

BELL SYSTEM PRACTICES
Outside Plant Construction
and Maintenance

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Standard

AERIAL CABLE MAINTENANCE

REMOVING BOWS FROM AERIAL CABLES

ON 10M AND 16M STRAND

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1. GENERAL

1.01 Bowing in aerial cables is productive of fatigue* of the sheath metal and in the case of the larger cables has been found to accelerate the rate of ring cutting of the cable at the cable rings near the poles. Also when bowing occurs at points where the cable sheath has been chafed by the cable rings or where there are wiped joints, splices, patches or other irregularities in the sheath there is a tendency for the stresses due to the bowing to concentrate at such points and produce sheath breaks much sooner than otherwise. Fatigue is progressive in nature and is usually not apparent until it has progressed to the point where an actual sheath break occurs or a break is imminent. These instructions cover

methods for removing bowing in aerial cables of the sizes carried on 10M and 16M strand.

*Note: Due to the fact that the surface of the sheath metal at points where fatigue breaks occur is usually broken up by fine cracks and the edges of the break present a crystalline appearance fatigue breaks are generally referred to as "crystallized sheath."

1.02 The removal of bowing in cables of the size carried on 6M suspension strand is not covered in these instructions as it is considered that remedial measures, at least at this time and in the form prescribed in these instructions cannot be justified for such cables.

1.03 Bowing in aerial cables may be removed by the following methods:

(a) Where the bowing is general it can be corrected most effectively and economically by slacking off the suspension strand until the bows disappear.

(b) Bowing occurring at poles near U.G.-aerial and cable dead-end poles or near corners in the line may be corrected by pulling the cable toward the end or corner poles and holding it permanently by means of grade clamps installed at those points. It frequently happens that when grade clamps are not placed on the cable at the above points at the time that it is installed the contraction of the cable in cold weather pulls the cable away from the corner or end. As the result of such accumulation of slack cable in the spans near the end or corner during cold weather, bowing occurs later in warm weather when the cable expands with the increased temperature.

(c) In some instances as the result of line changes in connection with highway work the amount of bowing produced by excess cable is such that it is impracticable to remove it by the methods outlined in (a) and (b) above. Under such conditions the excess cable may be pulled to one or more points and the slack cut out of the cable.

1.04 Bowing inspection of cable and bowing correction work as covered in these instructions should be made during hot weather at which time the bowing is greatest.

2. EQUIPMENT REQUIRED

2.01 Various items of standard equipment which are required to carry out these instructions are listed and described below for the convenience of the field forces.

Connecting Link 3/4"

Two of these links are required for connecting the eyes of the slings to the clevis on the strand pullers.

"H" Strand Pullers:

Two of these pullers are required to grip the strand and to hold it after the cut is made.

Hand-Lines:

Two hand-lines are needed to pump the cable and strand up and down as the strand is slacked off.

Ladder:

A ladder is required to reach the splicing platform.

**Splicing Platform
or
Pole Derrick Platform**

For supporting the workmen at the point of cut in the strand.

For supporting workmen at the point of cut in the strand where cable is accessible to motor vehicle travel.

**Slacking Off Tool:
Consisting of—
1 Light Pole Jack
2 4-ft. Wire Rope Slings**

Used for taking up and letting in slack in the suspension strand at the cutting point. Make up the slings of 7/16" improved plough steel rope with a rolled eye on each end.

**Split Cable Grips:
1-1/2 inch for 10M Cables
2-1/2 " " 16M "**

These grips are used with the tension splicing jack to pull slack out of cables.

Strand Cutter:

For use in cutting the strand in the slack section between strand pullers.

**Tension Splicing Jack
" " Clamp
" " Jack Slings**

Used to pull slack out of cables.

3. CLASSIFICATION AND DEGREE OF BOWS IN AERIAL CABLES

3.01 Experience has shown that in the case of large size cables the bowing developed by cable normally accumulates at the poles. With the smaller cables, however, the bowing will also be found frequently in the spans as well as at the poles. Therefore, for the purpose of these instructions, cable bows shall be classified as:

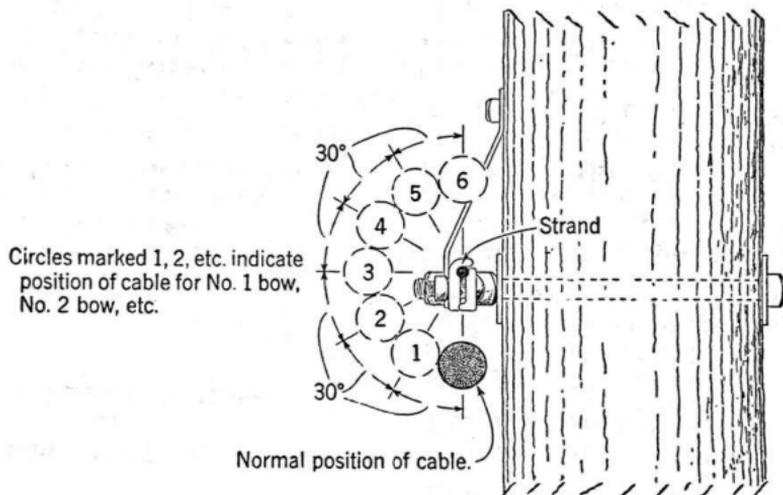
(a) Bows at poles:

(b) Bows in the spans.

The procedure for determining the degree of bowing for the two types is described in detail below.

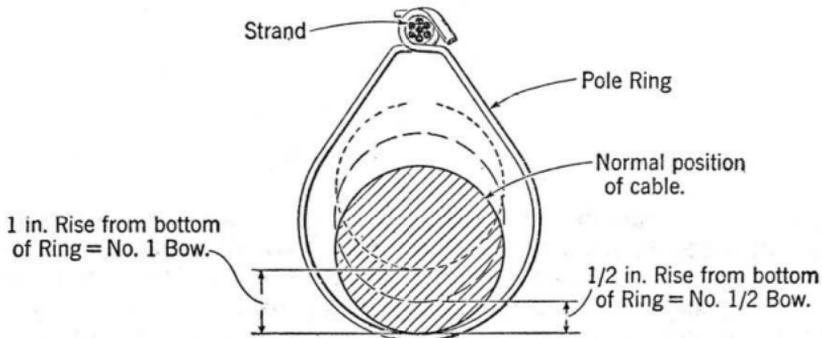
3.02 Bows at Poles. At poles the cable may bow either away from the pole or vertically off the rings. Where the cable bows away from the pole the severity of bowing is determined by the displacement angle of the cable from its normal position vertically below the strand. Considering the cable to move about the strand, the various degrees of bowing shall be designated as #1, 2, 3, etc., as the cable takes up positions 30°, 60°, 90°, etc. away from its normal position vertically below the strand. The method is illustrated in the following sketch.

Where cable bows away from the pole.



Where the cable bows vertically off the rings, the degree of bow is determined by the amount of the rise of the cable in the pole rings. A one-half inch rise shall be considered a #1/2 bow, a one-inch rise a #1 bow, etc. The following diagram illustrates the method.

Where cable bows vertically off the pole rings.



3.03 Bows in the Spans. Bowing which occurs in the span between poles is difficult to measure and for purpose of these instructions it is satisfactory to designate such bows as #1, 2 or 3 depending upon the severity as judged by its appearance.

4. BOWING INSPECTION ON AERIAL CABLES

4.01 Before bowing correction work is started, the cable should first be inspected in order to ascertain the severity and extent of the bowing of the cable throughout its entire length. Make this inspection during hot weather at which time bowing is greatest. The following field data should be obtained for use in making bowing inspection charts of the type outlined in paragraph 4.02 below.

Bowing Inspection Field Data

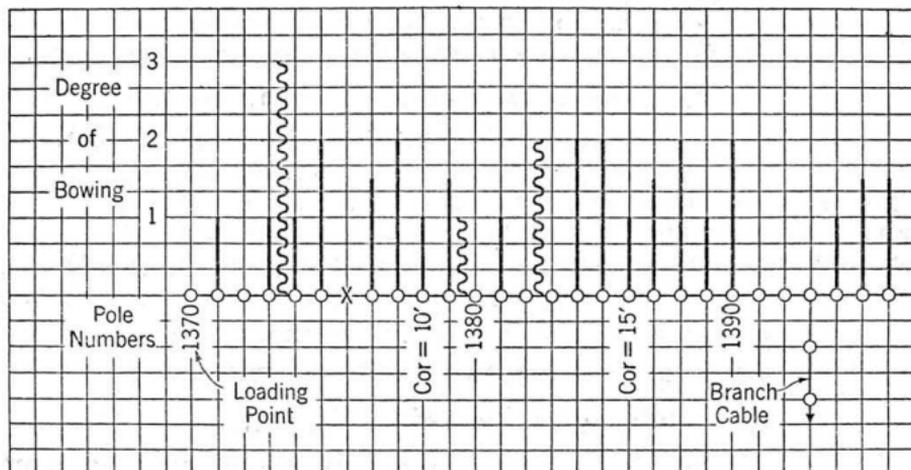
- (a) The number and pole location of each bow.
- (b) Sun temperature at which inspection is made.
- (c) Pole location of loading points.
- (d) Pole location of all corners, the amount of pull on each corner pole, and whether the cable at the corner is on the side of the corner pole toward the inside or outside of the corner.
- (e) Location of strand splices.
- (f) Pole locations of branch cable junctions.

4.02 Plot the field data on cross-section paper so as to obtain an overall picture of the condition of the cable throughout its length. The following bowing chart is suggested as a guide in setting up the field information in graphic form. It may be used conveniently for recording the field data during the course of inspection of the cable.

BOWING INSPECTION, _____ CABLE

July 10, 1927. Temperature = 95° F

Loading Section, Poles 1370 - 1425



- X = Existing strand splice.
 Cor = 15' = Corner pole having a pull of 15 feet
 ~~~~~ = Bows in the spans.  
 ————— = Bows at the poles.

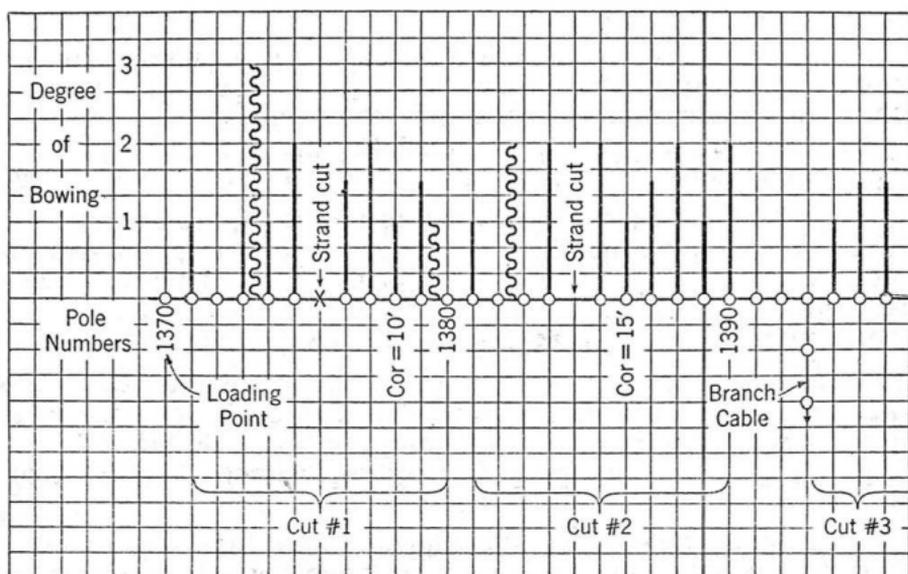
## 5. SELECTING SECTIONS OF AERIAL CABLE REQUIRING BOWING CORRECTION

5.01 The sections of cable requiring bowing correction are selected from the bowing chart laid out along lines indicated in paragraph 4.02. In sections where it is planned to slack off the suspension strand, indicate the points at which the strand cuts shall be made and the length of section affected by each cut. For the larger size cables the length of section to be treated should not exceed 9 spans, i.e., four spans on each side of the cutting span. With the smaller size cables the length of sections may be increased to, but should not exceed, 15 spans. In the case of a given cable a little experience will assist in selecting the most desirable length of section.

BOWING INSPECTION, \_\_\_\_\_ CABLE

July 10, 1927. Temperature = 95° F.

Loading Section, Poles 1370 - 1425



X = Existing strand splice.

Cor = 15' = Corner pole having a pull of 15 feet.

~~~~~ = Bows in the spans.

———— = Bows at the poles.

5.02 Where steep grades, heavy corners or junctions with branch cables occur in a cable line, it may be necessary to shorten the length of section in order to permit proper distribution of the extra slack introduced in the strand. Arrange the work so that heavy corners (20 ft. or more) or junctions with other cables will fall at the ends of the sections which are to be slacked off.

5.03 Indicate on the bowing charts those sections of cable in which the bows are to be corrected by pulling the cable toward U.G.-aerial, cable dead-end or inside corner poles.

5.04 Show also those sections where the bows are to be removed by pulling the cable to convenient poles at which the concentrated cable slack is to be cut out.

6. PREPARING THE CABLE SECTION FOR SLACKING OFF THE SUSPENSION STRAND

6.01 Placing Grade Clamps

(a) **At Loading Points.** Place permanent grade clamps, if not already in place, at each side of loading fixtures, so as to prevent the tension put in the cable from affecting the balloon splices or the loading coil stubs.

(b) **At Underground-Aerial Poles, Cable Dead-End Poles and Poles at Underground Dips.** Place permanent grade clamps, if not already in place, at these points so as to prevent the cable from pulling away from the poles during the slacking off work or later when it contracts in cold weather.

6.02 Loosening Suspension Clamps. Loosen the suspension clamps throughout the section to be treated (including the end poles in the section), in order that the strand may be free to move easily through them when slack is let in. The clamp shall be sufficiently loose to allow the strand to slide through but not enough to permit the strand to drop out of the groove down between the sides of the clamp. When this condition exists, proper distribution of the slack becomes difficult.

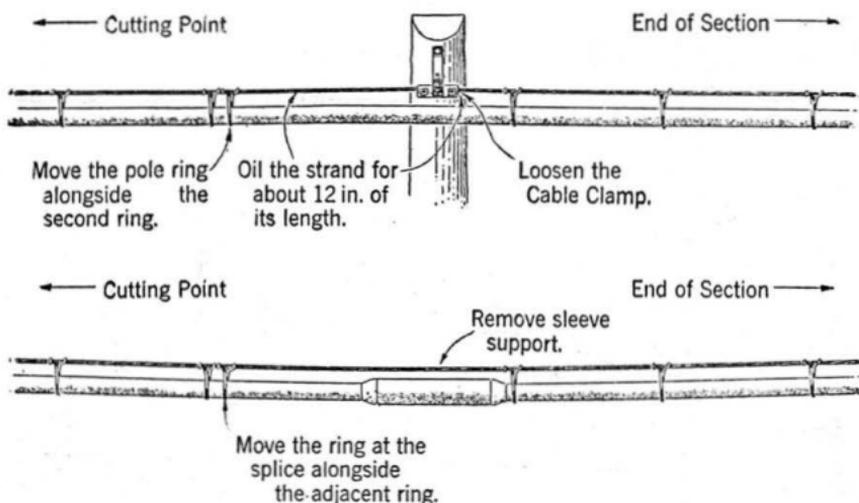
6.03 Loosening Reinforcing Straps. Loosen the drive screw which holds the reinforcing strap to the pole. Where this screw is not loosened, it has been found that the spring action of the strap tends to bind the suspension clamp to the strand.

6.04 Oiling Clamps, Reinforcing Links and Strand. Oil the clamp grooves, reinforcing links (if any) and the strand for about a foot on the side of the pole toward the cutting point. Any medium grade of oil may be used for the purpose.

6.05 Removing Ties, Clamps and Other Strand Attachments. Remove all ties, grade clamps other than those indicated in 6.01, strand pull-offs, false dead-ends, bonds between strand and cable and any other attachments which would prevent the free passage of the strand in the section to be slacked off.

6.06 Moving Rings. At poles move the pole ring on the side toward the cutting point to a position on the strand alongside the second ring. At splice points move the ring nearest to the wipe on the side toward the cutting point to a position alongside its adjacent ring.

MOVING RINGS

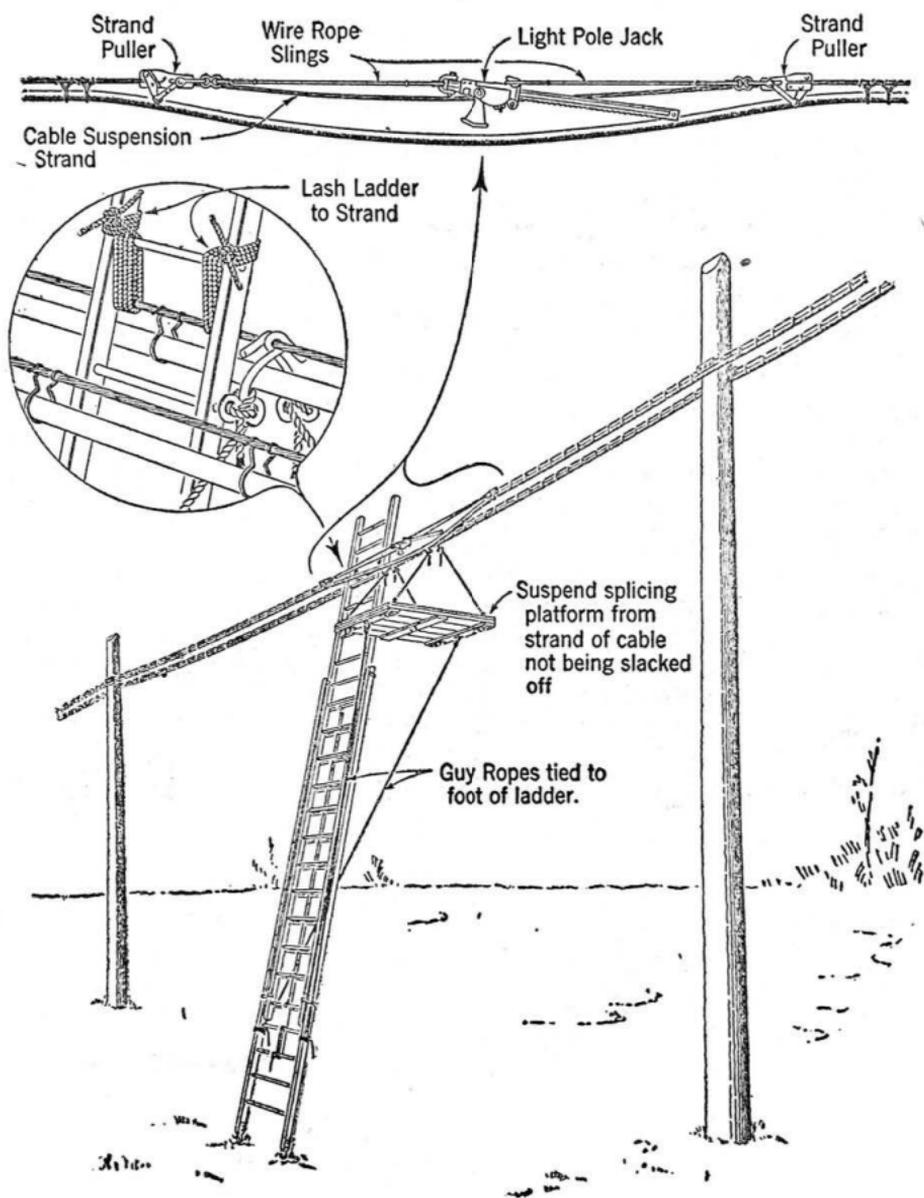


7. PLACING EXTRA LENGTH OF STRAND IN THE SUSPENSION STRAND

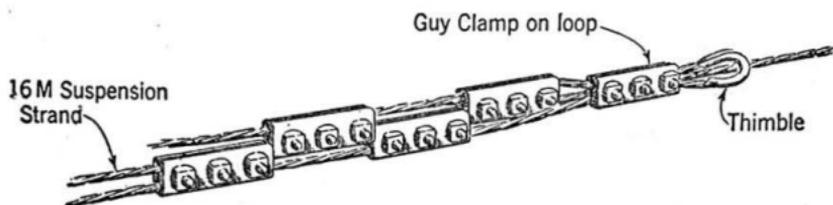
7.01 Selecting the Cutting Point. The point at which the suspension strand is to be cut should be near the middle of the span rather than at the pole. Experience has shown that some difficulty will be encountered in letting in the slack at poles. Where conditions permit, existing strand splices should be utilized as cutting points.

7.02 Placing Slacking Off Tools on the Strand Using a Splicing Platform. Where a splicing platform is used to support the workmen at the point of cut in the strand proceed as follows:

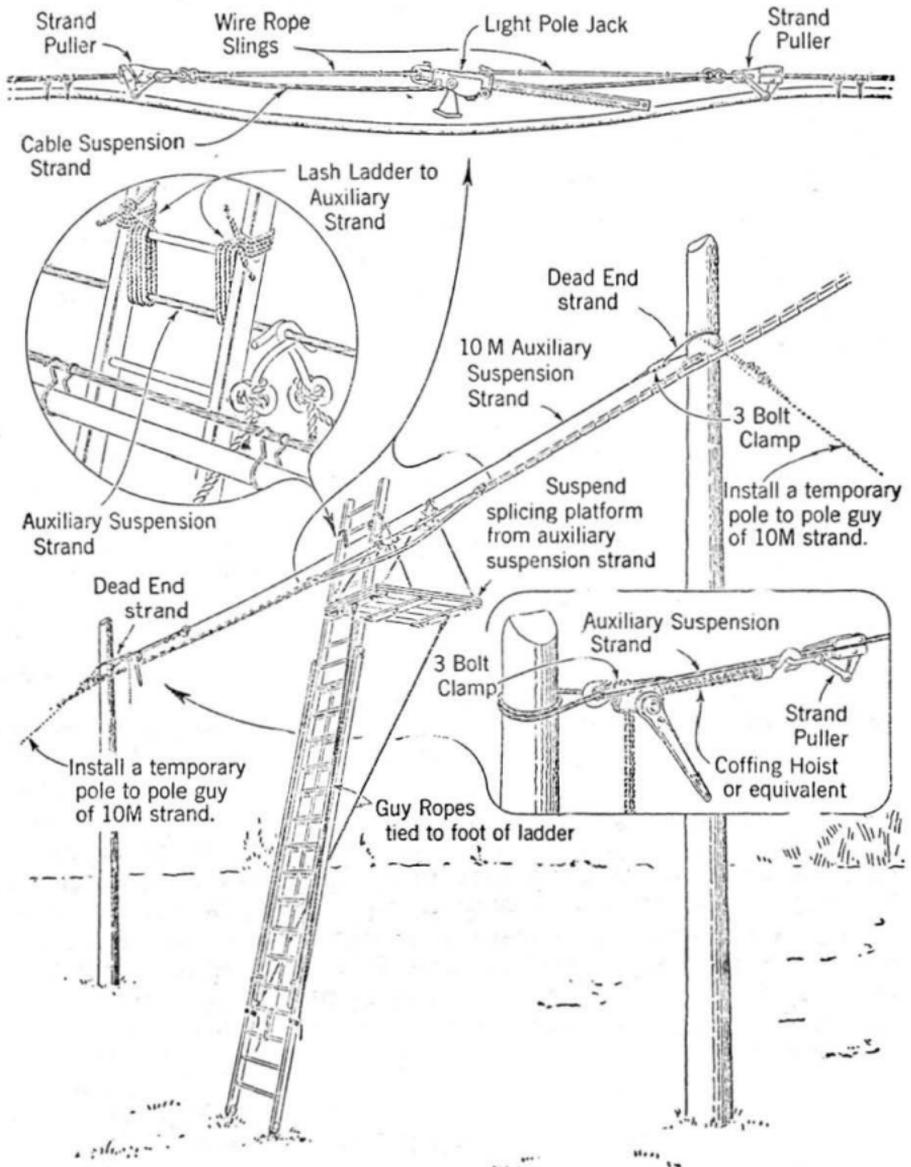
- (a) Where two cables are situated on the same pole line, suspend the platform from the suspension strand of the cable of which the strand is not being slacked off. With a dynamometer, measure the tension in the strand which is to be slacked off and where the tension is less than 10,000 lbs., connect the slacking-off tool (consisting of a light pole jack and wire rope slings) to the strand by means of "H" strand pullers as indicated below. Before placing the strand pullers on the strand, wipe off the strand and the jaws of the strand pullers with a clean cloth to remove any oil or dirt and make certain that there is no foreign matter such as bits of galvanizing in the grooves of the strand pullers.



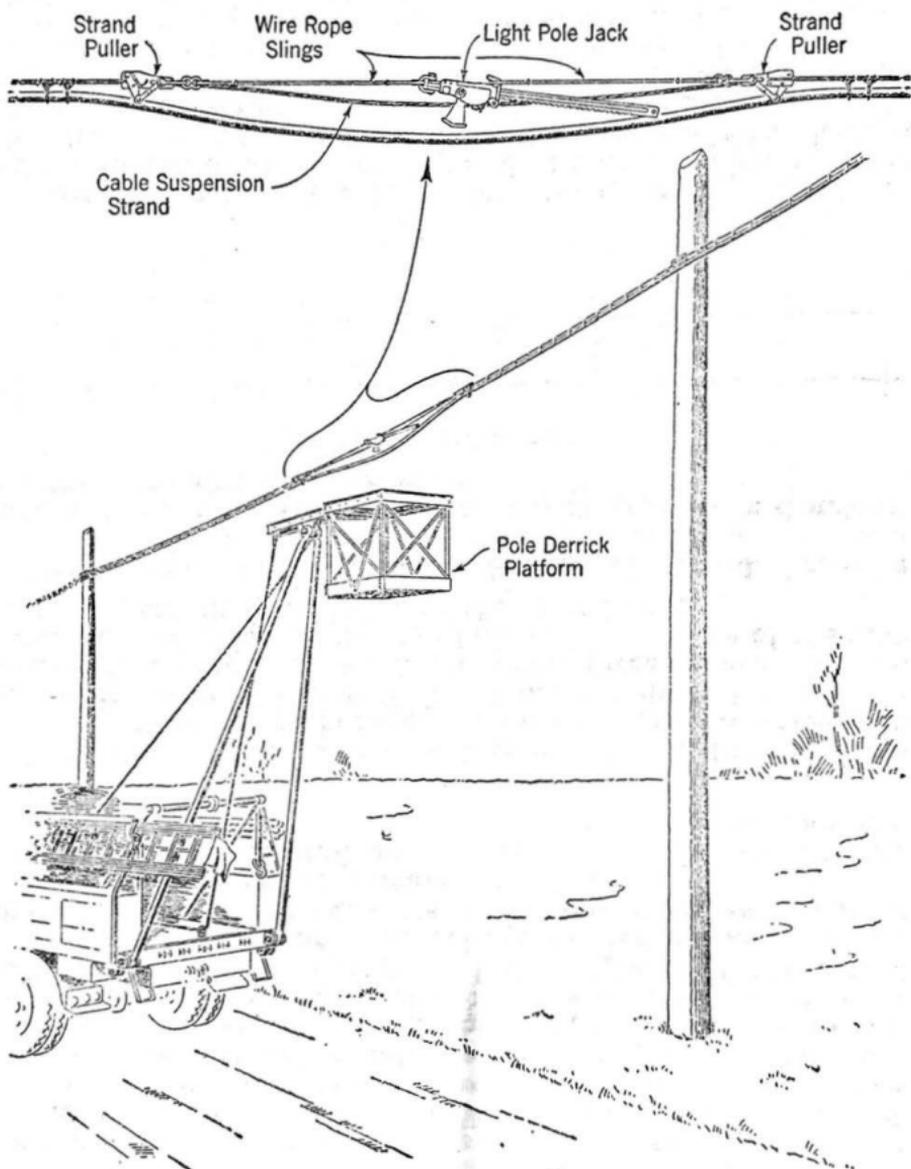
When the measured tension in the strand is 10,000 lbs. or more, make the connection to the strand with the "strand loop and clamp" method indicated below.



(b) Where only one cable is on the line, string an auxiliary 10M strand in the span in which the cut is to be made, install temporary pole to pole guys of 10M strand on the supporting poles, and suspend the splicing platform as illustrated below. The method of attaching the slacking off tools to the strand is in accordance with the procedure indicated in (a) above.



7.03 Placing Slacking Off Tool on the Strand When Using a Pole Derrick Platform. Where a pole derrick platform of the type described in Section J-6.421 and J-6.423 is employed for stationing the workmen at the point of cut in the strand, the set-up is as illustrated below.

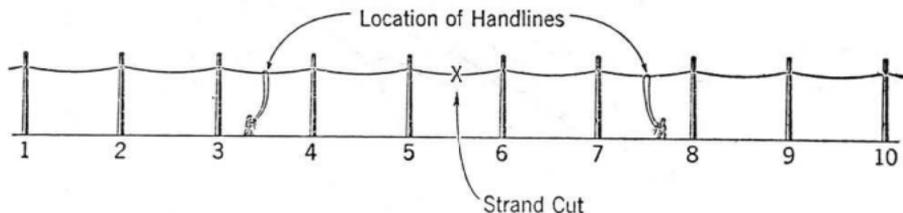


7.04 Pulling Up the Suspension Strand Prior to Cutting.

After placing the slacking off tool on the strand, operate the jack until the section of suspension strand between the strand pullers or clamp is slack. **Where strand pullers are used, be sure that this section of strand is really slack so that when the suspension strand is cut, there will be no jump load imposed upon the strand pullers which might cause them to slip.** Before cutting the strand, inspect the strand pullers in order to ascertain if any slippage had taken place. If the strand puller slips 1/2 inch or more, release the tension and take off the pullers. Clean the grooves of the pullers of any trace of foreign matter such as galvanizing, oil, etc. Place the pullers back on the strand and operate the jack again. If they slip again, replace with other pullers or employ the strand-loop and clamp set-up.

7.05 Cutting the Suspension Strand. After making the section of strand between the pullers slack, the suspension strand is ready to be cut. Select a point midway between the pullers and tape the strand for about three inches. Cut the strand in the middle of the taped piece. The purpose of the tape is to prevent the untwisting of the strand ends.

7.06 Letting in Slack in the Section of Strand. Throw a hand line over the strand in the second span on each side of the cut and station a man at each to assist in distributing the extra strand in the section.



Start the men at the hand lines pumping the strand and cables up and down moderately and at the same time slack off the strand by letting out the jack. After the cable has been in place for some time it frequently tends to seat itself in the rings and a moderate pumping of the strand makes it easier for the strand and rings to slide back over the cable. The man stationed at the cutting point can assist in distributing the slack by occasionally raising the cable and strand at his location. This will permit the strand to ease through the cable suspension clamps at the poles on both sides of the cut. **Continue slacking off until the bows just disappear.** To let in any more slack than this will only serve to place unnecessary tension in the cable which, if excessive, will increase the possibility

of sheath cracks at those points that have already been weakened by ring cutting and sheath crystallization. If the bows in the spans beyond the location of the hand line do not disappear with those in the spans toward the cutting point, transfer the hand line to these spans and pump the strand again.

7.07 Splicing the Suspension Strand. Equip a piece of strand, of the same size as the suspension strand, with strand connectors at each end such that the overall length will be from 6 to 8 feet. (This work may be done either at the storeroom or on the job, preferably the former.) Connect one end of the extra strand to the cable suspension strand in the usual manner. Before connecting the other end through, take up two or three notches on the jack for the purpose of compensating for the extra slack that is usually introduced when making up strand splices.

8. RESTORING THE CABLE TO NORMAL WORKING CONDITION

8.01 In restoring the cable to its normal condition observe the following points.

- (a) Remove all tools and apparatus at the point where the cut is made.
- (b) Tighten all cable suspension clamps and reinforcing straps.
- (c) On cables equipped with cable shields move the shields to their normal positions and center the rings about them. When the cable is not equipped with shields, install them in accordance with Section G52.135, "Cable Shields."
- (d) Restore all moved rings to their proper positions at poles, splices, tree guards, etc.
- (e) Replace all bonds strand pull-offs, grade clamps, false dead-ends which were removed before the slacking off work was done.

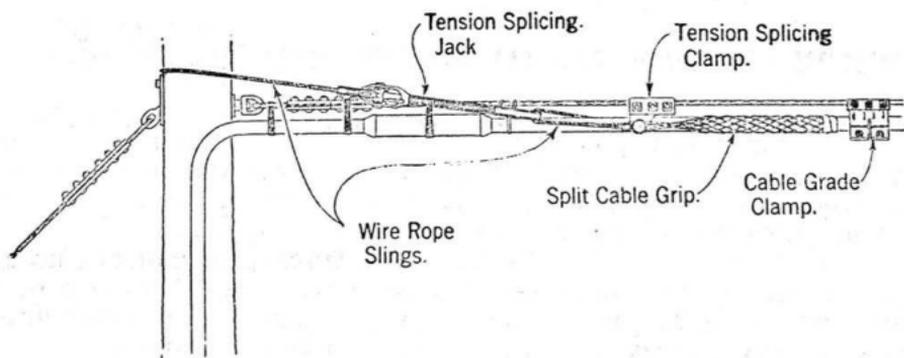
8.02 Following the work of slacking off suspension strand some slight motion of the cable with respect to the strand takes place. If cable shields are placed as specified in paragraph 8.01-c it may be found later that some of the rings will slide off the shields as a result of this movement. Therefore, an inspection should be made of the shields a month after the completion of the strand slacking work for the purpose of restoring on the shields those rings that are found off.

9. REMOVING BOWS IN SECTIONS OF CABLE ADJACENT TO UNDERGROUND-AERIAL, CABLE DEAD-END, U.G. DIP, AND CORNER POLES

9.01 At underground-aerial, cable dead-end, U.G. Dip or at corner poles where the cable is on the side of the pole toward the inside of the corner the cable pulls away from the pole in cold weather unless there are grade clamps installed at such locations to prevent it. This results in bowing in the spans near the corner or end poles in warm weather. Such bowing can be corrected during warm weather by pulling the cable back to the poles from which it pulled away and installing grade clamps to prevent a recurrence. The procedure is covered in paragraphs 9.02 and 9.03 below.

9.02 At Underground-Aerial, Cable Dead-End or U.G. Dip Poles proceed as follows:

- Place a tension splicing clamp on the strand about 4 feet from the pole. Do not tighten the bolts of the clamp more than finger tight at this time.
- Place a split cable grip on the cable beyond the tension splicing clamp and connect the eyes of the cable grip to the inner grooves of the buttons on the sides of the clamp.
- Pass the long sling around the pole and connect its two eyes to the hook on the traveling head of the jack. Hook the eyes of the short sling on the outside grooves of the buttons on the clamp and then connect to the hook on the end of the rack bar of the jack.



- Place the handle of the jack in the slot provided for it in the traveling head and operate the jack. Take up on the jack until the cable is brought back to normal position on the pole or the bows are removed and anchor the cable to the strand with a permanent grade clamp placed beyond the cable grip.

- (e) The light pole jack may be substituted for the tension splicing jack if desired.

9.03 At Corner Poles Where the Pull is Away from the Pole set up the tension jack and associated equipment as indicated for the end poles in paragraph 9.02 with the following modifications.

- (a) Where the pull is to be applied only on one side of the corner pole, place a permanent grade clamp on the other side before operating the jack. After the required amount of pull to remove the bows is applied, tighten the tension splicing clamp firmly on the strand, remove the jack and slings and place a second grade clamp on the cable between the pole and cable grip.
- (b) Where the cable is pulled on both sides of the pole, place a grade clamp on each side after the pull is made.

10. PERMANENT GRADE CLAMPS

10.01 Permanent grade clamps shall be placed on the cable at the following points if not already provided:

- (a) On both sides of every load point.
- (b) At poles where cables dead-end or connect to underground cables.
- (c) At each side of all corner poles where the pull of the cable is away from the pole, and corner poles of over 5 ft. pull where the pull is toward the pole.
- (d) At points on a grade where grade clamps are required to prevent the cable from sliding downhill as covered in the section of the practices on grade clamps.
- (e) On both sides of pressure testing plugs.
- (f) At pole on each side of underground dips in aerial cables.
- (g) At strand crossovers where there is a grade.
- (h) At pole on each side of railroad crossings.