURE PLUG USING J PLUG COMPOUND

A. List of Materials

3.01 Table A lists the materials required for construction of a pressure plug for the closure injection method. Instructions for the preparation of a pressure plug for paper, pulp, or PIC cables using the sheath-injection method are furnished with the J plug compound package.

♦ TABLE A ♦

LIST OF MATERIALS (NOTE)

CLOSURE INJECTION METHOD FOR PIC, PULP, ICOT, AND DEPIC CABLES (INCLUDING SCREENED CABLES)
J Plug Compound Package, AT-8649
Injection Gun (if not ordered in compound package)
1-Inch G Vinyl Tape (1 Roll)*, AT-8726
Orange Stick, KS-6320
D Bond Clamps (2), AT-8688
D Bond Strap (8-inch) AT-8688
B Sealing Tape (3/4-inch), AT-7601
B Sealing Tape (1-1/2 inch), AT-7601
4-Inch C Sealing Clamp (2)
1/2-Inch D Paper Tape
DR-Tape (2-inch), AT-6863
No. 4530 Closure†
No. 4430 Spacing Material†

Note: Materials listed are Bell System Standard unless otherwise indicated.

* Quantity may vary.

† May be obtained from 3M Company, St. Paul, Minnesota, or from any company which can supply equivalent material.

B. Location of Pressure Plug

3.02 The plug should be located in a straight section of cable (to avoid severe bending strains). The plug can be made in a horizontal or vertical section of the cable.

3.03 The location of a plug with reference to a splice should be as follows:

(a) In aerial cable, the plug can be made at any convenient point in the span. If near a pole, the plug should be located on the opposite side of the pole from the splice or proposed splice (generally the left side as viewed from the cable side of pole) If a splice exists, the plug should be made at least 20 inches or more from the nearest splice case or sleeve to avoid the flow of plugging compound into the splice.

(b) In main and subsidiary underground cable, the plug should be made as close to the splice case or sleeve as practicable, but not less than 20 inches.

(c) In plugging branch cables leaving manholes, the plug can be made in the branch cable if it can be located at least 20 inches from the branch splice; otherwise, the individual branch or subsidiary cables should be plugged at the next accessible location on the branch cable.

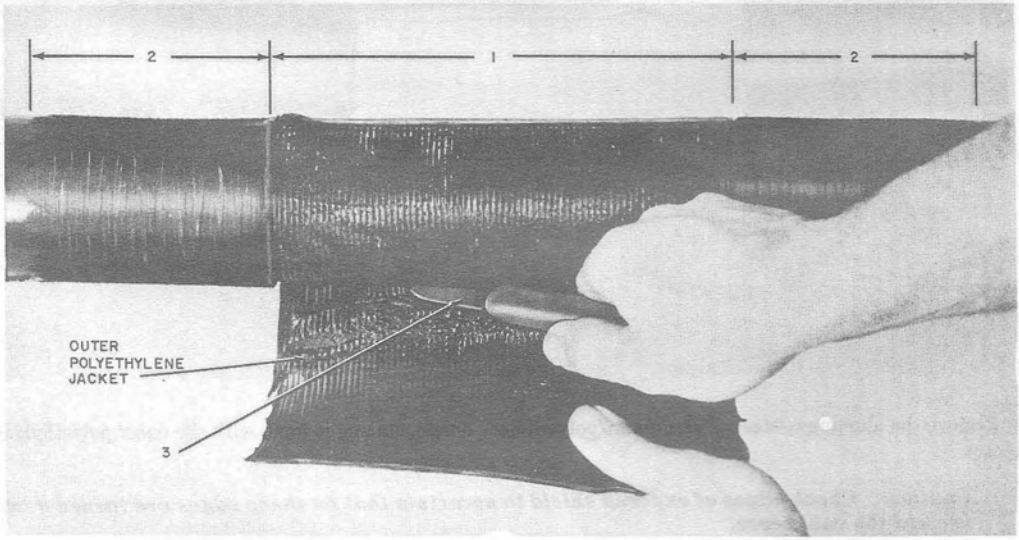
(d) Pressure plugs constructed at cable entrance facilities (vaults) must be located at least 20 inches from the tip splice and F pressure flange. In confined vault areas, the combination pressure plug/insulating joint may be constructed as described in Section 632-020-260.

3.04 ***Where a nonpressurized PIC cable is spliced to paper- or pulp-insulated conductor cable, the PIC cable should be plugged as close to the splice as practical, but not less than 20 inches.*** This is necessary to prevent moist air or water from flowing into the paper- or pulp-insulated conductor cable from the PIC cable.

C. Constructing Pressure Plug

PIC, Pulp, or DEPIC Cables—Including Screened Cables

3.05 The procedures for constructing a pressure plug using J plug compound in PIC, pulp, and DEPIC cables (including screened cables) and using 3M Company No. 4530 closure or equivalent are outlined in Fig. 1 through 18.



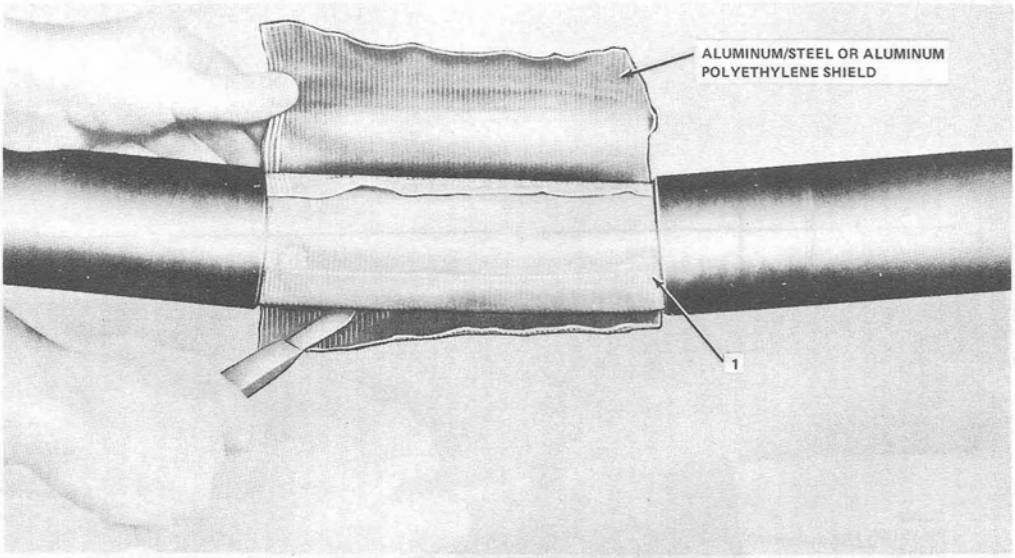
1. Measure and score an 8-inch section of the outer cable jacket.

2. Thoroughly scuff the outer sheath a distance of 5-inches on both sides of the proposed opening.

3. Cut and remove the outer polyethylene jacket

Note: With bonded sheath cable, the polyethylene jacket and metallic shield are removed in one operation.

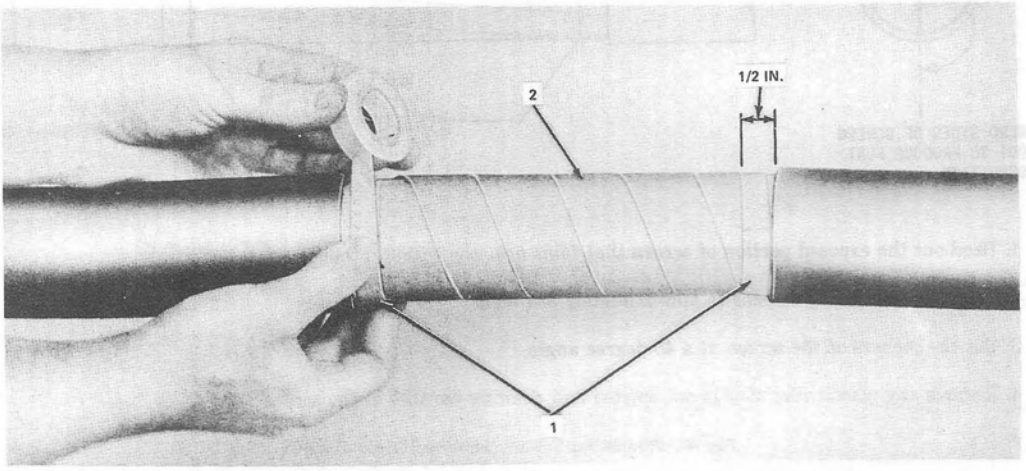
Fig. 1—Removing Outer Polyethylene Jacket



1. Remove the aluminum/steel or aluminum/polyethylene shield, cutting it flush with the outer polyethylene jacket.

Caution: Check edges of exposed shield to ascertain that no sharp edges are turned down toward the cable core.

Fig. 2—Removing Inner Shield(s)

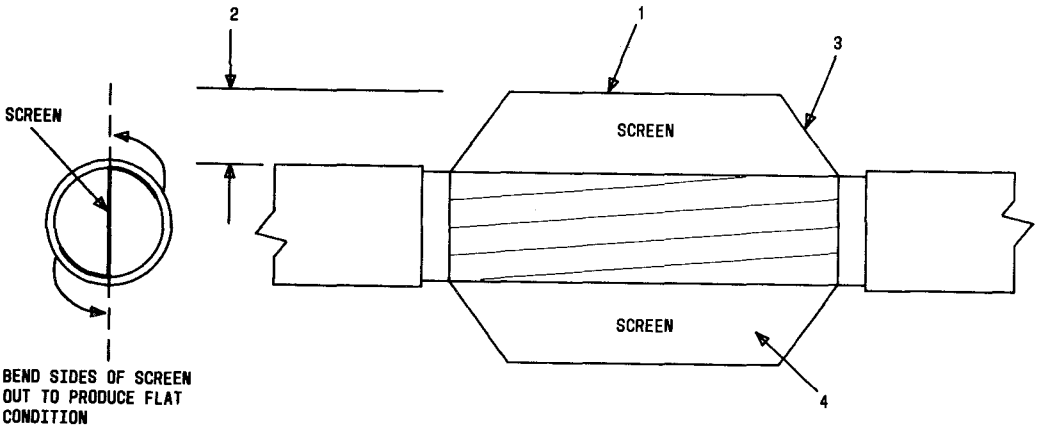


1. Wrap several layers of 1/2-inch D paper tape over each end of the exposed core wrap.

2. Remove the core wrap between the D paper tape.

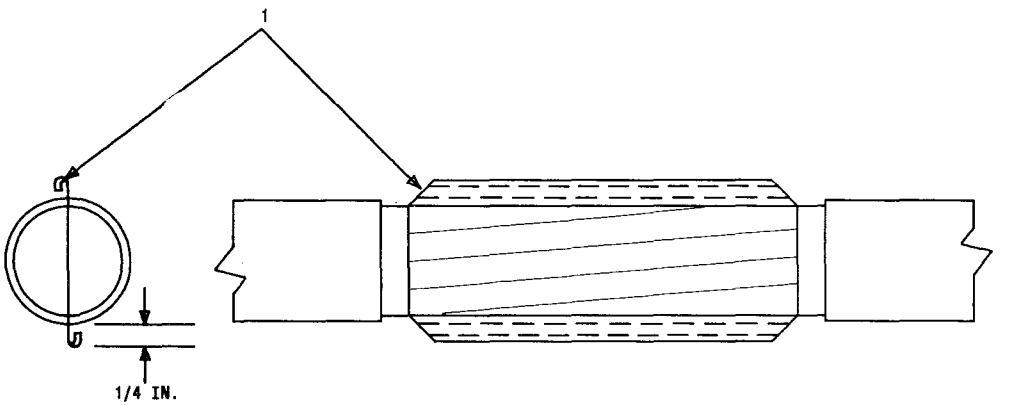
Note: For nonscreened cables, skip procedures in Fig. 4 through 9.

Fig. 3—Applying D Paper Tape and Removing Core Wrap



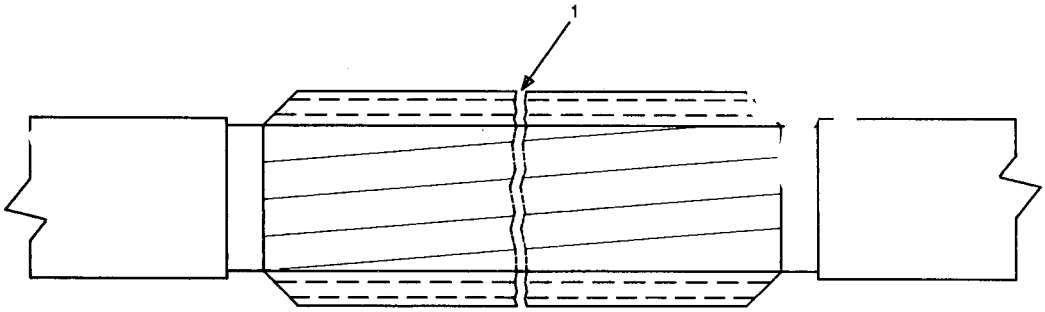
1. Bend out the exposed portion of screen that folds over the core to produce a flat condition.
2. Trim the protruding screens to approximately 3/4 inch.
3. Cut the corners of the screen at a 45-degree angle.
4. Remove any plastic film that is not bonded and running parallel to the screen.

Fig. 4—Preparing Screen (Screened Cable Only)



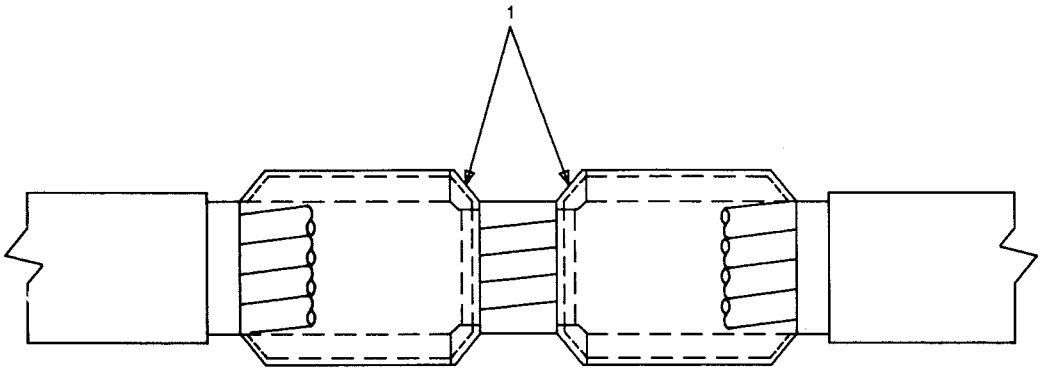
1. Fold the screen twice to eliminate sharp edges.

Fig. 5—Folding Screen (Screened Cable Only)



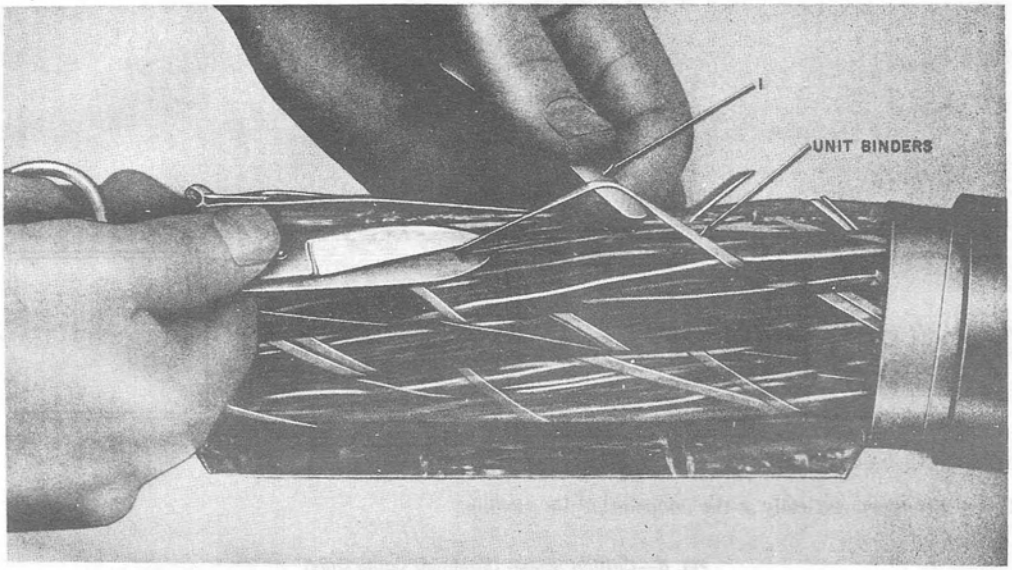
1. Cut the screen vertically at the midpoint of the opening.

Fig. 6—Cutting Screen (Screened Cable Only)



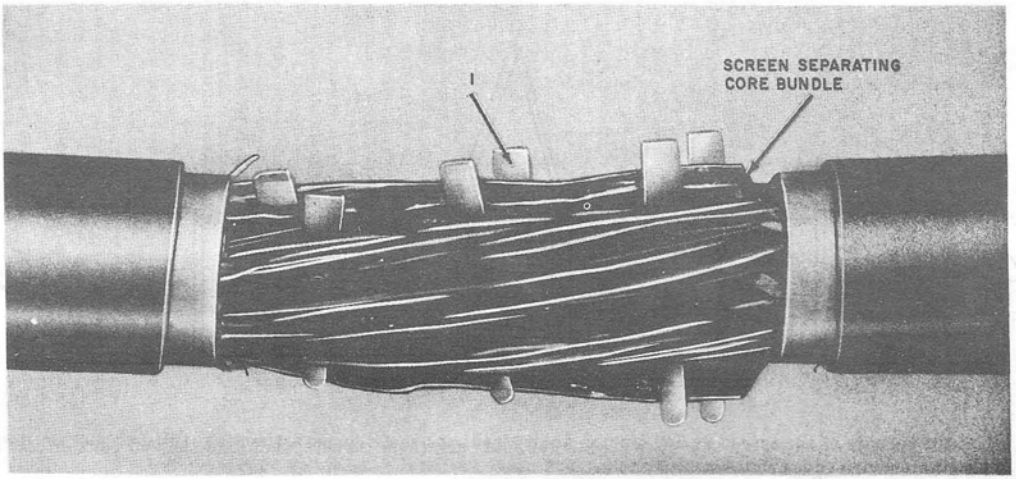
1. Cut the corners of the screen at a 45-degree angle, fold back these corners, then fold the end back on itself to eliminate sharp edges.

Fig. 7—Preparing Cut Screen (Screened Cable Only)



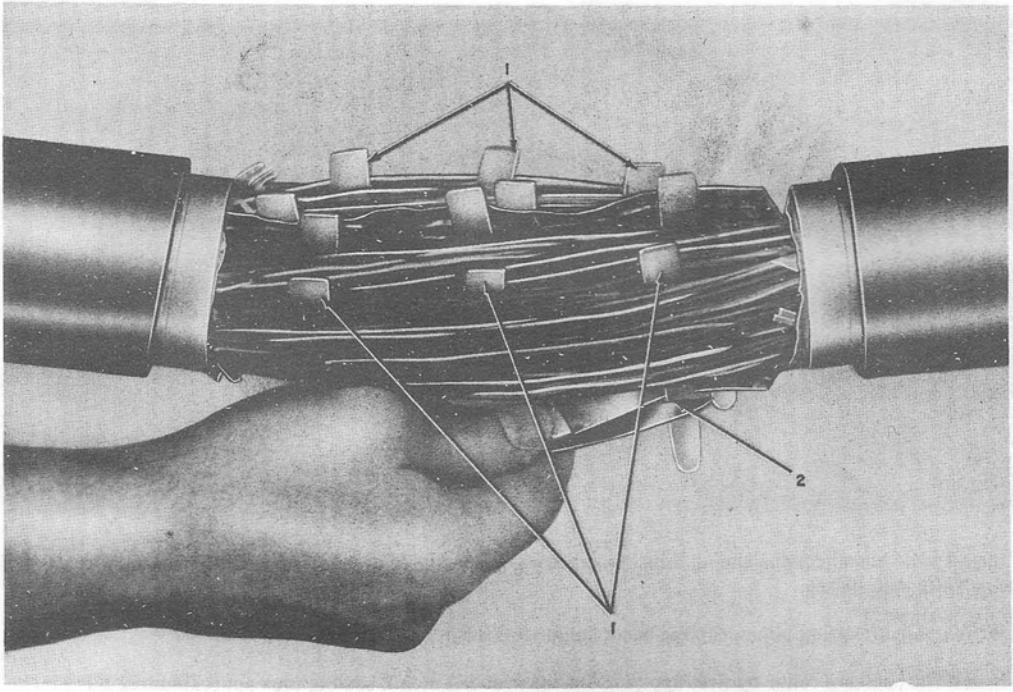
1. With the aid of an orange stick or channeling pin, cut and remove all accessible unit and multiple binders.

Fig. 8—Cutting and Removing Unit Binders



1. Insert ***three*** channeling pins ***on each side*** of the screen between the screen and core bundle.

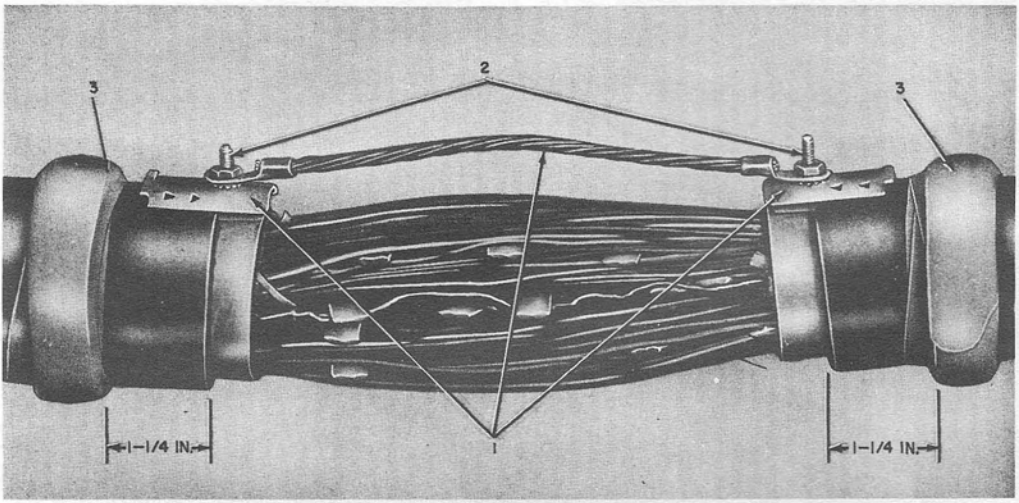
Fig. 9—Positioning Channel Pins Between Screen and Core Bundle (Screened Cable Only)



1. Insert six channeling pins into the core, following the pattern shown in illustration.

2. Trim excess channeling pin lengths.

Fig. 10—Positioning of Additional Channeling Pins

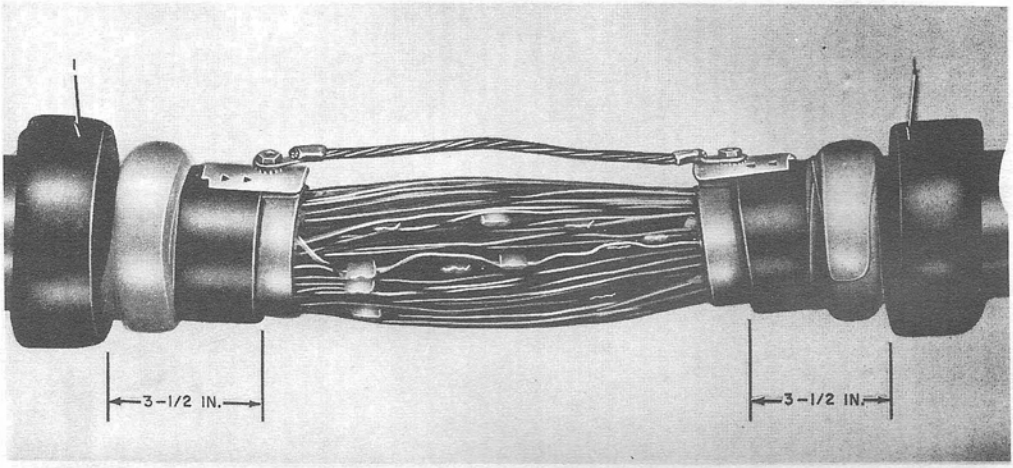


1. Install two D bond clamps and an 8-inch bond strap as described in Section 081-852-118, except do not split the polyethylene sheath.

2. With a pair of cutting pliers, cut the bond clamp stud flush with hex nut.

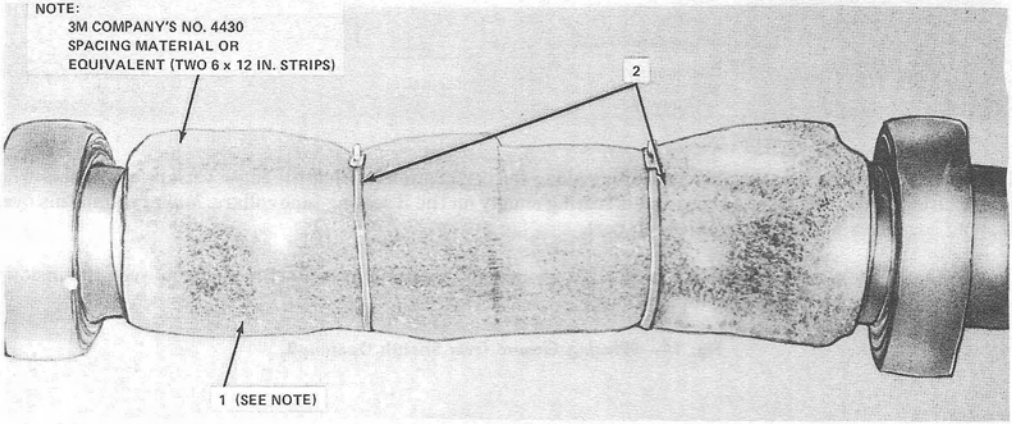
3. Install the pressure collar by first applying one layer of 3/4-inch B sealing tape approximately 1-1/4 inches on each side of the sheath opening, followed with two fully stretched layers of 2-inch DR tape (white side out).

Fig. 11—Maintaining Shield Continuity and Preparation for Closure Assembly



1. Apply two additional collars of 1-1/2 inch B sealing tape (approximately 3-1/2 inches from each end of the sheath opening) to a height sufficient to clear the top edge of the bond clamp hex nut by at least one thickness of B sealing tape.

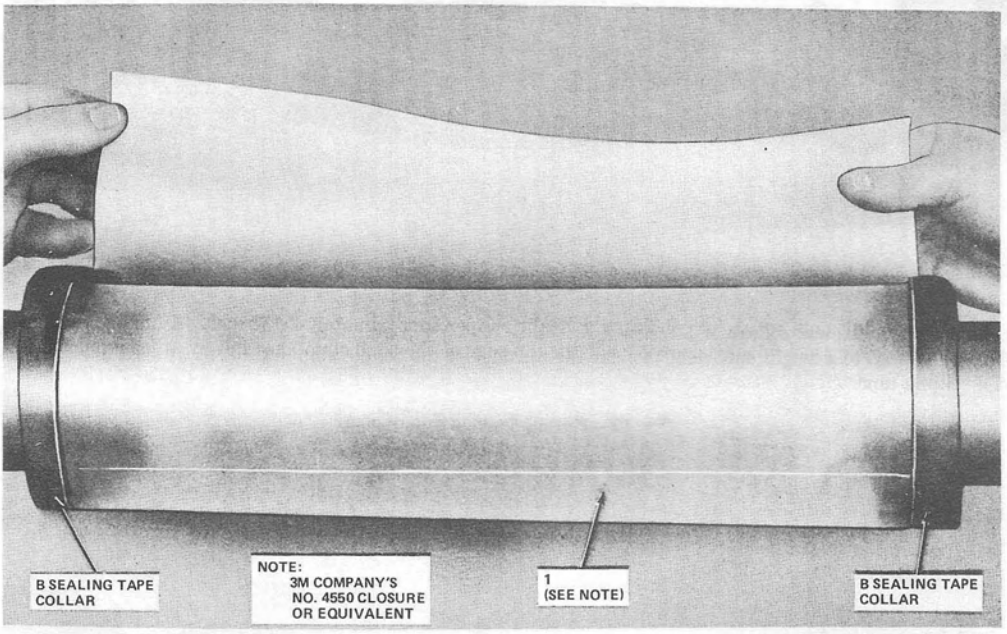
Fig. 12—Placing Sealing Tape Collars



1. Prepare an approximate 12- by 12-inch strip of spacing material and wrap the material around the entire sheath opening. Overlap the spacing material approximately 2 inches.

2. Secure the spacing material with tie wraps. Do not compress the conductor bundle.

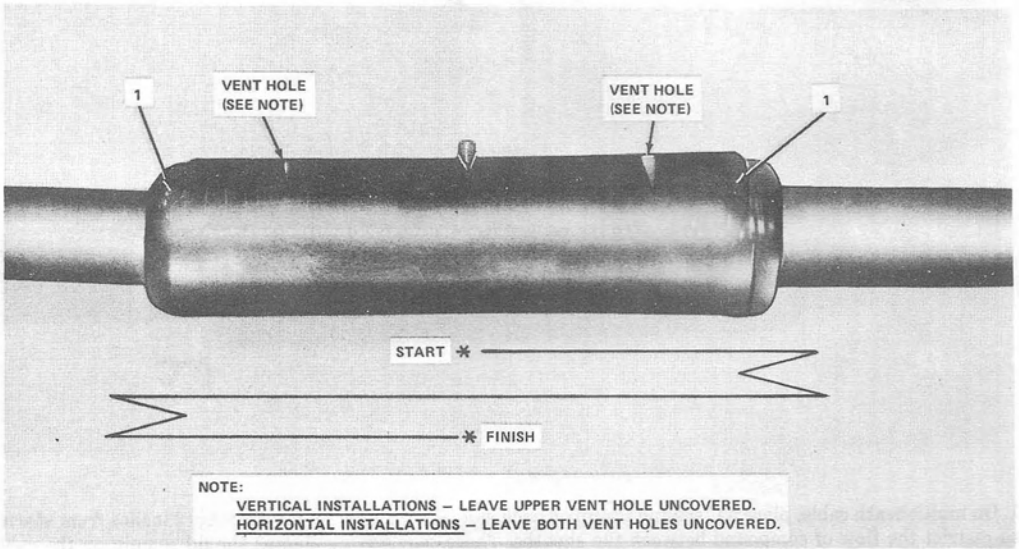
Fig. 13—Placement of Spacing Material



1. Prepare the closure for assembly by bending along the perforations so that the edge overlaps by 2 inches when it is positioned over the exposed core and is resting snugly on the B sealing tape collars. Make certain this overlapping edge does not block the injection port.

Note: The closure should be drawn tight enough so that annular contact is made between the inside of the closure and the sealing tape collars.

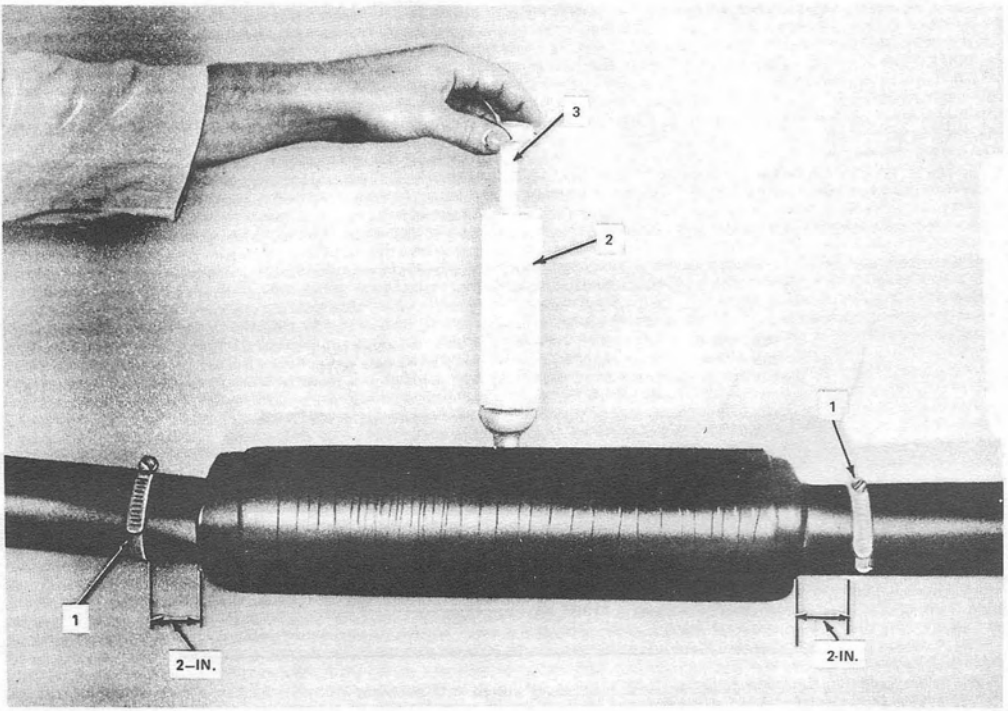
Fig. 14—Placing Closure Over Sheath Opening



1. Apply two half-lapped layers of 1-inch G vinyl tape over the entire sleeve. Apply two additional layers at each end, directly over the sealing tape collars.

Note: For ***vertical installations,*** do not cover the upper vent hole and, for ***horizontal installations,*** leave both holes uncovered.

Fig. 15—Applying Vinyl Tape Over Entire Closure Sleeve



1. On multisheath cable, place a C sealing clamp on each side of the sleeve (approximately 2 inches from sleeve) to restrict the flow of compound between the sheaths. These constricting clamps should remain on the cable at least 24 hours after the compound is injected into the sleeve.

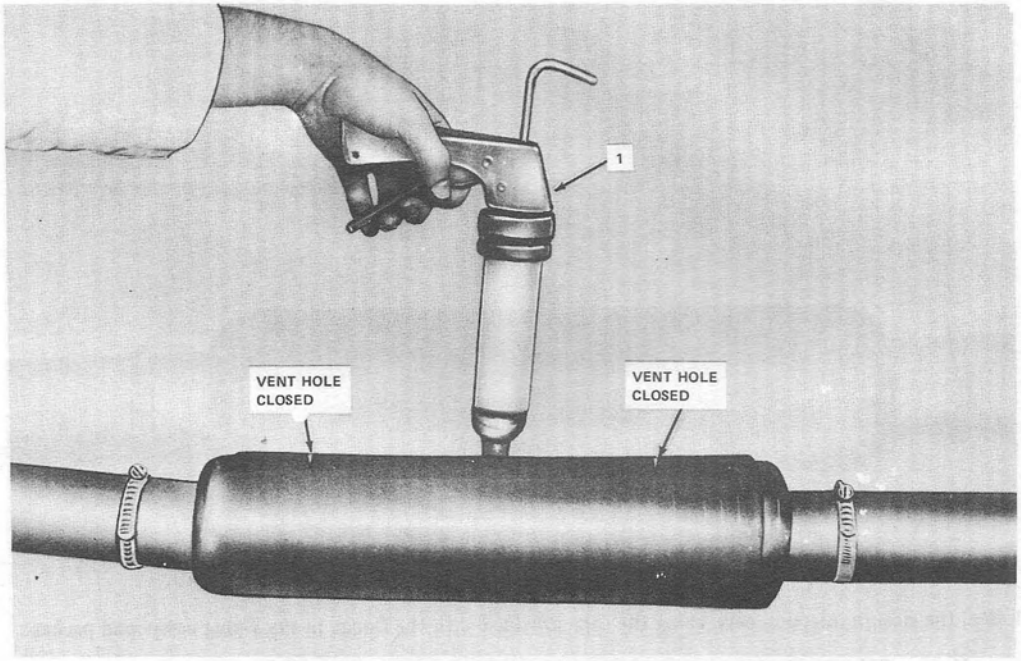
> ***Note:*** Cable under pressure should be vented on each side of the plug before injecting the compound to ensure zero pressure at the plug location.

2. Mix the compound as outlined in the supplier instructions furnished with the J plug compound and attach the cartridge to the injection port. ***Compound supplied by different manufacturers should not be mixed in the same plug.***

3. Using the dasher rod, inject the compound (several cartridges may be required) until it begins to flow out the vent hole(s). At this time, the vent hole(s) must be taped with several layers of vinyl tape.

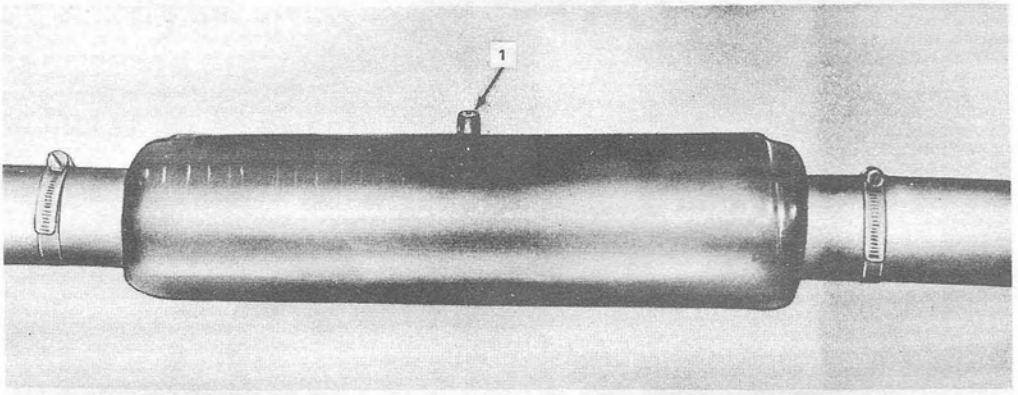
> ***Note:*** When compound flows from the vent hole(s), the cable is 2/3 full; inject 1/3 additional compound. Example: If compound flows from the vent hole(s) after 12 ounces, inject 6 additional ounces; total 18 ounces.

Fig. 16—Using Dasher Rod to Inject Compound



1. Install the injection gun on the cartridge and continue injecting the recommended amount of compound.

Fig. 17—Completing Injection of Compound With Vent Holes Closed



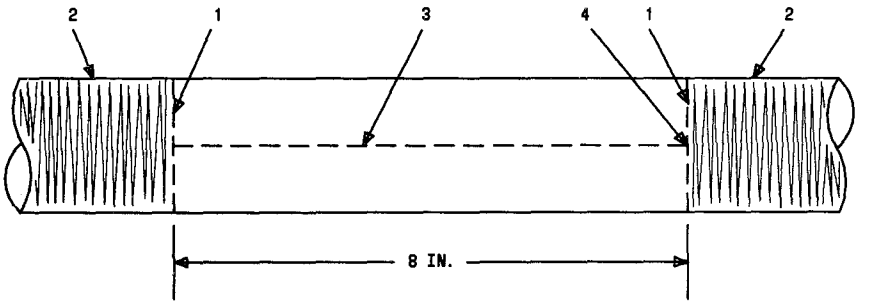
1. Seal the closure injection port, using the caps provided with the flange in the J plug compound package.

Note: Before applying pressure, observe the cure time versus temperature recommendations contained in the supplier instructions.

Fig. 18—Completed Pressure Plug

ICOT Screened Cable (Bonded PASP Sheath)

3.06 ▶The procedures for constructing a pressure plug using J plug compound in ICOT screened cable and using 3M Company No. 4530 closure or equivalent are outlined in Fig. 19 through 27.◀



1. Measure and score an 8-inch section of the outer jacket.

2. Thoroughly scuff the outer sheath a distance of 5-inches on both sides of the proposed opening.

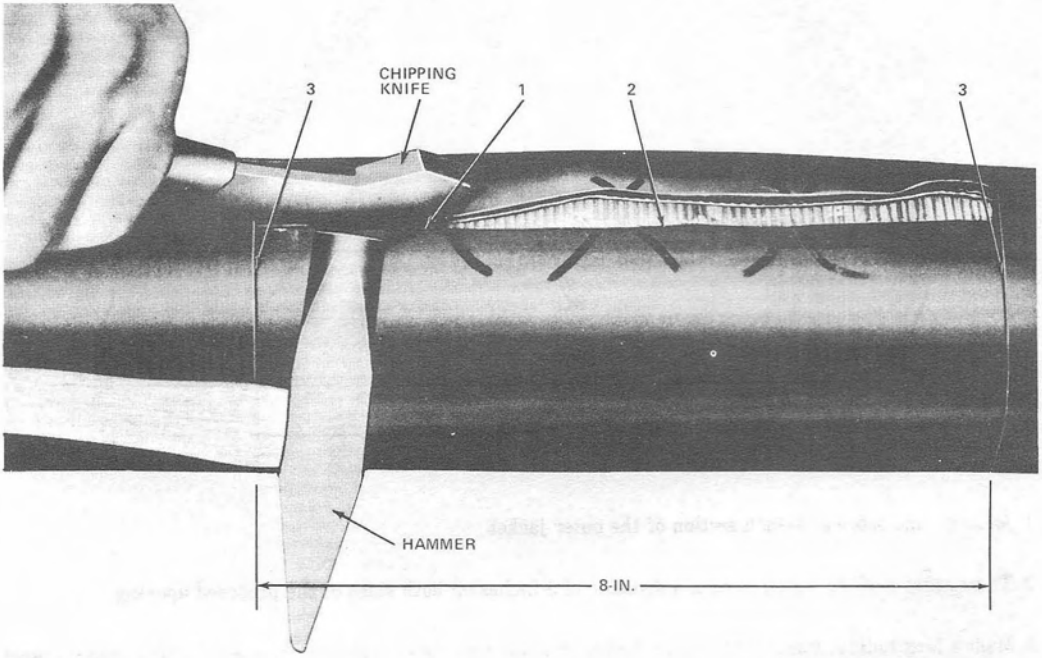
3. Make a longitudinal score into the outer jacket, but ***not through*** the underlying steel. Cutting ***into*** the steel should make a "zipper" sound.

Note: Cut ***into*** the steel, but ***not through*** the steel.

4. At the junction of the two scores, open a small portion of the underlying steel in the longitudinal direction using a cable knife.

Note: The opening need only be large enough to insert a portion of a chipping knife blade.

Fig. 19—Preparing Outer Sheath for Removal

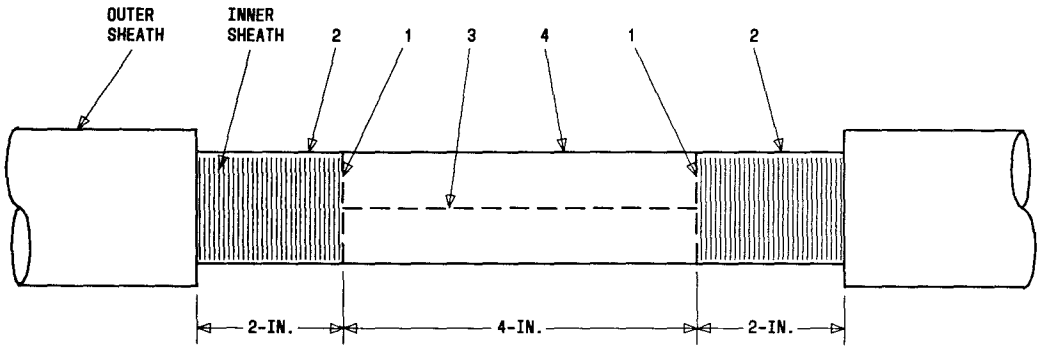


1. With the chipping knife in place, use a hammer to strike the ***side*** of the knife blade. If the score made in the procedure of Fig. 19 is deep enough, a sharp blow should open several inches; if not, the score should be deepened.

2. Open the outer sheath for a distance of 8-inches along the longitudinal score; then, remove the polyethylene, steel, and aluminum outer sheath.

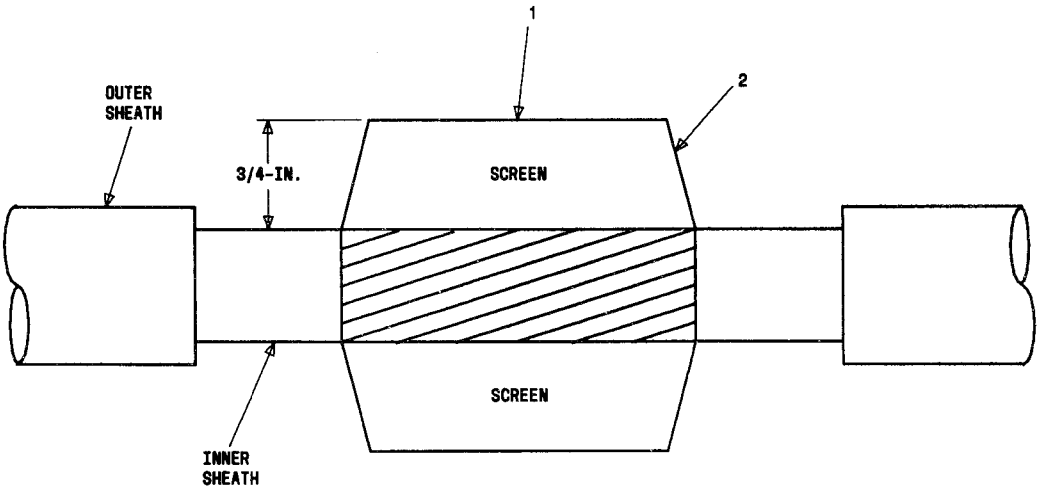
3. After the outer sheath is removed, trim the exposed shield flush with the outer polyethylene jacket.

Fig. 20—Removing Outer Sheath



1. Measure and score a 4-inch section of the inner sheath.
2. Thoroughly scuff the inner sheath a distance of 2-inches on both sides of the proposed opening.
3. Make a longitudinal score into the inner sheath, taking care not to cut the underlying conductors.
4. Remove the 4-inch section of the inner sheath and the underlying protective wrap.

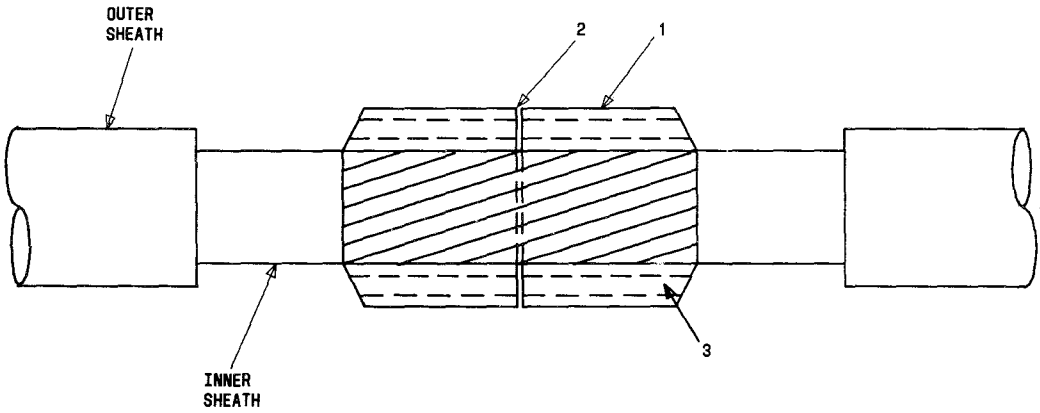
Fig. 21—Preparing Inner Sheath for Removal



1. Bend out the exposed portion of the screen that folds over the core; then, trim the protruding screen to approximately 3/4 inch above the inner sheath.

2. Cut the corners of the screen at a 45-degree angle.

Fig. 22—Preparing Screen

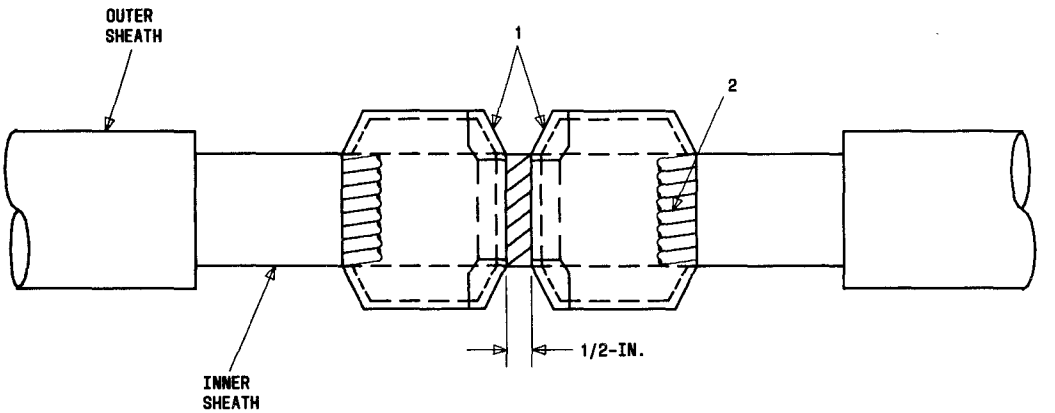


1. Fold the screen twice to eliminate sharp edges.

2. Cut the screen vertically at the midpoint of the opening.

3. Remove any plastic film that is not bonded and running parallel to the screen.

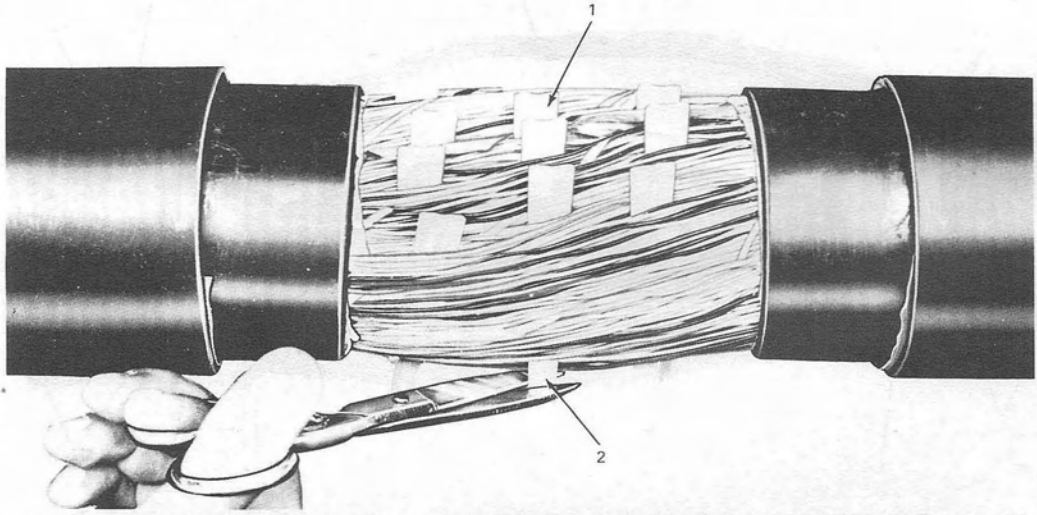
Fig. 23—Folding and Cutting Screen



1. Cut the corners of the screen at a 45-degree angle, fold back the corners, then fold the end back on itself to eliminate sharp edges.

2. With the aid of an orange stick or channeling pin, cut and remove all accessible unit and multiple binders.

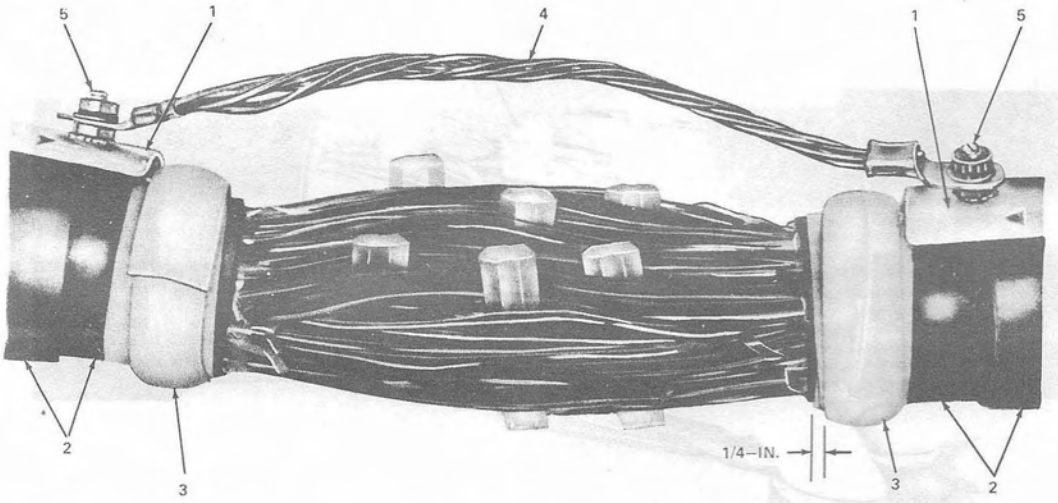
Fig. 24—Preparing Cut Screen



1. Insert three channeling pins ***on each side*** of the screen between the screen and core bundle. Also insert six channeling pins into the core, following the pattern shown in the illustration.

2. Trim access channeling pin lengths.

Fig. 25—Positioning of Channeling Pins



1. Place two D band clamps as described in Section 081-852-118, except do not split the outer sheath. ***Do not install the bond strap at this time.***

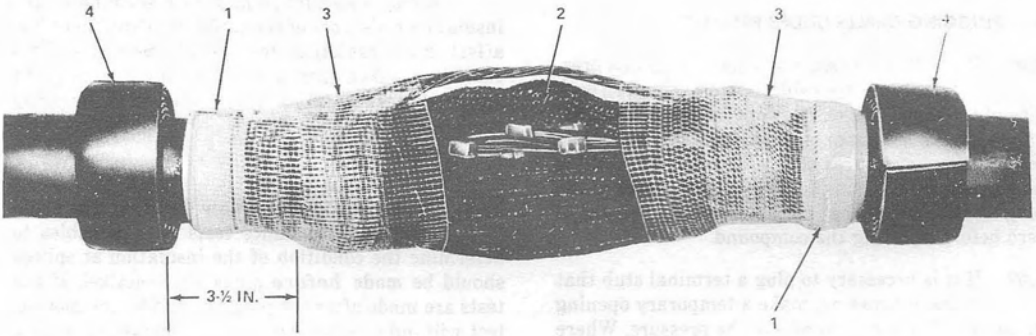
2. Apply C cement to the scuffed areas of the inner and outer sheath.

3. Install the pressure collar (on the inner sheath) by first applying one layer of 3/4-inch B sealing tape approximately 1/4-inch on each side of inner sheath opening, followed with three fully stretched layers of 2-inch DR tape (white side out).

4. Install an 8-inch bond strap to the already installed D bond clamps.

5. Cut the screw threads on the bond clamp flush with hex nut using cutting pliers.

Fig. 26 — ◊Placing D Bond Clamp and Inner Sealing Collars.◊



1. Install the outer sheath pressure collar by first applying one layer of 3/4-inch B sealing tape approximately 1-1/4 inches on each side of the outer sheath opening, followed with two fully stretched layers of 2-inch DR tape (white side out).

2. Add spacing material as shown. Secure with cable ties.

3. Apply one wrap of the two fiberglass strips at the locations shown and secure, using a channeling pin. Leave a space between the two wraps to allow free flow of compound.

4. Apply two additional collars of 1-1/2 inch B sealing tape (approximately 3-1/2 inches from each end of the outer sheath opening) to a height sufficient to clear the top edge of the bond clamp hex nut by at least one thickness of B sealing tape.

Fig. 27 — Maintaining Shield Continuity and Placing Outer Sheath Sealing Tape Collars.

3.07 Place spacing material, assemble the closure, and inject the compound as outlined in the procedures of Fig. 13 through 18.

D. Cleaning Tools

3.08 B cleaning fluid should be used promptly upon completion of the plugging operation to remove any compound which may have accumulated on the injection gun or other tools.

4. PLUGGING CABLES UNDER PRESSURE

4.01 When it is necessary to make a plug in a pressurized cable, the cable must be vented on each side of the plug. This can be done by opening nearby valves, making temporary openings in the closest lead sleeves or closures and, if necessary, installing an F pressure flange in the cable sheath. Check at the plug location to see that the pressure has dropped to zero before injecting the compound.

4.02 If it is necessary to plug a terminal stub that is under pressure, make a temporary opening in the terminal splice to relieve the pressure. Where many terminal stubs on a pressurized branch cable or section of cable are to be plugged, remove the valve core or make a temporary opening in the cable at the start of the branch or section.

5. INSULATION RESISTANCE OF PLUGGING COMPOUND

5.01 A large drop in insulation resistance will occur in ***paper-*** or ***pulp-insulated conductor cable*** immediately after inserting the compound. The lowest value occurs an hour or two after insertion when the cable becomes hot due to chemical action of the mixture. No permanent impairment in insulation resistance results; it gradually rises to normal over a period of several months.

5.02 If several plugs are installed on the same pair count (as occurs in multipled terminals), the insulation resistance of the cable may drop enough to affect line insulation tests (LIT) readings. This should be taken into account in interpreting LIT measurements on cables immediately after plugging operations.

5.03 ***Megger Tests on New Cables:*** The usual insulation resistance tests on new cables to determine the condition of the insulation at splices should be made ***before*** plugs are installed. If the tests are made after the plugs are made, the megger test will indicate low insulation resistance and give a false indication of the condition of the cable and splices.

5.04 When plugs are made in ***PIC*** or ***DEPIC cables,*** the plug compound does not saturate the conductor insulation. Accordingly, no noticeable change in insulation resistance occurs during or subsequent to the construction of the plug.