OVERVIEW

Proper care and handling of semiflexible coaxial cables during installation is critical to the long term reliability of a broadband coaxial cable transmission network.

The initial installation of a coaxial cable transmission system is a major determining factor in the longevity of the system and degree of continuing maintenance required. During construction, proper attention must be given to the mechanical and environmental factors which can cause degradation and failure.

The cable is subject to daily mechanical stresses resulting from day-to-night temperature changes and the consequent forces of expansion and contraction. These effects can be offset to a large degree with proper awareness of sag and tension factors and properly formed and placed expansion loops. Additional mechanical stresses are induced during the rigors of installation and handling.

The following paragraphs provide guidelines for a safe and trouble-free coaxial cable installation that avoids initial damage and provides for long term plant reliability.

CLEARANCES

Before starting construction and installation, determine if there exists enough clearance between the coaxial cable and other utilities, as well as clearance to the ground, roadways, rail or water surfaces below. If applicable, the clearance requirements in the latest issue of the National Electrical Safety Code (NESC) must be met throughout the cable plant.

In general, the final sag of the coaxial cable plant must be known to determine the minimum separation at the pole of the coaxial cable and the other utilities. Minimum separations for mid-span clearance will require more separation at the support pole. The final sag must also be known to determine the minimum coaxial cable attachment height on the pole for the required span clearances above the ground or roadway.

Although final sag can be calculated (refer to Appendix III, Technical Note 1006-A), the calculation is complex and requires a detailed understanding of the properties of all materials being utilized. Appendix II contains initial and final sag and tension tables which can be used to make sure the necessary clearances are met in conjunction with existing local requirements.

The basis of the Appendix II Sag and Tension Charts is 1.5% sag normalized to 60°F. The charts detail initial and final sag and tension for varying temperature conditions and span lengths. Included in the charts are stringing sag and tension, and ice loading examples. Please contact TFC Engineering Department for calculations relating to specific NESC Loading District requirements.

STRAND TENSION

Before actual installation, determine the tension that will be applied to the support strand under various loading conditions and span lengths. For this calculation, the size, weight and number of cables are very important.

Generally, tension can be reduced by increasing sag. Follow the initial and final sag tables of Appendix II to achieve the required initial and final tension. For combinations of cables and for conditions of installation not given, further information may be obtained by contacting the TFC Engineering Department.

STRAND INSTALLATION

The correct amount of sag is a function of clearance required and tension allowed. To begin, place the strand loosely in the strand suspension clamps so it can be pulled to adjust to the proper clearance and tension. Close the strand suspension clamp when the strand has been tightened to the stringing tension that gives the proper in-span clearances. These stringing tensions are given in Appendix II for various cable types and span lengths. An alternate technique is to adjust the sag to 1.5 percent relative to 60°F after the cable is installed and then tighten the strand suspension clamps.

CABLE REEL PLACEMENT

Obstructions

Observe all proper safety precautions during movement and setting up the cable payout trailer. Since it is possible that the payout reel may be left unattended, it is very important to precisely locate the reel in relation to the first pole or roller. The first pole location should be clear of any obstructions that might interfere with a smooth and uniform cable payout.

Potential obstructions include telephone drops, tree limbs, or support guys and other interfering hardware. If the first pole is heavily obstructed, or if the payout trailer can not be located in a stable position, consider relocating to the next pole. This is to be avoided if possible, but a mid-span take-off can be used if necessary and will be described later.

Reel Loading

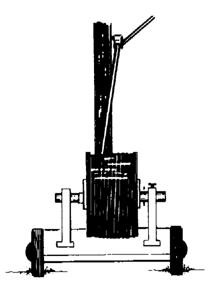
The cable reel should be loaded onto the payout trailer so that the cable will feed from the top of the reel so the cable will straighten properly as it pays out and up into the first roller on the pole.

Reel Centering

As the payout trailer is set up, the center of the cable reel to be paid out should be positioned so that the cable pulls from the center of the reel, directly into the first roller or chute, and along the line of sight directly with the strand. (See the next section, *Cable Chute.*) The cable reel flanges should be parallel with the strand and not at an angle.

If the cable reel is inadvertently placed at an angle, the cable may catch on the rotating flange of the reel and be damaged by kinking, flattening or sustaining jacket abrasion and damage. If the reel flanges are parallel to the strand and the cable is centered on the line of sight of the strand, the cable should always pull away from the reel flange with no damage.

The payout trailer should be leveled. If this is not possible or the setup is not stable, a crew member should be present to make sure the cable unwinds without making contact with the reel flanges.



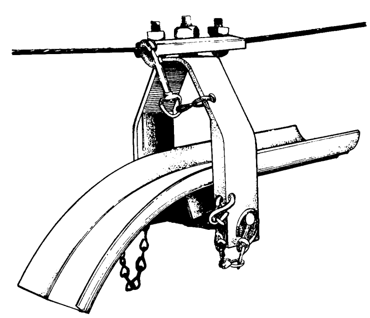
CABLE REEL CENTERED AT POLE

CABLE CHUTE

The purpose of the cable chute is to guide the cable being paid off from the reel onto the mid-span blocks. If more convenient, a 45° corner block may also be used instead of a chute.

A single roller (such as a mid-span block) should not be used as a cable chute because of the small radius of the single roller. The radius of the cable chute or the 45° corner block is much larger than a single roller so the cable passing over is not bent to a radius less than the minimum recommended bending radius.

Typically, a cable chute has a bearing surface with a low coefficient of friction; a 45° corner block has an even lower frictional force. This is necessary so the least possible back tension is applied to the cable as it is being pulled through the bend from the cable reel and onto the strand. Ideally, these devices are suspended from the strand at the first pole so they can pivot, allowing for some misalignment between the pay-off trailer and strand. Multiple chutes or rollers should be used when multiple cables are being pulled.

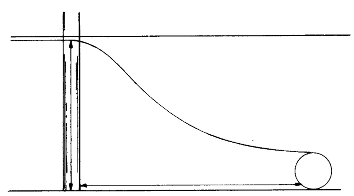


CABLE CHUTE

Alternatively, if a mid-span pay-off is absolutely necessary, the cable chute or corner block must be attached to the strand at some distance from the pole. As the cable is being pulled through the chute, pulling tension can vary and the corner block or chute tends to jump around. Careful control of pulling tension is necessary to successfully complete mid-span take-off pulls.

DISTANCE BETWEEN THE REEL AND THE POLE

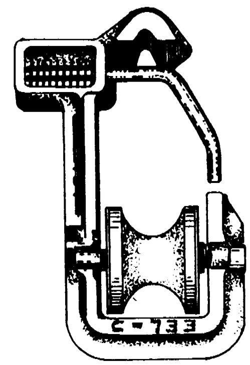
The payout reel should be located at a distance of 50 feet or more from the pole where the chute or roller is attached or at a distance of at least twice the height of the chute above the ground. This separation distance between payout reel and pole keeps the cable from being pulled into the chute at an angle which is too sharp. If the cable is pulled into and over the chute at too sharp an angle, it becomes difficult to control pulling tension. The cable can bend and straighten in a non-uniform manner since the sharper the angle, the more force is needed to pull the cable.



LOCATION OF PAYOUT REEL IN RELATION TO POLE

Using a minimum separation of payout reel to pole (twice the height of the chute distance from the ground) will help to reduce the pulling forces required, make the setup positioning easier to maintain, reduce the possibility of cable damage, and allow the cable to properly straighten as it pays off the reel.

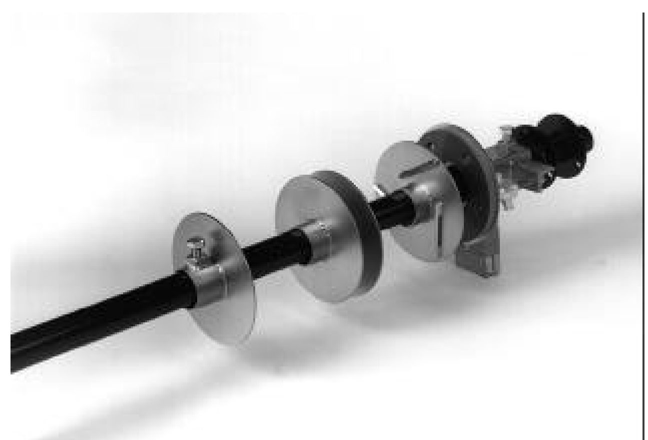
Cable blocks, or rollers, must be placed on the strand at least every 25 to 30 feet to support the cable as it is being pulled between poles. Proper deployment of cable blocks, or multiple cable blocks for pulling multiple cables will reduce pulling tensions. This will keep the cables straight and reduce the possibility of the cables “dripping” down when a pull is interrupted or whipping upward into power lines if a pull is abruptly started.



CABLE BLOCKS

REEL BRAKING

Before starting to pull the cable off the reel and onto the strand, the reel should have brakes set so that if a cable pull is slowed down or stopped abruptly, the reel will not continue to turn freely and allow the cable to overrun and droop down between the reel and chute. An adjustable friction braking assembly is used on the payoff shaft and should be set to provide the proper amount of braking force. The brake should be adjusted so that the cable and reel can be turned using one hand, but it will stop turning when the hand is removed.



REEL BRAKE FRICTION ASSEMBLY

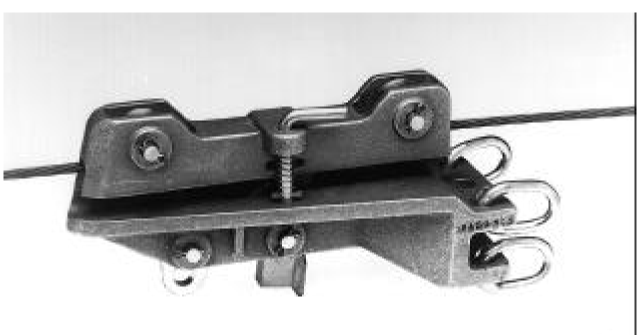
PAYOUT REEL TRAILER

PULLING THE CABLE

A swivel-type pulling grip should be used to attach the pulling line to the cable. A fuse-type pulling swivel, which separates at a predetermined level of force, can also be used. The force should be selected to match the cable being pulled and the manufacturer's recommended maximum pulling tension.

Cable Puller

The use of an anti-slack cable puller, which has a locking mechanism that grips the strand, is recommended to prevent slack from being pulled back into the strand line when tension is removed from the pull line.



ANTI- SLACK CABLE PULLER

Pulling Tension

When pulling the cable onto the strand and cable blocks, begin the pull slowly and continue with a smoothly uniform and constant force throughout the pull.

Even though the cable reel has brakes applied, pulling tension should be slowly and gradually reduced at the end of the pull or if it is necessary to stop.

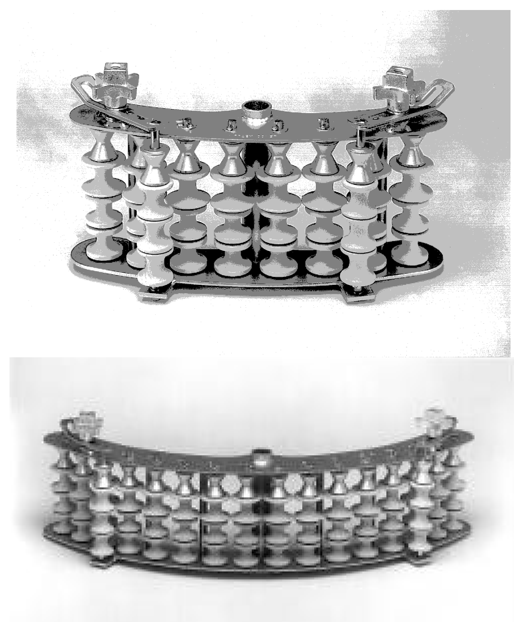
Good clearance should be maintained between the cable being pulled and any overhead power lines so that if the cable is accidentally pulled too abruptly and there is any slack in the cable between the blocks, the cable does not whip up into the power lines.

Pulling Summary

Using a combination of proper reel braking, an anti-slack cable puller, swivels, and properly spaced cable blocks and rollers will help to complete the cable installation in a safe manner with no “wee-wahs” or drooping cable.

45° AND 90° TURNS

In a typical installation, turns of 45° or 90° may be required as the cable is pulled along the strand, necessitating use of the proper 45° and 90° corner blocks and pole brackets to support them.



TYPICAL 45° AND 90° CORNER BLOCKS

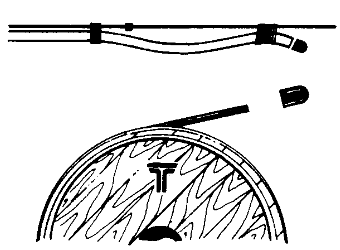
The cable blocks must be positioned so that the cable is tangent to the bend. If it is not tangent, the cable might be bent improperly around the very small radius of the first or last roller in the corner block, possibly causing the cable to wrinkle or flatten as it exits the corner block.

Although single 45° and 90° bends in a run are generally recommended, multiples can be successfully pulled if the maximum recommended cable pulling force is not exceeded and if the cable shows no signs of flattening or wrinkling as it exits the corner block. If either occurs, the pull should be stopped and the next bend pulled in separately.

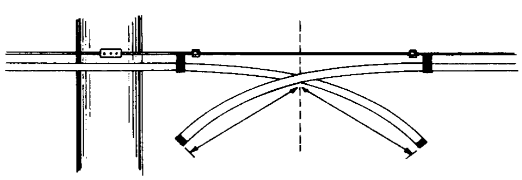
If a 90° bend is to be included in a run, position the cable as close to the bend as possible. It is better to have the bend at the start of the run since the bend multiplies the back tension in the pull rather than simply adding to it.

CABLE PROTECTION

When a cable pull has been completed, remove any damage from the end of the cable and make sure approximately 30 inches of undamaged cable remains for future use. Plastic end caps should be used to protect the cable (both on the line and on the payout reel) from moisture exposure. Extra end caps are available on request from TFC customer service representatives.



SEALING CABLE AGAINST MOISTURE



30 INCHES OF CABLE OVERLAP FOR FUTURE USE

LASHING

Lashing Wire Tension

Put a lashing machine into place on the strand and begin lashing the individual spans. The tension of the lashing wire is controlled by routing the lashing wire around one or two wheels inside the lashing machine or according to the individual manufacturer's directions. Routing the lashing wire around only one tensioning wheel usually provides sufficient but not excessive tension.

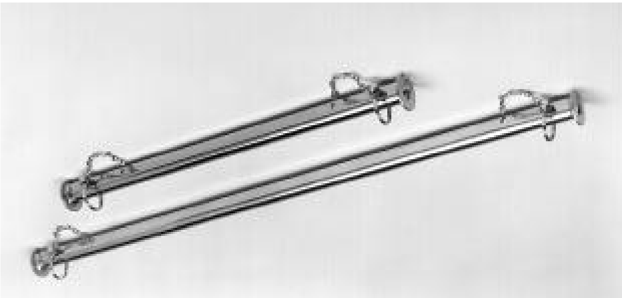
Do not adjust the tension to the maximum possible since cable damage can occur and the lashing wire itself might break. Also, the lashing wire should support the cable to the strand but should not restrict cable movement as the cable expands and contracts differentially to the steel strand. If the lashing wire is too tight, the cable, being bound tightly to the strand, will undergo cyclical daily stresses which can cause the cable to become brittle leading ultimately to fatigue fracture.

Lasher Pull Angle

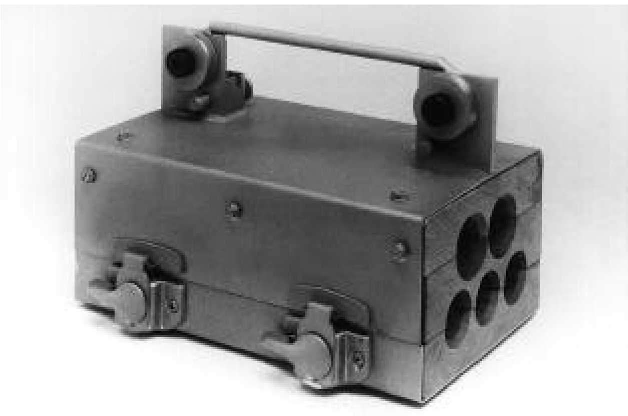
The lasher should be pulled in a straight line. If the angle of pulling is changed abruptly the cable will be pulled off to the same side as the lasher and the cable will appear to have a bend or a "wee-wah". Realistically, however, local obstructions can prevent the lasher from being pulled in a direct straight line or at a constant angle for the entire span. To the extent possible, smooth transitions in the lasher pulling angle can minimize cable appearance problems.

Cable Straighteners

A cable block pusher ("shotgun") in combination with a cable straightener attached to or pushed ahead of the lashing machine can be used to push the cable blocks and help straighten the cable in front of the lashing machine, resulting in a clean and straight looking cable span. The lasher should not be allowed to slip backward, nor should the pulling tension be released until the lasher has reached the end of the span being lashed and is under the control of a worker positioned at the pole.



CABLE BLOCK PUSHER("SHOTGUN"),



CABLE POSITIONER

CABLE STRAIGHTENER

Double lashing should be used when two or more trunk cables are lashed together. In addition, it is prudent to consider double lashing in locations where it would be difficult or inconvenient to relash, such as over rail crossings and major highways.

The lashing wire should be wrapped two or three turns around the strand, starting 8 to 10 inches from the clamp, before feeding it through the clamp washers for attachment. To avoid snapping or breaking the lashing wire, do not allow it to overlap itself.

EXPANSION AND CONTRACTION

The expected life and reliability of a cable plant are a function of daily temperature changes, length of spans, amount of sag, and the shape and location of expansion loops. Since there can be no control over temperature changes and only some control over span lengths, care must be taken to assure proper sag, and that properly shaped and located expansion loops are installed.

The aluminum outer conductor of semiflexible coaxial cable has a linear coefficient of thermal expansion (and contraction) approximately twice that of the steel strand, so the cable expands and contracts with changes in temperature twice as much as the strand.

As the strand expands and contracts with changes in temperature, increases and decreases in sag become evident unless the initial sag was so tight that the sag could change only a small amount. The expansion and contraction of the strand accommodates only some of the change in length of the semiflexible cable with the remainder coming from cable expansion (and contraction) loops.

For any geographic area, it is important to determine the range of extreme temperatures that will be encountered. For example, the following represents actual regional variances:

Texas:	113° high, -16°F low, mean 55-70°F
California:	118°F high, -8°F low, mean 40-70°F
North Dakota:	109°F high, -50°F low, mean 40°F

Additionally, solar heating and cooling can cause a temperature rise of 45°F above ambient for black jacketed cable, and about 24°F above ambient for unjacketed aluminum-sheathed coaxial cable. At night, the temperature of the black jacketed cable can be about 8°F below ambient, and 4°F below ambient for unjacketed cables. Thus, for black jacketed cables in Texas, the extreme temperature range becomes: 158°F high, -24°F low with a total variance of 182°F.

(Note: This information is taken from a publication titled "Climatic Averages and Extremes for U. S. Cities", available from the National Climatic Data Center, Asheville, North Carolina.)

Expansion loops are required to prevent uncompensated cable movement and center conductor pull-outs due to temperature changes and the effect upon the expansion and contraction of the cable. The number of loops required and their location depends upon temperature extremes to be encountered, strand tension and sag, span length, weights, and temperature at the time of installation.

Cable Movement

The following table illustrates the net cable movement that occurs for a single 0.750-inch trunk cable lashed to a 1/4-inch steel strand with a pole spacing of 150 feet.

Table 1.

Cable Movement

Initial Sag @ 60°F	@ -40°F	@ +130°F
0.5 percent	-2.68 inch	+1.75 inch
1.0 percent	-2.40 inch	+1.36 inch
1.5 percent	-2.00 inch	+1.19 inch
2.0 percent	-1.71 inch	+1.13 inch

Note that there is substantial cable movement due to temperature. Also, there is substantially more movement if the sag is less than the recommended 1.5% minimum sag at 60°F. As discussed later, cable has a better chance of providing extended reliable operation if expansion loops are used at every pole location.

Cable and Center Conductor Tension

If expansion loops are omitted, or if cable movement is restrained, cable length changes that occur result in relatively severe tension forces at low temperatures. Referring to the following table, a single 0.750-inch diameter trunk cable installed at 60°F with zero initial cable tensions generates the following forces at -40°F.

Table 2.

Tension at -40ºF

Initial Sag@ 60°F	Strand (pounds)	Sheath (pounds)	Conductor (pounds)
0.5 percent	1658	1123	387
1.0 percent	954	967	345
1.5 percent	474	712	277
2.0 perecent	48	713	202

This data illustrates the problems encountered when installing a cable with too little sag and insufficient or ineffective expansion loops. The resulting tension on the aluminum sheath and center conductor is very high. Predictable consequences include severe stress on both fittings and electronic devices, center conductor and/or radiation sleeve pullout, broken conductors and housings, intermittent or degraded signal quality, ghosting and other interference, and power failure. It should be noted that thermal expansion as temperature increases can cause unsightly cable waves ("wee-wahs") or, if the sag is too tight, buckling can occur.

Thermal contraction problems become progressively worse when the initial installation is done at temperatures of greater than 60°F, when pole spacing is greater than 150 feet, and if the sag decreases to less than 1.5 percent.

1.5% FINISHED SAG AT 60°F

The following chart gives some typical 1/4-inch steel strand initial tension forces resulting in a 1.5 percent sag at 60°F for various pole spacings and cable configurations.

Table 3.

Initial Strand Tension (pounds)

1.5% Sag at 60 °F

CABLE CONFIGURATION	100 FOOT POLE SPACING	150 FOOT POLE SPACING	200 FOOT POLE SPACING
Single T10 500J Feeder	188	282	377
Single T10 750J Trunk	284	426	568
T10 500J + T10 750J	366	549	732
Single T10 625J Feeder	228	343	457
Single T10 875J Trunk	342	514	685
T10 625J + T10 875J	401	601	802
Single TX10 565J Feeder	195	293	390
Single TX10 700J Trunk	240	360	480
TX10 565J + TX10 840J	377	566	755
Single TX10 840J Trunk	291	436	582

PROPER SAG AND TENSION

Based on years of field observations and experience, laboratory simulation and testing, and engineering analysis, ***TFC recommends that the minimum finished sag in a cable plant be at least 1.5% relative to 60°F.*** Sag and tension charts are available in Appendix II which give proper guidelines for the installation.

Proper sag in a span acts as an oversize expansion loop, providing excess cable for contraction during cold weather. This pulls less cable from the loop, extending loop life. If less sag is used, less cable is available for contraction and more of the excess must the come from the expansion loop which decreases loop life.

If proper sag is not available, excess cable must be provided by additional expansion loops. Additional loops should also be provided when installing cable and loops at temperatures above the mean temperature for the area.

EXPANSION LOOPS

Definition

Many differently shaped expansion loops have been used. First there was the popular “swag” loop. This was followed by the “flat bottom” loop, the most commonly used and effective loop in use.

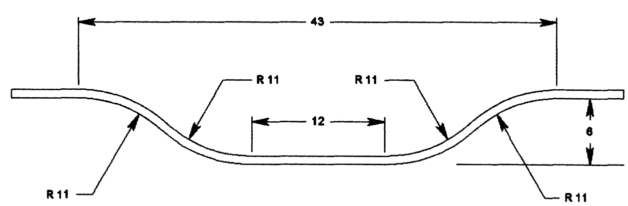
For consistent and properly formed loops, use mechanical forming tools instead of forming loops by hand. Hand-forming is risky because there will be a lack of consistency throughout the system, resulting in danger of damage to the cable and reducing the loop life expectancy.

No matter what forming tool or method is used, proper techniques must be employed. If the expansion loop is not formed properly or a portion of the cable is pulled out of the loop after the tool has been removed, the expansion loop may not have adequate depth. This may cause premature sheath cracking.

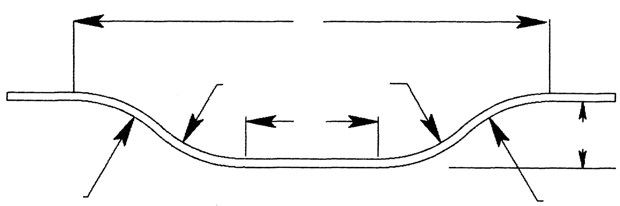
Properly formed and shaped expansion loops will exhibit no signs wrinkling on the outer conductor of the cable, will provide at least 6 inches of depth, and will be at least 43 inches in length.

Flat Bottom Expansion Loops

This loop is a typical 12 inch flat bottom expansion loop with dimensions suitable for cables up to 0.750 inches in overall diameter. The excess cable placed into the loop with these dimensions is located within the four 11 inch radius bends and places approximately 3.06 inches of excess cable into a span.



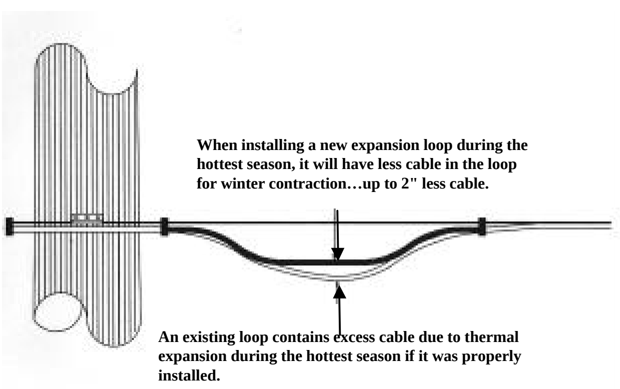
Typical 12” flat bottom expansion loop used for 0.750” diameter and smaller cable (contains approximately 3.06” of excess cable). Note that excess cable placed into the expansion loop comes only from the radii.



Typical 15” flat bottom expansion loop used for 0.875” diameter and larger cable (contains approximately 3.06” of excess cable). Note that excess cable placed into the expansion loop comes only from the radii.

This loop is a typical 15 inch flat bottom expansion loop with dimensions suitable for cables larger than 0.875 inches in overall diameter. As before, the excess cable is located within the four 14.8 inch radius bends and puts approximately 2.84 inches of excess cable into a span.

The excess cable provided is utilized for cable contraction during changes from warm to cool temperatures such as occur from day to night and summer to winter.

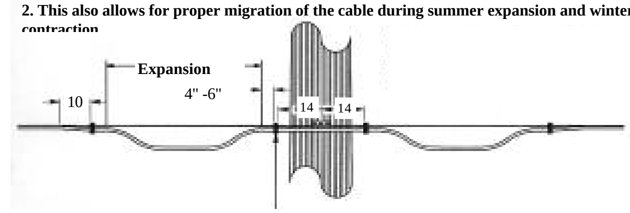


LOCATION AND NUMBER OF EXPANSION LOOPS

Expansion Loop at Every Pole

A properly designed and correctly formed expansion loop should be installed at every pole. When multiple trunk and feeder cables are in the same run, all the cables should have an expansion loop at every pole. For span lengths in excess of 200 feet, two loops should be used, one on each side of the pole.

Proper installation of the aerial support ties prolongs the expansion loop life for two reasons:
1. When the outboard radii of the expansion loop remains away from the aerial support tie, less pressure is applied on the flat section of the expansion loop.
2. This also allows for proper migration of the cable during summer expansion and winter contraction



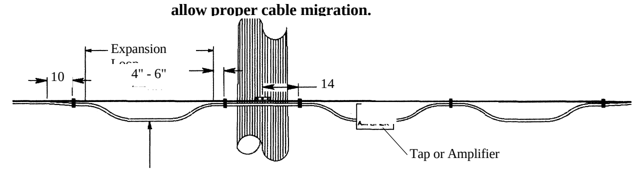
The aerial support ties should be located 4" to 8" past the point of tangency of the radii and straight section of cable at both ends of the expansion loop. Expansion loop life decreases proportionally as this dimension decreases.

Expansion loops should be placed on the output side of the pole. Installing loops across the face of the pole is not a recommended practice since the loop can be accidentally damaged by other utility personnel. In addition, if the adjacent spans have different lengths (for example 125 feet and 200 feet) there may be differential movement from each, which will reduce loop life.

Expansion Loop On Each Side Of Equipment

If the cable is connected to line equipment that is clamped to the strand, expansion loops should be installed on both sides of the equipment. When the equipment is located at a pole, the only loops that are necessary are the ones on both sides of the equipment.

Dimensions are typical of all loop form tools except 9" deep loops with proper radii. A 9" deep expansion loop has approximately 5.41" of excess cable in the loop. The aerial support ties would have to be moved away from the loop to allow proper cable migration.



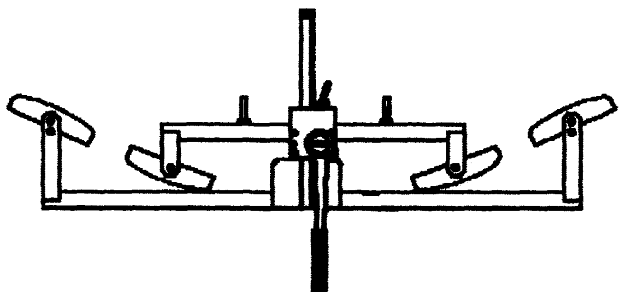
Do not place straps at this point for multiple cables. It restricts the free movement of the cable in and out of the expansion loop.

EXPANSION LOOP FORMING TOOLS

There are many expansion loop forming tools available to form flat bottom expansion loops that will provide long service life. These tools have been evaluated to ascertain the quality of loops formed. Based on testing, the following expansion loop forming tools have proven effective for use with TFC T10 and TX10 trunk, distribution and feeder cables:

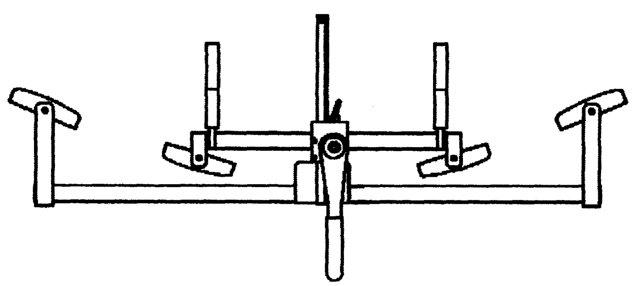
A. Jackson Bending Tool, P/N 1084
LEMCO Loop Forming Tool, P/N M-3206

These tools produce the same loop (approximately 36 inches in length) and should be used for cables smaller than 0.750 inches in diameter.



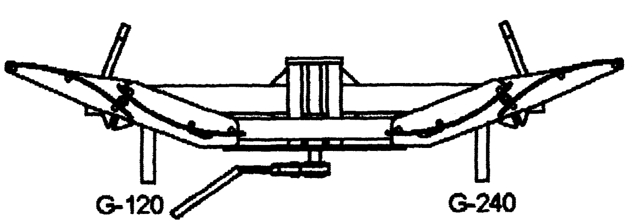
B. Jackson Bending Tool, P/N 1084-1
LEMCO Loop Forming Tool, P/N M-3195

These tools produce the same loop and are appropriate for cables larger than 0.750 inches in diameter.



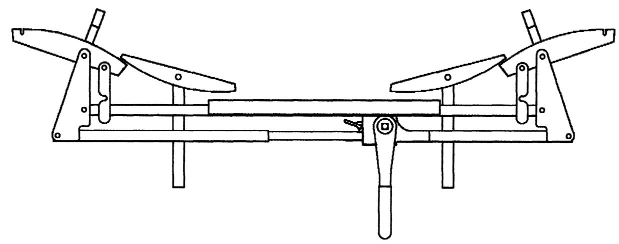
C. LEMCO Loop Forming Tool, P/N G-120
LEMCO Loop Forming Tool, P/N G-240

The G-120 should be used for cables up to and including 0.750 inches in diameter. The G-240 handles cables larger than 0.750 inches in diameter.



D. An improved tool is now available which provides extended loop life. These new tools are the LEMCO Loop Forming Tool, P/N L-1149D, designed for cables up to and including 0.750 inches in diameter and LEMCO Loop Forming Tool, P/N L-1150D for cables larger than 0.750 inches in diameter.

The manufacturer has generated extensive test data utilizing laboratory simulations to demonstrate and document extended loop life. TFC finds that these tools are effective for use with T10 and TX10 trunk, feeder and distribution cables



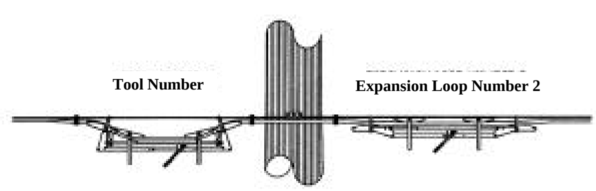
LEMCO MODELS NO. L-1149, L-1149D,
L-1150D, L-1150DT AND L-1150T-75.

E. The LEMCO Loop Forming Tool, P/N M-4306 is effective for forming a 9 inch deep loop in cables up to 0.750 inches in diameter, providing excess cable of approximately 5.41 inches. This tool is recommended for use in cold climates or when installing in hot weather.

FORMING EXPANSION LOOPS

There are several key factors about the shape of an expansion loop which cumulatively effect loop life. For extended loop life, an important key factor is the amount of excess cable in the loop. During loop formation in a short span, make sure that the forming tool does not allow cable to be pulled out of a previously formed loop.

In addition, it is advisable to keep the expansion loop forming tool in place during adjacent lashing so that lashing pressure does not pull cable from the expansion loop.



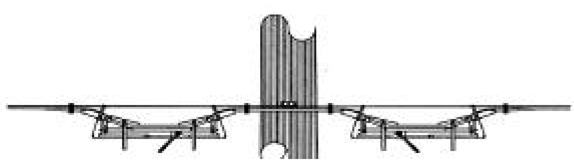
Expansion loop number 1 must remain in the loop form tool while forming loop number 2. Otherwise cable will be pulled out of number 1 and into number 2.

BANDS AND SPACERS

After the loop is formed, the band and spacer are installed. Spacers separate the cable from the strand and hardware attached to it such as lashing wire clamps and three-bolt strand clamps. This separation is needed to allow the cable to expand and contract without abrading against the strand hardware and damaging the cable. The band is used to hold the cable and spacers against the strand. Bands should not be tightly drawn down but should only cradle the cable.

The cable is now lashed over the spacer and the lashing wire secured on one side.

Do not remove the expansion loop tool from the cable until the lasher has been moved over to the other side of the pole and has lashed about fifty feet from the loop. This prevents the action of the lasher from pulling out the loop, rendering it ineffective and more shallow than desirable.



Expansion loops must remain in the loop form tools until the lashing machine has traveled at least 50 feet or 1/3 the distance to the next pole, whichever is greater. Otherwise cable will be pulled from both expansion loops, leaving insufficient cable for colder weather contraction.

CONTRACTION.

Band and Spacer Location

As previously stated, the cable needs to be free to migrate into and out of the expansion loop, so the bands should not be tightly installed. Bands and spacers should be located between 4 inches and 6 inches outside of a 6 inch deep, 12 inch flat bottom expansion loop, or approximately 25 inches to 27 inches from the center of the expansion loop, whichever is greater.

Since excess cable in the loop must migrate, the band and spacer must always be placed outside the outer radii of the expansion loop. This allows cable to be pulled from the loop during the coldest seasonal contraction.

For multiple cables, do not place straps in the flat part of the expansion loops. They will restrict free movement of cable in and out of the loop, especially when multiple cables are of different sizes, or the spans feeding into and out of the loop are different lengths.

LASHING WIRE TERMINATION

Lashing wire tension and termination must allow for free movement of cable along the strand. The lashing wire should be wrapped around the strand three times and then tied off at the lashing wire clamp (bug nut).