BELL SYSTEM PRACTICES
Outside Plant Construction and Maintenance

SECTION G73.151.1
Issue 1, January, 1953
AT&T Co Standard

PRESSURE TESTING
ASPHALT-FILLED HORIZONTAL PLUGS CABLES ENTERING SLEEVE FROM BOTH ENDS

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1. GENERAL

1.01 This section describes the methods of constructing horizontal asphalt-filled pressure testing plugs in paper-insulated cables when the cables enter the sleeve from both ends. This section replaces the related information in Section G50.670.2, Issue 1, which is cancelled.

1.02 Pressure testing plugs are used to divide cables into gas sections, and to seal off branch cables and terminals that are not gastight. The plugs are constructed at an opening in the cable made expressly for that purpose. The plug described in this section is suitable for underground or aerial cables having either lead or polyethylene sheath.

1.03 The plug described herein is not suitable for use on coaxial cables, cables containing video pairs, nor on disc-insulated spiral-four cables.

2. LOCATION OF PLUG

2.01 In aerial cable the pressure plug should be located in a horizontal section of the cable, preferably at the lowest point in the span.

2.02 In underground work the manhole chosen for installing the plug should have enough splicing bays to permit placing the plug in a horizontal position. Large, line or loading manholes having several splicing bays are best adapted for this work. At the end of the cable, the plug should preferably be placed in the cable vault, although it may be necessary to place the plug in the office manhole if there is no established vault and the plug might otherwise have to be located near a steam radiator or other source of heat. Plugs may fail if they are subjected to high temperature for a long period of time.

3. PREPARATION OF MATERIALS

3.01 **The Precautions** pertaining to the heating of asphalt and wax discussed in Section G73.150.1 should be observed in carrying on the operations outlined herein.

3.02 **The Cotton Sleeving, Houseline and Muslin** called for in these practices should be prepared as outlined in Section G73.150.1.

4. PREPARATION OF CABLE

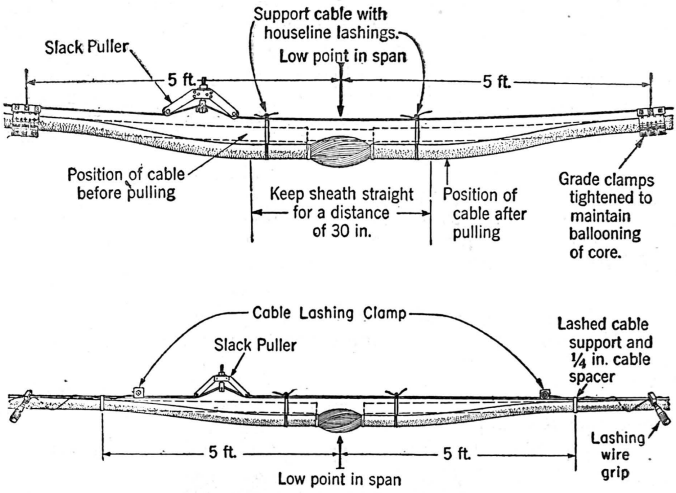
4.01 **Preparing Cable in Rings:** Grade clamps should be placed 5 feet from each side of the point where the plug is to be made. These clamps should not be tightened until the cable opening has been adjusted as outlined in Part 6.

4.02 **Prepare Lashed Cable** in the following manner:

(1) Secure the lashing wire to the strand with lashing wire grips placed about 6 feet from each side of the point where the plug is to be made.

(2) Cut the lashing wire at the midpoint and unwind it to the grips.

(3) Serve each end of the wire closely around the strand and secure to the strand with cable lashing clamps as illustrated.



4.03 Place the slack puller on the strand in the position indicated above in preparation for pulling slack in the cable.

4.04 A section of the sheath should now be removed at the point where the plug is to be made, as indicated in Table I.

TABLE I

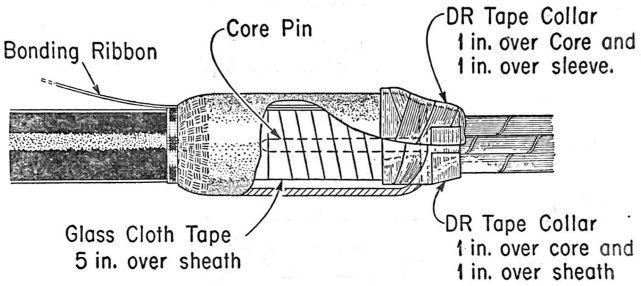
Diameter of Cable	Length of Sheath to be Removed	
	Lead Cable	Alpeth and Stalpeth Cable
1/2 in. to 3/4 in.	9 in.	11 in.
over 3/4 in. to 1-1/2 in.	10 in.	12 in.
over 1-1/2 in. to 3 in.	11 in.	13 in.
over 3 in.	13 in.	15 in.

5. PREPARING SHEATH ENDS

5.01 **Lead Cable:** In removing the sheath, the sheath ends on lead cable should be flared to prevent damage to the paper insulation on the conductors. Freshly-boiled tape should be placed around the core of the cable at both ends of the opening, extending it under the sheath. The core wrapping paper should then be removed up to the cotton tape binding.

5.02 **Alpeth Cable:** Follow the instructions on preparing alpeth sheath ends in Section G50.616.3. Then place two half-lapped layers of glass cloth tape extending over a 5-inch length of the sheath measured from the sheath end at each end of the opening. The bonding ribbon should be formed over the glass cloth wrapping.

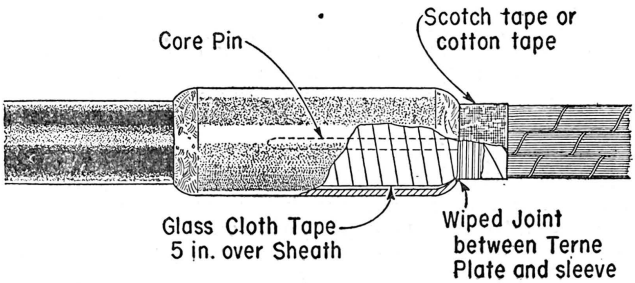
5.03 Place an auxiliary sleeve over the sheath at each end of the opening. Where the plug will be supported between racks in a manhole, make the auxiliary sleeves long enough to extend across the racks in order to support the main sleeve and keep the outer tape wrappings off the hooks. At the inside end of the auxiliary sleeves, cover the exposed wrapping of DR tape and one inch of sleeve with two half-lapped layers of DR tape. Then cover the DR tape with one half-lapped layer of glass cloth tape.



5.04 Construct a wrapped joint between the outer end of the auxiliary sleeve and the sheath at each end of the opening as described in Section G50.679.3.

5.05 **Stalpeth Cable:** Follow the instructions on preparing stalpeth sheath ends given in Section G50.616.4. Then place two half-lapped layers of glass cloth tape extending over a 5-inch length of the sheath measured from the sheath ends at each end of the opening.

5.06 Place an auxiliary sleeve over the sheath at each end of the opening. Where the plug will be supported between racks in a manhole, make the auxiliary sleeves long enough to extend across the racks in order to support the main sleeve and keep the outer tape wrappings off the hooks. A wiped joint should be used between the terne plate and the inside end of the auxiliary sleeve instead of a soldered joint.



5.07 Construct a wrapped joint between the outer end of the auxiliary sleeve and the sheath as described in Section G50.679.7.

6. PULLING SLACK AND BALLOONING CONDUCTORS

6.01 In aerial cable (either lashed or ring-supported), slack should be pulled in the cable with the slack puller as outlined in the section covering slack pullers. As slack is pulled, the cable should be lowered as shown in the illustrations in Paragraph 4.02, so that the cable will enter the sleeve properly. In underground cable the slack may be secured by rearrangement of the cable in the manhole or, when necessary, by pulling.

6.02 The cable core should be ballooned by bringing the ends of the sheath together until the length of opening shown in Table II is obtained. The core should be observed to see whether slack has developed in all the conductors, as under some conditions this reduction in the length of the opening is not sufficient to provide adequate slack in the inner layers of conductors. Slack in aerial cables should be held for a period of about 15 minutes after which the inner conductors should again be examined. If the conductors in the center have become taut, additional slack should be pulled until there is a decided bow in all of the inner conductors.

6.03 When adequate slack has been obtained proceed as outlined below. The slack puller should be left on the strand until the plug is completed.

(1) On cable in rings, the grade clamp at each side of the opening should be tightened securely to the strand and cable to maintain the slack.

(2) Lashed cable has little tendency to slip through the lashing and, therefore, grade clamps or other fastenings will usually not be required.

6.04 **Adjusting Length of Opening:** The opening between the two ends of the sheath should be enlarged, if necessary, by removing additional sheath to provide the opening called for in Table II. The specified length of opening is important in order that satisfactory impregnation of the core may take place.

TABLE II

Diameter of Cable	Length of Opening after Ballooning Core	
	Lead Cable	Alpeth and Stalpeth Cable
1/2 in. to 3/4 in.	8 in.	10 in.
over 3/4 in. to 1-1/2 in.	9 in.	11 in.
over 1-1/2 in. to 3 in.	10 in.	12 in.
over 3 in.	11 in.	13 in.

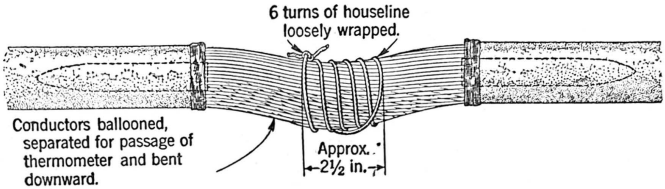
7. PLACING CORE PINS AND CONSTRICTING RINGS

7.01 **Core Pins** of the sizes indicated below are required. They should be prepared and inserted as outlined in Section G73.150.1.

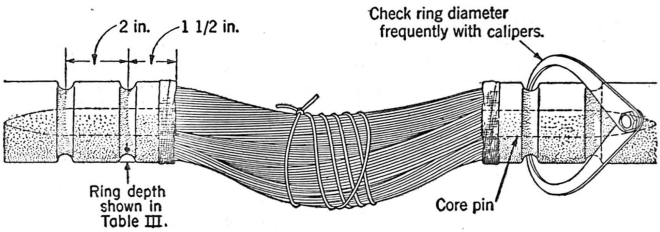
TABLE III

Diameter of Cable	Diameter of Pin			
	Lead and Stalpeth Cable	Alpeth Cable	Length of Pin	Depth of Rings
1/2 in. to 3/4 in.	1/8 in.	3/16 in.	4 in.	1/32 in.
over 3/4 in. to 1 in.	3/16 in.	1/4 in.	4 in.	1/16 in.
over 1 in. to 1-1/4 in.	1/4 in.	5/16 in.	4 in.	3/32 in.
over 1-1/4 in. to 1-1/2 in.	5/16 in.	3/8 in.	6 in.	1/8 in.
over 1-1/2 in. to 1-3/4 in.	3/8 in.	1/2 in.	6 in.	5/32 in.
over 1-3/4 in. to 2 in.	3/8 in.	1/2 in.	6 in.	3/16 in.
over 2 in. to 2-1/2 in.	1/2 in.	5/8 in.	6 in.	7/32 in.
over 2-1/2 in. to 3 in.	5/8 in.	3/4 in.	6 in.	1/4 in.
over 3 in.	3/4 in.	7/8 in.	6 in.	5/16 in.

7.02 The ballooned conductors should be bent downward so that they all dip at the midpoint, as illustrated below. The conductors should be separated to allow free passage of the impregnating materials, also to allow a passage for the thermometer mentioned later. If the outside diameter of the ballooned core is greater than the diameter of the sleeve indicated in Table IV, Paragraph 8.01, the ballooned conductors should be pressed together until the proper diameter is obtained. The core should then be wrapped loosely with 6 turns of houseline. This is done to keep the conductors away from the sleeve wall.



7.03 **Forming Rings in Sheath:** In lead cable two rings should be formed at each end of the sheath at the positions indicated in the following sketch. The depth of the rings should vary with the size of the cable as indicated in Table III. It is not practicable to make rings in alpeth or stalpeth cable.



7.04 Strips of cable pasters should be placed 1/4 inch on each side of the center line of the rings to serve as guides in the ring-forming operation.

7.05 The rings can be formed using the Cable Sheath Constrictor. As an alternative in large diameter cable, the rings can be formed by striking with a hammer a smooth 1/2-inch diameter steel rod which is held against the sheath between the paster guides. The position of the rod should be changed frequently and moved around the sheath between hammer blows to ensure the formation of a smooth ring of uniform depth. Excessive hammering at one point must be avoided as this tends to flatten the cable unduly and may result in a final average diameter smaller than that specified.

7.06 A pair of outside calipers should be used to gauge the depth of the rings. The caliper points should be set to a separation equal to the cable diameter minus twice the required

ring depth. As the ring is formed, the diameter of the sheath should be checked frequently until the points of the caliper pass freely over all points on the ring.

8. PLACING LEAD SLEEVES

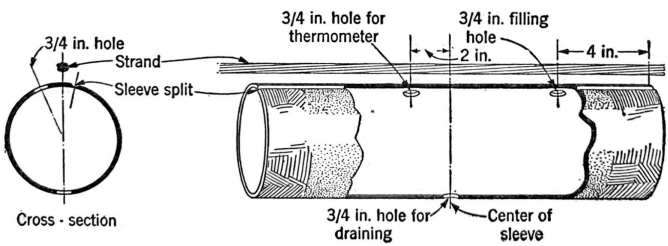
8.01 A lead sleeve of the length and diameter indicated in the following table should be prepared.

TABLE IV

Diameter of Cable	Inside Diameter of Sleeve	Length of Sleeve	
		Lead Cable	Alpeth or Stalpeth Cable
1/2 in. to 3/4 in.	2 in.	17 in.	15 in.
over 3/4 in. to 1 in.	2-1/2 in.	20 in.	16 in.
over 1 in. to 1-1/4 in.	3 in.	20 in.	16 in.
over 1-1/4 in. to 1-1/2 in.	4 in.	20 in.	16 in.
over 1-1/2 in. to 1-3/4 in.	4-1/2 in.	22 in.	17 in.
over 1-3/4 in. to 2 in.	*5 in.	22 in.	17 in.
over 2 in. to 2-1/2 in.	*5-1/2 in.	22 in.	18 in.
over 2-1/2 in. to 3 in.	*6 in.	22 in.	18 in.
over 3 in.	*7 in.	26 in.	22 in.

* Use Extra Strength Lead Sleeve

8.02 Openings of 3/4-inch diameter are required in the sleeve to permit filling and draining. For aerial cable the openings should be located as indicated in the following sketch. For undergound cables, the openings need not be offset from the center line of the sleeve unless it is necessary in order to permit the use of a split sleeve. The lower opening, which is used as a drain, should be equipped with an L Pressure Testing Flange. In placing the flange it is advisable to flatten the sleeve slightly around the hole, after which the flange can be fitted in the hole and soldered in position using a cable soldering form. Flanges should not be installed in the upper two holes at this time.



8.03 If it is necessary to split the sleeve, it should be split along a line a little to one side of the two top holes as indicated above. After opening, the inside of the sleeve should be examined carefully, removing any lead or solder projections that may be seen near the holes. The sleeve should then be centered over the opening, marking its correct position on the ends of the sheath, after which the seam can be soldered and the sleeve wiped in position. For aerial cable the two top openings should be placed slightly to one side of the strand and the seam at the other, as shown in Paragraph 8.02.

8.04 In constructing plugs in cables 1-1/2 inches or less in diameter, it is advisable to check the distance between the marks on the sheath before the sleeve is wiped in position to ensure that the length of the opening has not changed while placing and beating in the sleeve.

9. PREPARATION FOR IMPREGNATING CORE

9.01 After the lead sleeve is wiped in position proceed as follows:

(1) On **Cable in Rings,** the grade clamps should be loosened.

(2) The slack puller is then released slowly and the cable and sleeve are raised to their permanent position and temporarily lashed in place with houseline.

(3) The grade clamps should then be retightened and left on the cable.

(4) On **Lashed Cable,** the slack puller should be slowly released and the cable and sleeve raised to their permanent position and temporarily lashed in place. If necessary, tapping the strand with the cable dresser will facilitate feeding excess length of cable through adjacent turns of lashing wire.

(5) In **Underground Cable,** there is usually no rearrangement necessary at this stage of the operation.

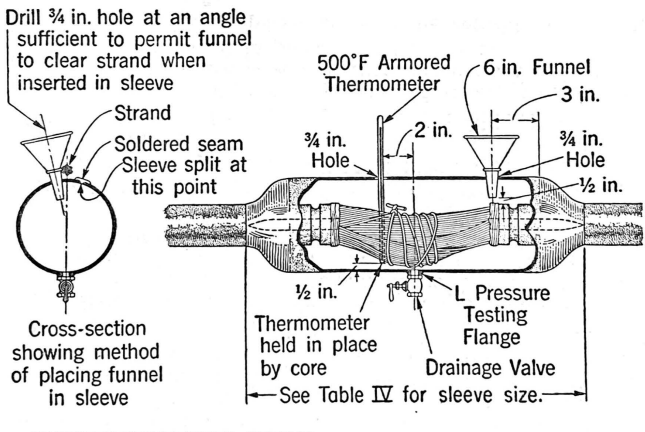
9.02 **Placing Valves:** If the plug is being made between two gas sections, a valve should be installed in the cable sheath two feet from each end of the lead sleeve. At end plugs a valve should be installed on the pressure side of the plug two feet from the end of the sleeve and a hole should be drilled at the other side two feet from the sleeve. If the cable is under pressure the valve caps and cores should be removed so that the cable at the plug will remain at atmospheric pressure during the filling operation. After removing the cores, the open valves should be protected to prevent water entering the cable through the valves.

9.03 **Preparation for Impregnating Core:** A six-inch filling funnel should be placed in the hole in the sleeve nearest the wiped joint. The lower end of the stem should project to a point 1/2 inch above the top of the cable sheath. It is important that a seamless metal funnel be used and that the diameter of the lower end of the stem be not less than 1/2 inch, preferably larger. The end of the stem may be cut off in order to obtain an opening of sufficient diameter to permit free flow of the wax and asphalt.

9.04 An armored thermometer reading to 500°F. should be inserted in the other hole. The bulb end of the thermometer should be worked through the core to a point about 1/2 inch from the bottom of the lead sleeve.

9.05 Later cleaning of the sleeve will be facilitated if at this stage two or three layers of heavy paper are wrapped tightly around the sleeve. Openings should, of course, be provided to fit over the filling and draining holes in the sleeve.

9.06 The flange at the bottom of the sleeve should be equipped with a drainage valve to control the flow of wax through the sleeve.



10. IMPREGNATING CORE

10.01 One 18-quart pot of hot No. 1 Pressure Plug Wax (approximately 22 pounds) should be sufficient for impregnating a plug in a 2-5/8-inch diameter cable. Approximately 2 pounds of the wax will be absorbed in the impregnating process. Two pots are necessary for the filling operation, one

containing the wax used in filling the sleeve, and an empty pot for receiving the wax as it flows from the sleeve.

10.02 **To impregnate the core of lead cable** pour three or four dippers of wax, heated to a temperature of 350°F. (25° higher at 32°F. air temperature; 40° higher at 0°F. air temperature), through the plug with the drain valve open, allowing the wax to drain from the valve into a pot. Then partially close the valve and adjust so that a thin stream of wax flows into the pot. Hot wax (350°F.) should now be poured in rapidly enough to fill the sleeve, after which the pouring should be continued keeping the sleeve full and the rate of drainage adjusted to a point where a reading of 265°F. (or above) is obtained on the thermometer. The drain valve should then be closed.

10.03 The temperature of the wax should then be kept within the range of 250° to 265°F. for a period of 15 minutes, by opening the drainage valve as necessary and adding sufficient hot wax to the sleeve to keep it filled. Then, with the drain closed, the temperature should be permitted to drop as rapidly as it will, the sleeve being kept full by the addition of hot wax.

10.04 When the thermometer reaches 200°F. or slightly below, the valve should be opened until all the wax has drained out of the sleeve. Then the thermometer and drainage valve should be removed. The flange at the bottom should be sealed, using an L Flange Plug with threads coated with pipe joint compound or equivalent.

10.05 **To impregnate the core of polyethylene sheath cable** the same procedure as outlined in Paragraphs 10.02 to 10.04 is followed except for the use of lower temperatures. Heat the wax to a temperature of 300°F. (25° higher at air temperatures of 32°F. or lower). The temperature of the wax in the sleeve should be maintained within a range of 225° to 240°F. for the same period of impregnation.

11. FILLING SLEEVE WITH ASPHALT

11.01 Approximately 15 minutes (12 minutes at 32°; 9 minutes at 0°F. air temperature) after the sleeve is drained it should be filled with No. 1 Pressure Plug Asphalt heated to a temperature of 200° to 220°F. Approximately 12 to 15 pounds of asphalt are required for filling a 6-inch diameter by 22-inch plug sleeve. This material will flow into the sleeve very slowly due to its consistency at the specified temperature. Under no condition should the asphalt be admitted to the sleeve at a temperature above the 220°F. specified.

11.02 Asphalt should be poured into the funnel until the sleeve is full. During the operation the wiped joints should be tapped with a cable dresser to force out any air that may be

trapped at the ends of the sleeve. Then the pouring should be continued slowly, keeping the funnel full, until the flow from the funnel into the sleeve has almost ceased at which time no more asphalt should be added.

11.03 At this stage the funnel should be removed without waiting for the asphalt to settle further. Then the paper wrapping should be removed and the sleeve cleaned with a cloth soaked in kerosene.

11.04 **L Pressure Testing Flanges** should now be soldered over the two upper holes, using cable soldering forms. The completed pressure plug should be allowed to cool to approximately atmospheric temperature before placing L Flange Plugs in the upper flanges. Standard pipe joint compound or equivalent should be applied to the flange plugs.

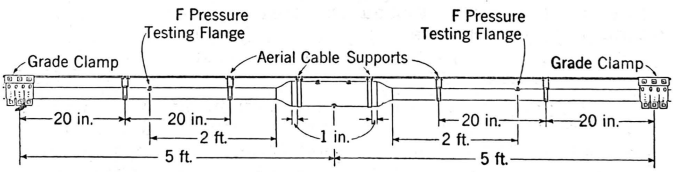
11.05 Where polyethylene sheath cable is involved, complete the auxiliary sleeve splice on alpeth cable as described in Section G50.680.3, and on stalpeth cable as described in Section G50.680.1.

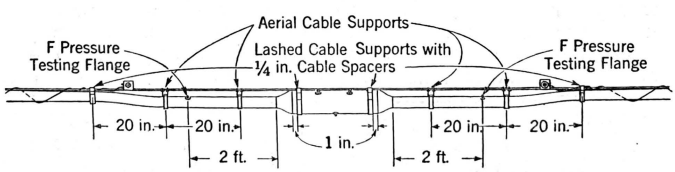
12. PLACING PERMANENT SUPPORTS

12.01 The permanent supports should now be placed as outlined below:

(1) **In Underground** installations, the cable and sleeve should be racked in their permanent position.

(2) **Cable in Rings:** The cable and sleeve should be supported with aerial cable supports as illustrated below. The cable should be kept parallel to the strand at the grade clamp level.





(3) **Lashed Cable:** The cable and sleeve should be fastened securely to the strand as illustrated above. The supports should be installed as described in the G52 division.

(4) Gas warning tags should be installed on the sleeve in the usual manner.

13. PRECAUTIONS IN MAKING PLUGS IN SMALL CABLES

13.01 In making plugs in small cables the downward bow of the ballooned core is easily deranged by movement of the cable. Therefore, before the sleeve is placed, the entire length of the ballooned core should be sewed loosely with cotton sleeving. The turns should be spaced about an inch apart using a lock stitch as in sewing cable forms, to maintain uniform spacing. The wrapping should be tight enough to prevent individual pairs or groups of pairs from buckling upward if the length of the opening is readjusted after beating in the sleeve, but the wrapping should not be so tight as to eliminate the separation of conductors.

13.02 Plugs in cables having a diameter up to 3/4 inch, may be made with a lead sleeve as short as 12 inches where it is desirable because of space limitations. When short sleeves are used the constricting rings should be located 1 inch and 2 inches from the ends of the sheath at the opening instead of the usual distances. The length of the sheath opening should be 7 inches before ballooning and 6 inches after ballooning.