BELL SYSTEM PRACTICES
Outside Plant Construction and Maintenance

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PRESSURE TESTING
RESIN PLUGS—SHEATH INJECTION LEAD CABLES OVER 5/8-INCH DIAMETER

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1. GENERAL

1.01 This section describes the sheath injection method of constructing cold resin plugs in lead sheath cables larger than 5/8-inch outside diameter. Distribution terminal stubs and other cables of 5/8-inch diameter and smaller are plugged as outlined in Section G73.157.2.

1.02 The sheath injection method is used primarily for cables up to 1-1/4-inch diameter. Larger diameter cables should preferably be plugged by the sleeve injection method.

1.03 The sheath injection method may be used on large size cables when field conditions make it impracticable to place a lead sleeve.

1.04 Lepeth, alpeth, and stalpeth sheath cables are plugged by the sleeve injection method, as covered in a separate section.

2. LOCATION OF PLUG

2.01 These plugs can be made in a horizontal, vertical, or curved section of cable.

2.02 In aerial cable, the plug can be located at any convenient point in the span. If near a pole, the plug should be at least 30 inches beyond the point where a splice may later be made. If a splice is present, the plug is made at least 30 inches from the nearest wiped joint, to avoid compound flowing into the sleeve.

2.03 In main undergrounded cable the plug is made as far as practicable from the lead sleeve. In subsidiary cable, the plug is made at least 30 inches from the nearest wiped joint in the manhole, or in the riser on the pole, or in the subscriber building.

2.04 In plugging branches from the manhole, the plug can be made in the stub cable if it can be located at least 30 inches from the main and stub splices. Otherwise the individual branch or subsidiary cables can be plugged.

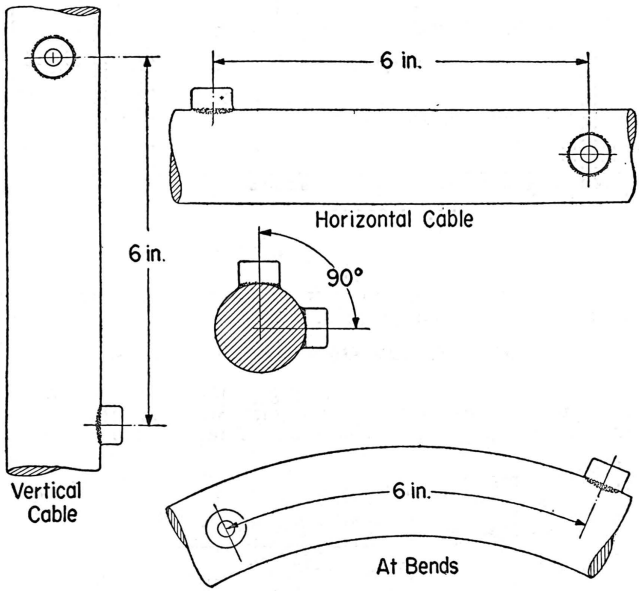
2.05 In cable vaults, the plugs can be made in the textile insulated cables if necessary, to avoid flow of compound into a splice.

3. PREPARATION FOR PLUGGING

3.01 The number of injection points, type of flange, and the drill used in preparing cables of various sizes are indicated below.

Cable Diameter Inches O.D.	Injection Points	Type of Flange	Type of Drill
Over 5/8 to 1 inch	2	B Pressure Plug Flange	Cable Drill (1/4-in.)
Over 1 inch	2	D Pressure Flange	D Drill (3/8-in.)

3.02 Where two flanges are used, they are installed 6 inches apart at 90°, as illustrated.



3.03 **Drilling Sheath:** Clean the sheath with a carding brush and coat with stearine; then proceed as follows:

(1) Drill the holes with the appropriate size drill, being very careful to avoid damage to the conductor insulation.

(2) Remove burrs from the under edge of the hole with the B cable core depressor.

(3) **On cables under 1 inch diameter,** depress the core and raise the sheath about 1/16 inch using the core depressor. **On cables of 1 inch and larger** the sheath is raised with the B sheath lifter after placing the flanges.

(4) Remove the core wrapping paper at each hole. This can best be done by making a series of closely spaced holes in the paper around the opening with the tweezers and then picking out the paper disc thus formed.

3.04 **Probing the Core:** A transverse channel is then made in the core at each hole using the orange wood stick. The tapered end should be lubricated with stearine and worked carefully through the core to a depth ranging from 3/4 the diameter of the core for the smallest size cable to full diameter for a maximum size cable. During this operation, withdraw the

stick several times and relubricate. The stick must be worked through the core slowly and carefully to avoid damaging the conductors.

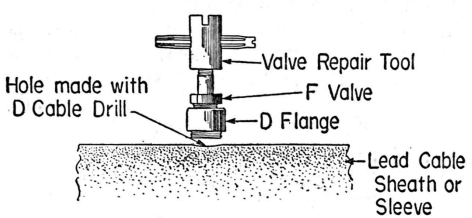
4. PLACING FLANGES

4.01 The flanges should then be soldered in place using a soldering copper on underground cable and the acetylene torch, if available, on aerial cable.

4.02 **When B Pressure Plug Flanges** are used, they can be installed as outlined in Section G73.157.2.

4.03 **When D Pressure Flanges** are used, they can be installed as follows:

(1) Screw the base of the flange in the hole using the valve repair tool as a handle, as illustrated below.



(2) Solder the flange and after it has cooled raise the sheath 1/16-inch (two full turns), using the sheath lifter as outlined in Section G73.106.1.

5. QUANTITY OF RESIN AND ACTIVATOR

5.01 **Cables Over 5/8 inch to 15/16 inch:** The total quantity of material required is indicated below.

Outside Diameter of Cable—Inches	Number of Small Charge* Injections	*Small Charge Consists of
0.65 to 0.73 inc.	2	1—50 gram tube C Resin and
0.74 to 0.83 inc.	3	1—19 gram tube C Activator
0.84 to 0.90 inc.	4	
0.91 to 0.99 inc.	5	

5.02 **Cables 1-inch Diameter and Over:** The quantity of material required is as follows:

Outside Diameter of Cable—Inches	Number of Large Charge* Injections	Number of Injections Using 3 Small Charges**
1.00 to 1.16 inc.	2	2
1.17 to 1.35 inc.	3	4
1.36 to 1.62 inc.	4	5
1.63 to 1.86 inc.	5	6
1.87 to 2.02 inc.	6	7
2.03 to 2.15 inc.	7	8
2.16 to 2.25 inc.	8	9
2.26 to 2.33 inc.	9	10
2.34 to 2.47 inc.	10	11
2.48 to 2.61 inc.	11	12

***Large Charge** consists of 1—168 gram can C Resin and 1—64 gram tube C Activator

****Small Charge** consists of 1—50 gram tube C Resin and 1—19 gram tube C Activator

5.03 The B gun will hold one 50 gram tube of resin and one 19 gram tube of activator; the C gun will conveniently hold one 168 gram can of resin and one 50 gram tube of activator, or three 50 gram tubes of resin and three 19 gram tubes activator, if only the small tubes are available. These quantities must not be exceeded.

6. MIXING AND INJECTING RESIN—ABOVE 45°F.

6.01 When two flanges are used, the mixed resin is injected into one and then the other, alternately, with the unused flange plugged (hand tight fit) to prevent escape of the resin.

6.02 The procedure for mixing and injecting the resin depends on whether the B or C gun is being used.

6.03 **B Pressure Gun:** When using this gun, proceed as follows:

(1) Fasten the gun holder to a pole, ladder, or other convenient support. Remove the front cap from the gun, back off the piston screw to its full travel, then place the gun in the holder.

(2) Empty one tube of C Resin and one tube of C Resin Activator in the gun barrel and stir the contents vigorously with the B cleaning rod for at least one minute. Clean the rod when finished.

(3) Replace the cap on the gun and remove from the holder. With the gun orifice pointing upward, expel the air from the gun by turning the piston screw clockwise until the resin mixture appears at the nozzle.

(4) Then back off screw slightly if necessary, to stop the flow and screw the gun to the flange.

(5) Inject the mixture into the cable by operating the wrench handle clockwise, using quarter to half turns until the gun is empty. Leave the gun attached to flange for **one minute** to prevent backflow of the compound.

(6) Detach the gun and place a screw plug in the flange just used.

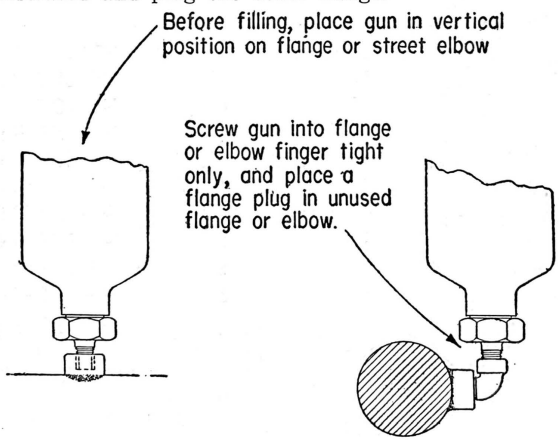
(7) Prepare the second charge as before, then attach the gun to the other flange and inject the material as in (5). About 5 minutes should elapse between injections, except the final injection which should follow the preceding one by about 15 minutes.

(8) After the final injection is made, wait one or two minutes, remove the gun; then place screw plugs in the flanges and tighten securely.

(9) Clean the gun promptly as covered in the tool section, otherwise the resin may set and make removal difficult.

6.04 **C Pressure Gun:** When using this gun, the resin and activator are mixed in the resin can which is purposely underfilled to provide space for the activator and permit stirring. A street elbow is required in both flanges on a vertical cable or in the front flange on a horizontal cable, to hold the gun vertically while filling. The procedure when using the C gun is as follows:

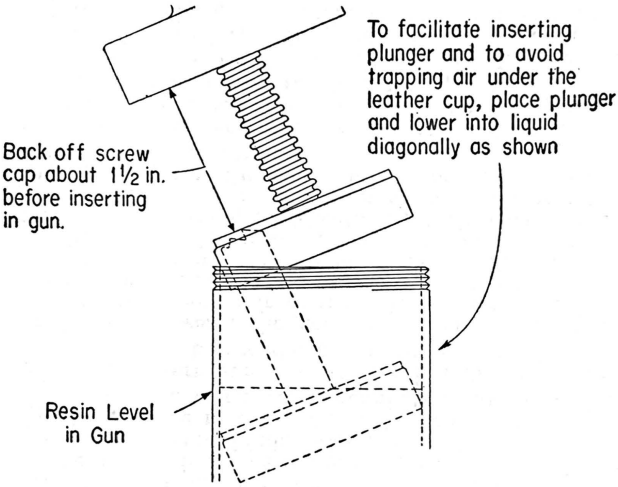
(1) Unscrew the cap of the gun and remove the plugger. Then mount the gun on the flange or street elbow as illustrated and plug the other flange.



(2) Open the 168 gram can of resin and form the pouring lip, then mix in the 64 gram tube of activator, stirring thoroughly for at least a minute, as outlined in the general section.

(3) Pour the mixed resin in the gun, using the flat end of the cleaning rod to clear out the material adhering to the can.

(4) Insert the plunger diagonally as illustrated and screw the cap in place hand tight.



(5) Inject the resin into the cable slowly. This operation should be timed to take about five minutes. When the piston travel is complete, leave the gun attached for one or two minutes to avoid backflow of the resin.

(6) Then detach the gun from the cable and place a screw plug in the flange just used. The piston **must not** be withdrawn before detaching the gun as this will suck compound out of the cable.

(7) After the gun is removed, unscrew the cap, remove the plunger and attach the gun barrel to the other flange.

(8) About 5 minutes should elapse between injections, except the final injection which should follow the preceding one by about 15 minutes.

(9) Prepare the mixture for the second and subsequent injections as needed, so as to maintain the 5 or 15 minute waiting interval between charges. **Do not** mix in advance, particularly in hot weather, as the material may set up in the gun.

(10) After the final injection, wait 2 or 3 minutes, remove the gun and street elbows if used, then seal the flanges permanently with screw plugs.

7. PROCEDURE AT TEMPERATURES BELOW 45°F.

7.01 Cold resin plugs should preferably be made at temperatures above 45°F. If the plugs must be made at lower temperatures, it is necessary to observe the following precautions:

(a) The resin and activator should be moderately warm before mixing. The material to be used the following day should be stored indoors in a heated building overnight. On the job, the material should be kept indoors, if practicable, or in a truck cab or manhole to avoid chilling.

(b) The pressure gun and the lead sheath should likewise be warmed before the first injection is made.

(c) **In aerial work,** the acetylene torch can be used to remove the chill from the cable sheath. This is done after the flange is soldered in place. A soft flame should be applied evenly over about 18 inches of sheath for the smallest cables, increasing to about 36 inches on full size cable. After heating, the sheath should feel warm but not hot to the hand. If a tent is set up, a tent heater can be employed to bring the cable, gun and plugging materials to the desired temperature.

(d) **Caution:** Do not reheat the sheath with a torch after the first injection is made as this may cause the plugging compound to set up too rapidly.

(e) **In manholes,** the cable can be warmed using a heat lamp if available, or by pumping hot air into the manhole to raise the temperature of the sheath, pressure gun and resin.

8. CORRECTING FAULTY PLUGS

8.01 When it is necessary to repair a faulty plug, proceed as follows:

(1) Remove the screw plug from both of the flanges and look for a void between the bottom of the flange opening and the core. A void may be found in one or both of the flanges. When a void is found, prepare one 69 gram charge

of the plugging mixture and inject into the cable through each flange having a void.

(2) If no void is found, it may still be possible to inject the resin by making a void below each of the flanges. To do this the solidified plugging compound is broken with the orange wood stick and the pieces are picked out with the tweezers until the insulated conductors are visible in the flange opening. Then, prepare one or two charges of the plugging mixture and inject into the cable through each flange.

(3) In replugging cables it will be found that the plugging mixture already in the cable offers considerable resistance to the entrance of the new material. The gun handle is turned clockwise until the resistance encountered makes it impracticable to turn the handle further. After waiting a minute or two, the handle is turned until high back pressure is again encountered. During the initial stages of the injection it may not be possible to turn the handle at all after high resistance is first experienced. However, it is necessary to maintain a high injection pressure in order that a channel can be formed in the core. When this occurs it will be possible to operate the handle at more frequent intervals until the charge has been injected into the cable.

8.02 If it is found impracticable to repair the plug as outlined above, a new plug should be constructed as close as practicable to the faulty plug. The flanges for the new plug should be installed about 18 inches from the nearest original flange for cables under one inch diameter, increasing to 30 inches for full size cables.