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Conductor Installation Guidelines

WORK INSTRUCTION : AILS/IM/TP/01
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1. PURPOSE

1.1. The purpose of this document is to provide experienced transmission engineers, field inspectors, utility personnel and linemen with guidelines, recommendations and requirements necessary to safely install the Bare Overhead Twisted Pair Conductors.

2. SCOPE

2.1. These guidelines apply to equipment and techniques required to install Twisted Pair (TP) Conductors. ***(TP construction is most typically built with ACSR component sub-conductors, but are also available with AAC, AAAC, ACAR, AACSR, TACSR and ZTACSR sub-conductors as well.)***

3. ASSOCIATED DOCUMENTS

3.1. IEEE Standard 524™ Guide to the Installation of Overhead Transmission Line Conductors.

4. DEFINITIONS

4.1. **Twisted Pair Conductor:** A two-conductor twisted construction designed to control wind - induced motion.

ACSR/TP : Aluminum conductor, Steel Reinforced twisted pair.
AAC/TP : All Aluminium conductor, twisted pair.
AAAC/TP : All Aluminium Alloy Conductor, twisted pair.
ACAR/TP : Aluminium conductor, Aluminium alloy reinforced, twisted pair.
AACSR /TP : Aluminium Alloy conductor, steel reinforced, twisted pair.
TACSR/TP : Thermal Resistant Aluminium Alloy conductor, steel reinforced, twisted pair.
ZTACSR/TP : Super Thermal Resistant Aluminium Alloy conductor, steel reinforced, twisted pair.

5. RESPONSIBILITY

5.1 It is the responsibility of the Installation Contractor and Field Inspectors to ensure a safe installation by following the instructions provided in this guideline, as well as customary safe installation practices.

6. TOOLS, GAUGES, FIXTURES

6.1. All equipment shall be maintained in accordance with applicable safety standards.

7. SAFETY REQUIREMENTS

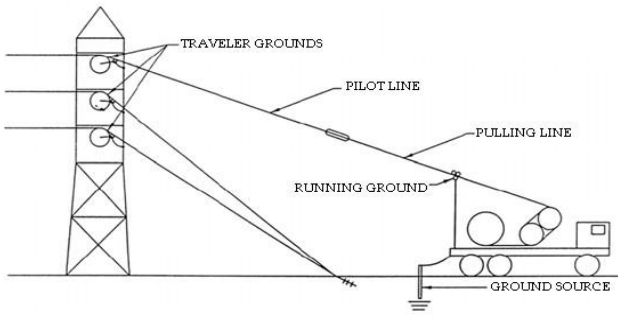
7.1. All safety requirements associated with the operation of approved equipment shall be followed.

7.2. The conductor can be broken or damaged if bent or handled in a careless manner that exceeds this document recommended bend radiuses.

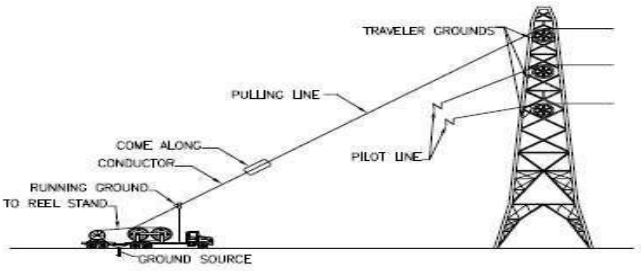
7.3. Electrical grounds shall be placed on all equipment and conductor per OSHA Regulation 1910.269 and 1926.950 in the U.S. and similar requirements in other countries; must include Equipotential. First and last traveler shall be grounded along with the running ground at the tensioner. The grounds shall be placed approximately 20 feet (6 meters) out from the insulators during the dead-ending process and likewise the grounds shall be placed 20 feet (6 meters) on each side of the splice during

the splicing process. The placement of the grounds at 20 feet (6 meters) helps to eliminate the bird caging process that could occur in Aluminium wire of conductors.

7.4. CONDUCTOR GROUNDS MUST BE PLACED DIRECTLY ON THE ALUMINUM STRANDS.



Puller equipped with pulling line connected to pilot line



Tensioner with conductor connected to pulling line and ground
Connection between conductor, tensioner and reel

7.5. We at APAR are always committed to the health and safety of the people who produce and work with our conductor in the field. For Twisted Pair (TP) conductors, rolling grounds can be used. It is advised to consult the equipment ground manufacturer to make sure the rolling ground design selected will work with the Twisted Pair (TP) conductors and accommodate the twisted conductor configuration.

8. SHIPPING AND REEL HANDLING REQUIREMENTS

8.1 Aluminum conductors are shipped in sturdy, carefully designed containers or reels that safeguard the conductor from damage in transit, storage, and at the point of installation. The conductor is carefully inspected during all stages of fabrication; packaging is inspected prior to shipment, and only properly packaged material is delivered to the carrier. Drum Drawings available along with the conductor data sheet should be referred for drum/reel dimensions & spindle hole diameter.

8.2 Reel Handling. Reels are constructed so that they must be supported either on an axle through the arbor hole or by the reel flange. Returnable metal reels may be supported by a singletree arrangement that clamps to the flange and is lifted from above. When an axle supported from above lifts the reels, a spreader bar must be employed to prevent damage to the conductor or reel, or both, by inward pressure on the reel flange. Proper equipment must be available to lift the reels.

8.3 Reel stands are designed to be used with tensioners to supply the necessary back tension to the conductor. The stand(s) are selected to accommodate the conductor (or ground wire) reel dimensions and weight.

8.4 Some reels are not designed to withstand the forces developed by breaking during tension stringing operations. Direct tension stringing from the reel at transmission line stringing tensions should not be attempted. The conductor may be pulled directly from the reel stand when employing slack stringing methods.

8.5 If the reel stand is not self-loading, a crane, forklift or other suitable equipment is used to load the reel into the stand.

8.6 Reels should be properly controlled during the loading, unloading and staging processes.

8.7 Cranes or other equipment of adequate capacity should be used to avoid damage and to avoid safety hazards.

8.8 It is important that reels of conductor are not lifted by placing the forks of the forklift directly under the drum area of the reel which would allow the forks to come in direct contact with the conductor or its wrapping material. Slings, winch lines, nylon straps or other types of lifting devices shall never be placed around the conductor to lift the reel. The conductor could be damaged if such devices are used.

8.9. Lift reel by approaching from the side and placing forks under flanges.

8.10 A spreader bar with slings or chains attached directly to the reel is the preferred method of unloading.

8.11 At no time should the reel be laid on its side either during unloading or storage.

8.12 If the conductor is to be rewound on the existing reel or onto another reel, extreme caution shall be exercised. The conductor must have backpressure applied at all times. Personnel must ensure that the conductor doesn't cross over itself during the rewinding process. Rewinding process at site may be avoided as far as possible.

NOTE: PREVENTING CONDUCTOR CROSS-OVER ON THE REELS AND KEEPING BACK PRESSURE WHILE REWINDING HELPS TO ENSURE THAT THE CONDUCTOR REMAIN INTACT.

9. STORAGE

9.1. If the conductor is to be stored for an extended period of time before use, the reel containing the conductor should be kept off of the ground and otherwise protected from possible damage. It is recommended that steel reels be used for storage of backup conductor.

9.2. Identification tags and other markings should be retained on all packages until such time as the conductor is to be used. Identification tags should be protected from weather to retain information.

9.3. The reels are delivered from the factory with a wooden lagging cover or polypropylene sheet covering held down with steel bands or polyester straps over the outermost layer of conductor. It is recommended that the cover be left on the reels if they are going to be stored for an extended period of time

9.4 Please refer APAR's instruction manual for **"Handling, Loading, Unloading and Storage Guide of Conductor Drums"**.

10. STRINGING CONDUCTOR

10.1 Twisted Pair (TP) are bare overhead conductors manufactured with two tension-balanced conventional component conductors twisted around each other. While this conductor type may be installed using techniques and equipment similar to that used to install standard round overhead conductors, there are some special procedures that are recommended. Also discussed in this guide are problems that can be encountered during installation and suggested troubleshooting steps that may be of further assistance during the installation of Twisted Pair (TP).

10.2 Conductor reels should be loaded into their payout cradles prior to the removal of protective covering. After the removal of the covering, all reels must be examined for sharp objects that may damage the conductor (Nails in case of wooden reels), as it is unreeled. Reel trailer mandrels shall match the size of reel or correctly sized collars shall be used to maintain control of the reel. If the mandrels are too small, the conductor has a tendency to bounce and could damage. Additionally, brakes will not work properly if the reel isn't controlled properly.

10.3 In all cases, the reel stand shall be anchored before pulling any conductor.

10.4 A reel brake mechanism must be utilized in a straight line with tensioner at all times to avoid spring action or uncoiling. Adequate back-tension must be applied at all times during the pulling operation to prevent the conductor from unraveling, binding or jumping out of alignment with tensioning or stringing equipment.

10.5. Conductor must be continuously inspected as it is fed into the stringing equipment for dirt, bits of foreign material, nicks or abrasions in the conductor.

10.6. Precautions should be taken to keep pulling lines and stringing sheaves free from dirt and foreign debris that would cling to the conductor as it passes through the sheaves.

10.7. The conductor must not be pulled across the ground or underlying structure (such as a fence) as that could damage the aluminum strands causing electrical discharge or corona when energized.

10.8 It is a good practice to retain the reel tags and document the section of line where the specific reels of conductor are used.

10.9 It is recommended that the protective paper wrap that is removed from the reels be placed on the ground to protect the conductor during set up and splicing operations.

10.10 Should the conductor unintentionally come in contact with the ground, any dirt or debris build up should be cleaned off.

10.11 The maximum pulling tension applied to the conductor should ideally be 10% or less of the conductor rated breaking strength as recommended by IEEE Standard 524. A good guideline is not to exceed 50% of the sagging tension.

10.12 Always use Polyurethane lined dollies, sheaves, rollers, blocks, etc. when stringing conductor.

10.13 Grips must be rated for conductor strength. Ensure that tape is placed on any rough edges on the outside of the grip near the pulling eye(s) and swivel to help the grips and swivel pass smoothly through the blocks (sheaves). The tape also helps protect the lining on the blocks as the grip pass through the sheaves.

10.14 A single woven wire grip sized to fit over both component conductors and a swivel link should be used for tension stringing. Each shipping length of Twisted Pair (TP) conductor has metal bands applied at the factory around both component conductors. It is recommended by IEEE Standard 524 that these bands not be removed for the stringing procedure and that the woven wire grip be slid over them. Please note that if the Twisted Pair (TP) conductor is to be cut before the entire reel of conductor is consumed, it is important that the conductor pair is re-banded while still under tension. Failure to do this may result in problems while stringing the remaining length of conductor on the reel.

10.15 The Twisted Pair conductors are manufactured with equal length and tension of the component conductors. To ensure consistency during the twisting process, a mark is made on each component conductor at the same longitudinal location prior to being passed through the twisting process. The marks are then observed throughout the process, up until the take-up reel, to ensure they do not move back and forth relative to each other by more than 1.5 inches (3.8 cm). This testing is conducted at first 30m of production run followed by regular intervals of 100 meters throughout the reel length and factory markings are made available on the Twisted Pair conductors to indicate the longitudinal location of the component conductors during the twisting process.

10.16 During the unwinding operation of the Twisted Pair (TP) conductor during installation, the installation crew must take care that the factory markings do not move. The crew should handle the conductor carefully to prevent any unnecessary tension or twisting that may cause the markings to shift.

10.17 If the factory markings are inaccurate or abnormal in the reel, the installation crew should contact the manufacturer or supplier of the Twisted Pair (TP) conductor for guidance on how to proceed.

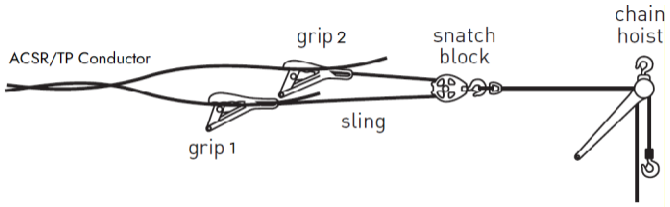
10.18 The installation crew should verify that the markings are still visible and accurate after each pull of the conductor. If the markings have moved or are no longer visible, the crew should stop the installation and take the necessary steps to adjust the tension or twisting of the conductor before continuing the installation.

Note :
Each Drum/Reel shall bear a printed label containing the following information, which must be verified prior to the use of the conductor at the installation site.

Black ink marking is done on the entire length of the Twisted pair conductor intermittently at every 100 mtrs, should remain in its permissible range of 1.5inches, this is an indicator of conductor integrity and compliance to the specification. If line marking got disturbed than please don't use the particular reel, it will be replaced. If line marking remains on the conductor in permissible range, then it confirms the conductor integrity with specification, thereafter any stringing related issues like bagging cannot be attributed/accepted to conductor manufacturing.

10.19 For Twisted Pair (TP) conductors, it is important for both conductors to be simultaneously tensioned, as recommended by IEEE Standard 524. During installation, a Kellem grip shall be applied over both of the TP conductors and used to connect the conductor to the pulling swivel to the pulling line as shown below. The two grips are connected through a snatch block with a sling. Tension is applied to

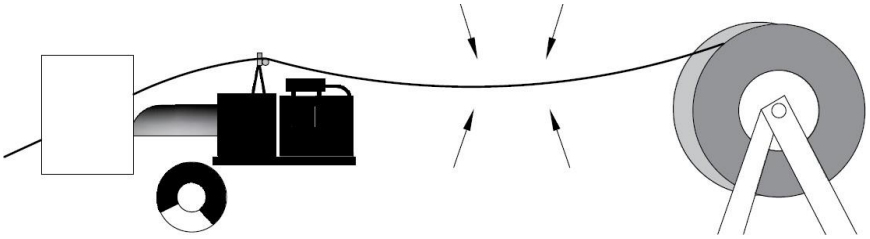
the snatch block with a hoist or other appropriate tensioning device. This arrangement will apply even tension to the component conductors.



10.20 Never bend the conductor less than the recommended minimum bend diameter of conductor. We at APAR recommend the minimum bend diameter of Twisted Pair (TP) conductor as 20 times the maximum conductor diameter.

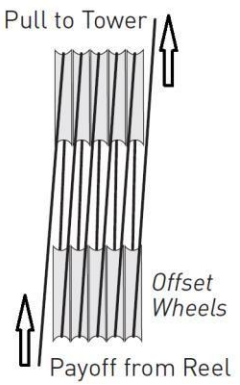
10.21 Damage to the conductor can occur if it is over bent.

10.22 It should be ensured that the conductor do not bounce up and down from the payout reel.

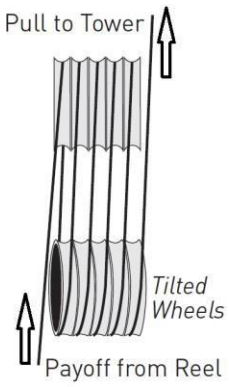


11. TENSIONERS

The Figure below illustrates two multi-groove bullwheel tensioners that can be used to install Twisted Pair (TP) conductor.



Offset Bullwheel Tensioner



Canted / Tilted Bullwheel Tensioner

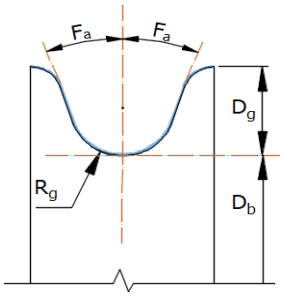
11.1 **Offset Bullwheel Tensioner** represents a unit in which the alignment of the front and back bullwheels is offset by one half of the groove spacing. This design is satisfactory for installing smaller sizes of Twisted Pair (TP) conductor where the conductor will lay flat in the bottom of the groove. If improper equipment is used, the ridge between the grooves may separate the Twisted Pair (TP) conductor individual members and result in the conductor being tangled inside the machine.

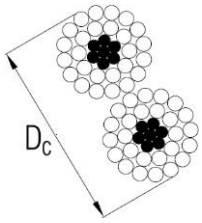
11.2 **Tilted Bullwheel Tensioner** illustrates another preferred type tensioner. In this design, one bullwheel is tilted slightly in relation to the other bull wheel. This allows the conductor to ride in the bottom of the grooves. This type of tensioner, properly sized, is preferred.

11.3 The groove radius must be large enough so that the conductor, when laid flat, will fit into the groove. This can be verified with the bull wheel manufacturer.

11.4 The groove radius of the bull wheel must be wide enough for the TP conductor to pass through with the two sub-conductors lying side by side (refer figure 19 of IEEE Std 524).

Recommended Bullwheel Tensioner Dimensions



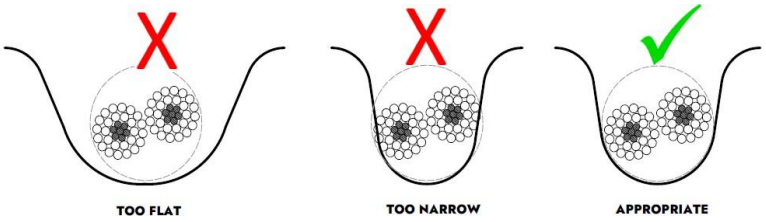


D_C is defined as the conductor outside diameter,
for Twisted Pair Conductor D_C = 2 x diameter of one of the component conductors.

Minimum Bullwheel Diameter at Bottom of Groove: D_b	D_b = 28 D_C
Radius of Groove: R_g Layer(s) of Aluminum: 1-2 layers 3 layers > 3 layers	Minimum R_g = 0.525 D_C R_g = 0.525 D_C R_g = 0.525 D_C
Minimum Groove Depth: D_g	Dg*= 0.5 x (Diameter of Comp. Conductor)
Groove Flare Angle: Fa	5° to 15°

** Based on the commercial available Bullwheel in the Market*

11.5 The bottom of the groove and flare profile is important for Twisted Pair (TP) conductors. The bottom of the groove profile must not restrict the conveyance of the normal twist in the conductor pair in passing over and through the stringing sheave. If the profile is too flat, it may cause the twist to be pushed back, and this action can be observed as violent rocking motion of the stringing sheave. If the profile is too narrow, it may cause pinching of the individual conductors and result in the pair of conductors having to rise up and fall down as they pass through the sheave. An inappropriate sheave groove profile will result in excessive scratching and displacement of the outer aluminium wires in one or both conductors.



11.6 The tensioner bullwheel diameter must be large enough to avoid excessive bending of the conductor. The bottom groove diameters for tensioner bullwheel should be sized in accordance with IEEE Std. 524. Apar recommends a minimum bullwheel bottom of groove diameter should not be less than 28 times the maximum conductor diameter.

11.7 For standard ACSR/TP conductor (individual conductors with a right hand direction of lay and a left hand direction of lay for the twisted assembly) the direction of wrap across the bullwheel should be from left to right.

11.8 Two (2) or three (3) wraps of the conductor around the bullwheel should be sufficient for normal pulls.

11.9 V-groove tensioners should not be used.

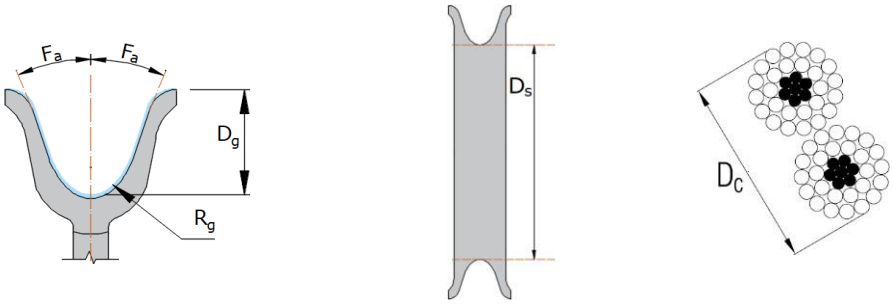
12. SHEAVES

12.1 Sheave selection is very important to avoid conductor damage and installation problems. The recommended minimum sheave bottom groove diameter should be 14 times the maximum diameter of the Twisted Pair (TP) conductor assembly. Field experience has demonstrated that smaller diameter sheaves may be used with TP-ACSR conductors that have only one layer of aluminum (example for the 6/1 ACSR AWG sizes). The entrance sheave and angle sheaves, for angles greater than 15 degrees, should be larger. Proper size will be evident by smooth passage of the conductor through the sheaves, minimizing potential conductor bending and damage.
Use of improperly sized sheaves can result in excessive torsional twist in the twisted pair conductor as it is installed. The excessive twist can result in bagging of one conductor, a shorter lay length, and/or bird caging.

12.2 Groove radius (Rg) should not be less than 0.55 times the maximum diameter of TP conductor assembly (Dc).

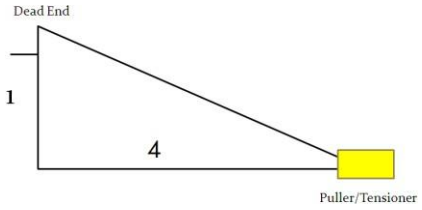
12.3 Flair angle (F) of the sides of the sheave groove shall not be less than 20° from vertical. Sloping side walls (flair angle) of the sheave appear to aid in lifting the sub-conductors over each other.

Refer to IEEE Std 524 for more sheave related recommendations.

Recommended Stringing Sheave Dimensions		
		
D_C is defined as the conductor outside diameter, for Twisted Pair Conductor D_C = 2 x diameter of one of the component conductors.		
Minimum Diameter at Bottom of Groove: D_S	For component conductors: < 795 kcmil ≥ 795 kcmil At angles or elevation changes :	 14 Dc 15 Dc 16 Dc
Radius of Groove: R_g Layer(s) of Aluminum: 1-2 layers 3 layers > 3 layers	Minimum R_g = 0.55 Dc R_g = 0.55 Dc R_g = 0.55 Dc	Maximum : Refer section 11.5 above
Minimum Groove Depth: D_g	D_g = 1.25 D_C	
Groove Flare Angle: Fa	> 20°	

13. STRINGING PRECAUTIONS

13.1 The ratio of the distance to the first structure and the height to the first stringing sheave should be four to one (4:1), as recommended by IEEE Standard 524, which corresponds to an upwards conductor angle of about 15° in order to avoid bending the conductor at severe angles. The pay-off reel must be positioned 50-80 feet back from the start of the bullwheel tensioner. Wherever possible, the use of rollers on or between the reel trailer and the bullwheel tensioner should be avoided. A roller can cause distortion in the conductor twist. If a roller must be utilized, it should be as large as possible and constructed of a material that will not scratch the conductor.



13.2 For Twisted Pair (TP) Conductors, higher pay-off tension can mark the surface of the conductor as the conductor enters the tensioner. Excessive brake tension can also cause the top layer of the conductor to crush down the layer of conductor below and damage or distort the surface of the underlying conductor.

Note: There may be times when the 1 to 4 height to distance ratio can't be maintained. In this case, use of an alternative-stringing plan with larger blocks may be deployed. It may be possible to rotate the tensioner and puller so that the conductor can be stopped at the dead end without causing any damage to the conductor. It is recommended for significant accumulated angle changes that the pull is broken up in separate pulls. Larger stringing blocks or tandem configurations should always be used at angles.

13.3 To prevent untwisting of conductor pairs, it is important to use suitable equipment and techniques when pulling the cable. Speeds of 5 km/h (3 mph) to maximum 8 km/h (5 mph) usually provide a smooth passage of the running board or connecting hardware, or both, over the travelers; whereas slower speeds may cause significant swinging of the traveler and insulator-hardware assemblies. Higher speeds create a potential hazard of greater damage in case of a malfunction.

13.4 The conductor reel shall be back from the first structure at least at a 4 to 1 ratio. If the structure is 100 feet (31 meters), the reel shall be back a minimum of 400 feet (102 meters) before starting to pull any conductor.

13.5 If the 4 to 1 ratio cannot be achieved use of oversized block on the first structure from the tensioner may be used.

13.6 Prior to dead ending, it is critical that the grip/hoist and any grounds be placed as far out on the line as possible, preferably 10 feet (3 meters) or more.

13.7 If at any time during the installation process the Twisted Pair (TP) conductor is bent at a sharp angle, and if this portion of the conductor is going to be put up under tension or non-tension, this section of conductor must be cut out and a full splice installed. Sharp angles can be avoided by proper sheave placement and attention to back tension and reel payout.

13.8 Where there is a severe uplift or down pull on the Twisted Pair (TP)conductor at any structure or tower, it is critical to use double blocks, preferably 28 inches (712 millimeters) or larger for each block. This is measured to the inside of the sheave wheel and not the overall size of the block.

13.9 It is recommended for significant accumulated angle changes that the pull is broken up in separate pulls. Larger stringing blocks or tandem configurations should always be used at angles.

13.10 Swivels in good operating condition must be used at all times during pulling operations.

13.11 Klein "Chicago" grips or an approved equal grip may be used to grip the conductor when tensioning the conductor.

13.12 The grips must be properly sized to match the conductor diameter in order to minimize strand distortion and maximize gripping power.

13.13 The jaw length for these grips must be the long body type with smooth finish.

13.14 Do not use grips designed to fit a large number of conductor sizes, or with the short length jaws.

13.15 Consult with the grip manufacturer for the correct sizing and the recommended installation procedure.

13.16 AII of the conductor grips must be clean, properly sized, and load tested prior to use to ensure that they will exceed the intended maximum installation tension(s).

13.17 It may be necessary to use tandem grips for certain high-tension applications.

13.18 Consult with the equipment supplier to ensure the attachment device is suitable for the Twisted Pair (TP) conductor and for the intended load rating.

13.19 Stringing tension/sagging time.

1. IEEE 524™ recommends that conductors be 'sagged' and 'clipped' in place within 24 - 48 hours of installation.
2. IEEE 524™ recommends that the maximum time for conductors sitting in the rollers (from initial installation until clipping) should never be more than 72 hours.

14. TROUBLESHOOTING AND PRECAUTIONS DURING INSTALLATION

During installation, it is crucial to be aware of potential conductor damage caused by excessive conductor assembly rotation, particularly in larger conductor constructions like 2 x 336.4 kcmil 26/7 ACSR/TP "Linnet" and larger. This issue is less common in smaller sizes as they can withstand more conductor assembly rotation without risking damage to the wires in the outer layer. To ensure a safe installation process, we strongly advise rigging all sheaves in angle structures to maintain the appropriate line of pull.

Improper conductor installation can lead to two issues: overtightening or bird caging of the outer layer strands. This often occurs due to excessive conductor rotation caused by using the wrong sheave or not employing rigging on angle structures during installation.

To troubleshoot this, follow these steps:

1) Determine the direction and extent of conductor assembly rotation by marking one side of the lead end with paint after installing the pulling sock over the factory conductor clamps.
2) If available, use a small surveying flag to visually track the conductor's movement after passing through the bullwheel tensioner.

Once the lead end of the conductor is visibly marked to indicate the direction and number of rotations, begin the pulling process while keeping track of the conductor's rotations. Observe whether the rotations are clockwise or counterclockwise as the conductor is pulled in, looking towards the puller.

Industry experts strongly recommend limiting the average number of rotations to 3 or less per 1000-foot span during the installation of Twisted Pair Conductors. Following this guideline has proven successful, as it has resulted in over 7500 installations of conductor lengths without any reported issues.

15. DEAD-END AND SPLICE INSTALLATION:

15.1 It is important that the line hardware maintains an even conductor tension balance with the two individual conductors.
APAR does not recommend, nor take responsibility, for the use of any conductor hardware. All dead-ends and splices must first be approved by the hardware manufacturer for use with Twisted Pair (TP) Conductor.

15.2 For splices in Twisted Pair (TP), the conductors are joined by separately splicing each component conductor together. Compression-style splices are preferred; however, for small AWG sizes, provided the utility will allow their use, "automatic" type splices have been used. Where possible, the individual conductor splices should be staggered about 1.5 m (5 ft). An additional twist may be needed before the second splice is made to remove any looseness between the component conductors. This will ensure that each component conductor carries an even share of line tension. Both splices should be made before tension is applied. Care should be taken to maintain equal tension on the component conductors to prevent them from separating.

15.3 Always consult with the Hardware manufacturer for the correct sizing and the recommended installation procedure.

16. REPAIRES

Repairs to damaged component conductors can be made using the following procedure:

1) Attach two wire grips facing each other approximately 4.6 m (15 ft) apart on the undamaged component conductor.
2) Attach a chain hoist to the grips and take up tension. (As the tension increases, slack will appear in the damaged component conductor).
3) Increase tension until there is enough slack to make repairs.

Helically applied rods may be used for repair in accordance with utility policy, given the nature and severity of damage. Follow the above procedures to install the repair rods on the damaged conductor.

CAUTION

If it is necessary to cut the damaged conductor to install a splice, a second set of grips and hoist should be installed on the damaged conductor before it is cut. The above procedure should be used to install the grips.

17. CONDUCTOR SAGGING

17.1 Twisted Pair (TP) conductor is "sagged" the same as conventional ACSR (Aluminum Conductor Steel Reinforced).

17.2 Standard sight, return wave, transit and dynamometer methods are applicable for installing Twisted Pair (TP) conductor.

18. LEGAL NOTICES

PLEASE READ THESE LEGAL NOTICES CAREFULLY.

Disclaimer: This guide provides suggestions for methods, equipment and tools that have been found practical based on field-testing. These guidelines are meant to provide procedures that will help provide a high quality, trouble-free installation so that the Twisted Pair (TP) conductor once installed, will perform its intended function. Failure to follow these guidelines may cause a hazardous condition or result in premature line failure. The information contained herein or related hereto is intended for evaluation by technically skilled persons, with any use thereof to be at their independent discretion and risk. Such information is believed to be reliable, but the accuracy or completeness thereof is not guaranteed. The user assumes all risks and liability whatsoever in connection with such use.

This document is provided for guidance purposes only and shall not be considered a legally binding document.

WARNING: A potential for electrical shock exists when using cables energized with electrical power. Use appropriate safety procedures.

*** END ***