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I. Introduction

The purpose of the ACCC® Conductor Installation Guidelines is to provide experienced personnel with guidelines, recommendations, and requirements necessary to successfully install the bare overhead composite-core ACCC® Conductor and Accessories. This document is an overview and guideline covering what to do but not necessarily how to do it. It is not intended to serve as a more intensive training manual or act as a substitute for proper training, required personnel skill sets, or industry experience.

Safety practices applicable to other conductors are identical for ACCC® Conductor installations. Proper grounding is a critical aspect for the safe installation of any high voltage conductor particularly when nearby line circuits may remain energized during installation. Refer to Subject Matter Experts for directions on working in areas where high induction currents may be present.

ACCC® Conductor is installed using industry standard installation equipment, methods, and standards such as IEEE-524, National Grid Linesmen's Manual M1 (UK), and others. Many regulatory and utility standards exist world-wide, and applicable standards and requirements must be observed.

These standards apply equally to ACCC® Conductor with a very few but important exceptions. These guidelines cover those exceptions.

Individual utilities or contracts may include restrictions or requirements not covered or more stringent than in these guidelines. Where these do not conflict, they should take precedence over the guidelines.

II. Scope

These guidelines are for use where conductors are suspended below insulator strings at tangent structures, typical for transmission and some sub-transmission voltages. For lower voltage applications, where conductors are mounted above or alongside insulators, see companion ACCC® Conductor Installation Guidelines for Distribution Applications, M181005-15.

These guidelines apply to all sizes and types of ACCC® Conductors including ACCC® Ultra-Low Sag (ULS) Conductors, ACCC® AZR Conductors, and InfoCore® Certified ACCC® Conductors.

III. Supporting Documentation

- Minimum Sheave and Tensioner Sizes Chart M181005-62 (Appendix A)
- Die Selection Chart M181005-64
- IEEE Std. 524-2016
- Tooling and Equipment List M181005-61

IV. Storage, Conductor, and Conductor Drum Handling

A. Storage

ACCC® Conductor may be stored indefinitely and there are no ambient temperature limits for storage. All-steel reels are recommended for storage greater than one year and required for storage exceeding six (6) months if average humidity is greater than 80%. ACCC® Conductor should never be submerged or allowed to remain wet during storage.

B. Drum Handling

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

Proper equipment must be available to hoist and handle conductor reels. Cranes or other equipment of adequate capacity must be used to avoid damage and safety hazards.

Reels may be handled with forklift equipment of adequate capacity. It is important that reels of ACCC Conductor are not lifted by placing the forks of the forklift 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 any other types of lifting devices shall never be placed around the conductor to lift the reel. The ACCC® Conductor will be damaged if such devices are used.

Conductor reel packaging should be inspected for damage before removal as it may indicate conductor damage has occurred during transport or handling.

Reels are constructed so that they must be supported either by the reel flanges from below or on an axle (mandrel) through the arbor hole. When an axle through the arbor hole is used to lift reels, a spreader bar must be employed to prevent damage to the reel flanges, or conductor, or both, by inward force on the reel flange. A spreader bar with slings or chains rigged vertically to each end of an adequately sized axle through the arbor hole is the preferred method of hoisting. If a spreader bar is not available at least 3 – 4-meters (15') steel or nylon slings or lifting chains must be used to prevent damage to the top of the reel flange.

Steel reels may be supported by a singletree arrangement that clamps to the flange and is lifted from above.

Reels must be placed on flat ground or floor. Always chock the reel flanges (never chock under the conductor itself or it's protective lagging) to prevent rolling.

At no time shall a loaded reel be laid on its side either during handling, loading, unloading or storage.

C. Conductor Handling



Never bend ACCC® Conductor further than its minimum sheave working diameter.

To prevent damage, it is CRITICAL that the conductor never experiences sharp bends. The minimum bending diameter for each conductor is found in the Minimum Sheave and Tensioner Sizes Chart.

It is not always obvious that a particular handling practice may apply a bending force over a too-small radius and result in core damage. For instance:

1. Fairlead rollers
2. Undersized sheaves
3. Entry and exit points of grips and hardware
4. Poor brake operation on the payout reel, resulting in bouncing or excessive tension on the tensioner fairlead rollers
5. Hoisting a section of conductor or placing a force on the conductor using a hook, chain, rope, or narrow sling
6. Dropping the conductor on, or pulling it over trees, obstacles, structures or edges
7. The conductor itself if looseness on the payout reel results in a cross or a jam

V. Training

CTC's ACCC® Installation Training course is included for all crews inexperienced with the installation of ACCC® Conductor. Linemen, operators, groundmen and supervisors should attend the training which consists of classroom instruction, hands-on deadend and splice assembly instruction (for approved hardware), and then on-the-job training up to a total of up to 7 days. This training is most effective when presented immediately prior to the start of installation.

VI. Installation Planning

A. ACCC Hardware

Termination hardware (deadends and splices) and all auxiliary hardware which contacts ACCC® Conductor must be approved for use by CTC Global. The current list of approved hardware, manufacturers, and part numbers may be found on the CTC Global website: <https://www.ctcglobal.com/accc-hardware-suppliers-parts-database/>

When unapproved hardware is used on ACCC® Conductor, please note the hardware section of Installation Training is eliminated and any associated ACCC® Conductor Warranty is invalidated.

B. Manual Stringing

Either “slack” (conductor is pulled from stationary reel along the ground) or “layout” (conductor is deposited on the ground from moving reel) methods may be used. Braking of a moving reel to prevent overrun is required. When using manual methods, it is critical to prevent sharp bends in the conductor. It is also important to avoid damage to the surface of the soft aluminum (except ACCC® AZR Conductors). Ground rollers or temporary ground cover are recommended.

Hoisting ACCC Conductor from the ground into position must always be done with great care to avoid creating sharp angles in the conductor.



Pulling, laying out, lifting, carrying, or hoisting ACCC® Conductor must always prevent sharp angles or over-bending the conductor.

C. Tensioned Stringing

Tensioned stringing, using pulling and tensioner equipment is the preferred method for installation of ACCC® Conductor. Most of these guidelines assume that the tensioned stringing method is in use.

Core retainers must always be used for tensioned stringing on the leading end of the conductor, and on the trailing end for multiple drum pulls.

D. Pulling ACCC Conductor

Hard line or pilot line is always recommended for pulling ACCC® Conductor, especially for long pulls, long crossings, mountainous terrain or many line angles. Existing conductor may be used as a pulling bond providing it is in good condition. It is not recommended to pull ACCC® Conductor directly using rope.

It is recommended to cut out and replace splices in existing conductor. Splices can damage sheaves which may then damage ACCC® Conductor and will cause significant bouncing during the pull. Splices should be replaced with pulling socks and swivels. If splices are not removed, then pulling speed should be reduced whenever splices pass over sheaves. Splices pulled over sheave angles of 30° or more is prohibited.



ACCC® splices are longer than conventional splices and are NEVER allowed to be pulled over sheaves in any case.

E. Long Pulls

ACCC® Conductor reels may be pulled back-to-back for a variety of reasons including to avoid difficult setup areas. A maximum of 20 structures is recommended for long pulls. Contact your Regional Service Manager or fieldservice@ctcglobal.com for specific recommendations for very long pulls exceeding 20 structures.

F. Long Spans, Mountainous Terrain, Elevation Changes

Providing that bending limits and angles are respected, ACCC® Conductor may be installed exactly as any other conductor in special applications. Due to its typically higher tension capability, ACCC® Conductor may be strung or sagged at higher tensions than other conductors; up to 35% of rated tensile strength (RTS), assuming structure and equipment capability.

G. Bundled Pulling

It is recommended that all of the sub-conductors for bundled applications using ACCC® Conductor be pulled in together using normal bundled pulling equipment, tools, and techniques.



If ACCC® bundled sub-conductors are not pulled in together, the alternate sagging procedure must be used (see Section X.2).

H. InfoCore® System

The InfoCore® System provides confirmation of ACCC® Core integrity at any point in the supply chain and particularly to verify that installation was correct. A confirmation of integrity can be made on conductor that has been delivered to the installation site, just before it is installed and then again just after installation is complete. The inspection is performed by the Certified InfoCore System Operator, usually also a Master Installer, with assistance from linemen in the structures who prepare the ends of the InfoCore for inspection. The process takes about 5 minutes per (sub-)conductor per section.

VII. Tools and Equipment

CTC will produce a size-specific Required Tooling and Equipment checklist upon request. Send your request, with the desired ACCC® Conductor size, to: FieldService@ctcglobal.com

A. Tensioner



Tensioner bull-wheels must be minimum diameter as specified in Minimum Sheave and Tensioner Sizes Chart M181005-62 (Appendix A).

Tilted bull wheel style tensioners are recommended for stringing ACCC® Conductor. Offset style bullwheel style tensioners must be threaded left-to-right for right-hand lay conductors and right-to-left for left-hand lay conductors.

Tensioner bull-wheel groove surfaces must be hard enough to avoid torsional friction on the outer layer of strands which can lead to bird-caging on the bull-wheels.

B. Payout Reel Stand and Brakes

Payout reel stands must have axle and axle adaptors as needed to properly fit the arbor hole diameter of the conductor reels.

Hydraulic brakes synchronized with and controlled by the tensioner are strongly preferred for ACCC® Conductor installation. Properly maintained and operated disc brakes may be used.

C. Pulling Socks



Pulling grips (socks) must have reinforcement at the eye end to protect the wires of the sock where they come in contact with the Bug.

D. Sheaves and Blocks

Correct sheaves (pulleys, blocks, travelers) are a crucial element for successful installation of ACCC Conductor.



The working diameter (measured at the bottom of the groove) must meet or exceed the minimum diameter (Minimum Sheave and Tensioner Sizes Chart, Appendix A).

Tandem sheaves or 4-roller array blocks are recommended where conductor pulling angles exceed 30°.

Groove surfaces should be free of surface defects which will mark or mar the aluminum surface. Grooves may be nylon or lined with polyamide or urethane. Neoprene lining is not recommended; its high friction at line angles may not allow the conductor to settle in the bottom of the groove.

E. Tension Grips

When preparing the conductor for termination (deadending) the tension grips (clamps) must temporarily hold the conductor and the ACCC® Core.



Parallel-jaw (“Chicago”) style grips or “wedge” style clamps are required; no other styles are allowed. Grip (or grip insert) diameters must be sized correctly for the conductor diameter, and the working surfaces free from damage or contamination.

Parallel-jaw type grips must be long jaw, rated for the loads as determined by the conductor size and the project pulling and sagging tensions. Jaw length must be 185mm (7.25 inch) or greater for conductors with 21.8mm (0.858 inch) outside diameter or smaller, and jaw length must be 270mm (10.75 inch) for larger conductors

F. Hoist Hooks, Rigging

ACCC® Conductor can be damaged by using a simple hook to handle the conductor.



Hoisting or side forces in a length of conductor must not create conductor angles greater than 8° (6° for ULS), and forces must be spread using wide hooks or nylon slings.

Slings should be spread to provide for wide contact with the conductor.

G. Hand Tools

1. Ratchet Cutter or Cable Cutter

Use for rough cuts only! Never use a ratchet cutter or cable cutter for final cut.

2. Hacksaw

Use a fine tooth (24 TPI or more) blade. In all cases, the final cut of ACCC® Core must be made with a fine-tooth hacksaw

3. Cable Trimmer

Cable trimmers must be kept sharp and in good mechanical condition. Cable trimmers with (correctly selected) cut depth control bushings are preferred. A cable trimmer that cuts too deeply can nick or score the conductor core, which will result in failure.



4. Crescent Wrenches

Two (2) standard adjustable “crescent” wrenches approximately 380mm (15 inches) length will provide sufficient leverage to apply the necessary torque (115 Nm or 85 ft-lb) to Core Retainers and hardware.

5. Presses and Dies



Hydraulic press motor and press head must be of sufficient capacity to completely close the dies.

Use of press dies sized and configured correctly for both the press and the hardware, is critical for successful termination hardware installation. Die Selection Chart M181005-64 is available for guidance, but the manufacturer's hardware drawing die call-out must be followed.

Locally manufactured dies may be used **only** when approved by the hardware manufacturer, and they must conform exactly to the manufacturing drawings. Certified dies from the hardware manufacturer are always strongly recommended.

6. Consumables

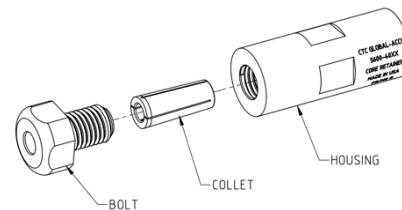
- Hacksaw Blades – Fine Tooth (24 TPI)
- Deadend Body and Splice Body Lubricant or Soap
- Electrical grease oxidation inhibitor MUST be rated for high temperature (200° C) oxidation inhibitor. This is normally supplied, and its use directed by the hardware manufacturer.

H. Special Tools

Special tools necessary for the installation of ACCC® Conductors are supplied by CTC, free of charge. Order tools on-line here: <https://ctcglobal.com/accc-special-tools-request/>

1. Core Retainer (Bug)

ACCC® Conductor is constructed with a smooth composite core surrounded by one or more layers of aluminum strands. A special fitting called a core retainer ("Bug") assures that the core and aluminum are kept the same length during tensioned stringing and that the core is accessible for termination at the end of the pull. The Bug is temporary, used only during handling and pulling/stringing and removed after the tension grips are installed.



Bugs are ACCC® Conductor specific and supplied by CTC without charge. Bugs may be re-used. Do not reuse a Bug when the nut does not screw into the body easily or if the inside collet or outer collar are worn or damaged.

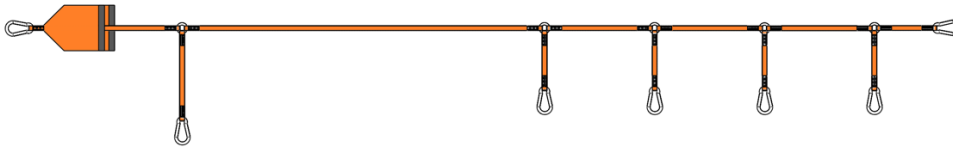
2. Core Retainer (Ring)

Smaller ACCC® Conductors may use Core Retainer Rings for the purpose of keeping core and aluminum together during stringing. Core Retainer Rings require presses and dies for installation. The rings and dies are supplied by CTC without charge, but the press equipment is not. The correct press equipment for each conductor may be found in the Tooling and Equipment Lists for that conductor, available from Master Installers or fieldservice@ctcglobal.com.



3. TDZ

CTC supplies an installation accessory to control the “free” or non-tensioned sections of conductor during deadending and splicing operations which are statistically relatively high risk for conductor damage. This function, normally performed by individual tie ropes, is accomplished by a simple length of nylon webbing with incorporated loops equipped convenient quick-release hooks. Use of the TDZ is required where they are available.



4. AZR Sleeve Installation Tool

ACCC® AZR Conductors utilize an alloyed aluminum which is harder than the standard fully annealed aluminum normally used for ACCC® Conductors. The compression ratios for compressed deadends and splices are higher, and it is necessary to insert an aluminum sleeve over the core to protect it from the higher compression forces. A special tool is needed for installing the sleeve, and CTC supplies these, no-charge.



VIII. Equipment Set-Up

A. Tensioner Placement

The tensioner must normally be placed no closer than **three times** the attachment height of the highest conductor to be pulled and the bullwheels should be aligned with the sheave at the first structure.

B. Payout Reel Placement

Minimum 10 meters is required between the tensioner and payout reel to avoid loosening of the strands between tensioner and payout reel.

The payout reel must be aligned with the tensioner (or tensioner feed sheave) to avoid scrubbing of the conductor surface against the adjacent wrap of conductor or contact with the reel flange.

C. Tensioner Feed Sheave



A sheave (meeting the minimum working diameter requirements) is required between the payout reel and the tensioner. Position the sheave to guide the conductor into the CENTER of the tensioner fairlead.

The purpose of the tensioner feed sheave is to guide the conductor into the tensioner without causing deflection at the fairlead. **The feed sheave should be positioned at any distance or position that achieves this purpose.**



The tensioner feed sheave must be positioned in the plane of the conductor path and be located far enough from the payout reel that the conductor does not scrub on the sheave flanges at the maximum fleet angles during payout.

D. Sheave Alignment



All sheaves and sheave blocks must be supported and rigged in the plane of the conductor path.

Assure that ACCC® Conductor always runs in the center of the sheave groove to avoid twisting, birdcage, and possible core damage.

Sheave block support rigging is always required at line angle structures. The rigging must be adjustable and adjusted during the pull to keep the conductor in the bottom of the groove as weight and tension changes will change the plane of the conductor path.

IX. Stringing / Pulling

A. Load Payout Reel

All normal conductor reel and drum handling safety and procedures apply. Control the free end of the conductor when it is released from its shipping constraint.



The residual energy of the coiled ACCC® Conductor can cause the end to whip as it tends to straighten, which can cause personal injury and can damage the conductor.

B. Install Bug and Pulling Grip (sock)

Install the core retainer (Bug) and pulling grip (sock) on the leading end of the new ACCC® Conductor before it is threaded through the tensioner. After the sock is in place, anchor the sock near its open end and tape the sock around the anchor and the Bug to assure that the Bug stays in the sock and to protect sheave surfaces. Otherwise, all normal requirements and procedures of working with sock grips apply.

C. Reeve the Tensioner

To avoid the conductor strands loosening as they pass over the tensioner bull-wheels, it is important to reeve (thread) the tensioner as follows:

- Right hand lay - left to right as facing the first tower
- Left hand lay - right to left as facing the first tower

D. Connect to Pulling Line



When pulling ACCC Conductor, swivels must be used at every connection to ACCC® conductor (hard line, old conductor, and ACCC®) and between every length of ACCC.

Swivels must be rated for loads and checked for proper function under tension.

E. Payout Reel – Brake Operation

Payout reel brakes should apply only the minimum tension needed to prevent over-run during a speed reduction or stop. Excessive brake tension can wedge conductor between underlying wraps, risking conductor damage. Where disc brakes are used for the payout reel it is important that a trained operator controls the brake throughout the duration of the pull. Good payout reel operation will avoid bouncing between the payout reel and tensioner and risk of damage to the conductor at the payout reel or tensioner fairlead.

F. Pulling Tension and Speed

Pulling (stringing) tension should be high enough to clear obstacles (approximately 10% of conductor rated tensile strength) and should never exceed sagging tension. The pulling speed for installing ACCC® Conductor should not exceed 5 km/h. Low pulling speeds should also be avoided as they can cause significant insulator swinging.

G. Last Tower

Don't pull ACCC Conductor through the last sheave unless puller to structure distance ratio is 3:1 or more and sheave is minimum working diameter or greater.

H. Rewinding

ACCC® Conductor may be rewound, however, it is important that crossing of the conductor wraps on the reel and excessive looseness are avoided.

I. Weather

No special considerations exist for ACCC® Conductor installation with respect to any other conductor installation, due to weather conditions.

J. Birdcage Discussion

Mild loosening and opening of the conductor strands, commonly called "birdcage" is not a failure, is not a conductor defect, but is difficult to avoid in some special situations, and can usually be corrected.

Birdcage is caused by a displacement of the aluminum strands which first appears as a loosening of the strands. In most cases, the loosening normally appears not at the source of the displacement, but where the strands are constrained near the source. If the nearest constraint is far enough away (about 10m in the case of ACCC® Conductor), the strands have room to distribute the displacement and the loosening is not noticeable.

The first cause of displacement is the result of compression of the conductor, usually the normal compression of installation of a compression sleeve – deadends and splices and compression repair sleeves. These are usually avoided by making successive compressions away from the constraint, known as back-pressing.

A second cause of displacement is the result of normal tension applied with compression grips. As the conductor on the tension side of the grip stretches the conductor, the aluminum on the non-tension side is displaced. Another grip (“short-gripped”), a Bug, or a previously installed deadend or splice can act as the constraint in this case.

A third cause is displacement of the aluminum strands by “unwinding” which can occur if the conductor is not running in the bottom of sheave or tensioner grooves. This happens particularly at line angles when the sheave is not supported in the plane of the conductor path. Unwinding can also occur as a result of failure to use or maintain swivels.

Finally, a fourth cause occurs if there is keystone in any layer of the conductor. This may allow relative movement between the layers, effectively allowing displacement of the top layer. Keystone is a defect in the manufacture of the conductor.

If loosening occurs, it often takes care of itself when the constraint is removed, allowing the displacement to re-distribute over a longer length of conductor and become unnoticeable.

The re-distribution can be assisted if necessary, by applying pulling force after the constraint has been removed. Tapping the conductor with a rubber hose can supply vibration which facilitates the re-distribution.

Never strike the conductor with wood or a hammer in an effort to address a birdcage condition. Never attempt to realign strands with a screwdriver or other tools.

Extreme birdcage, involving severe plastic deformation of the strands, cannot be corrected and must be replaced.

X. Sagging

Sagging methods used for ACCC® Conductor are identical to methods for any other bare conductor. Any of the four common methods of sagging may be used: 1) line of sight (sagging scope), 2) transit (theodolite), 3) stopwatch, or 4) dynamometer.

A. Sagging Grips

See section VII.D Tension Grips.

The tension grips used for sagging must apply sufficient clamp force to lock the core and aluminum layers together during the sagging operations.

B. Pre-tensioning

In special cases, ACCC Conductor may be pre-tensioned. Please contact your conductor supplier or fieldservice@ctcglobal.com.

C. Termination, Deadend Assembly

Deadend (and splice) assembly and pressing instructions are always included and provided by ACCC Hardware manufacturing partners and ACCC® Installation Training.



The most common installation errors with ACCC® Conductor are due to excessive bending loads at the tension grips or clamps during tension transfer or termination procedures. See section XII.2. Use TDZ, section 0.

The only unique element of ACCC® AZR Conductor installation, compared to other ACCC Conductors, is the installation of an extra sleeve during deadend assembly. Sleeves and instructions are included with deadend (and splice) hardware. A special tool is required to install the sleeve (VII.H.4). These tools are ACCC® Core specific and supplied by CTC without charge. The tools are re-useable.

D. Splicing, Mid-Span Joints

Splices should be located a minimum of 15 meters (50 ft.) from the nearest tower or another splice.

Installing an ACCC® Conductor mid-span splice is very similar to installing a mid-span splice for any common bare overhead conductor with two exceptions: a) conductor, grip, and splice handling (same issues as with deadends above), and b) pressing direction. Splices must be pressed from the short side of the conductor span toward the long side of the conductor span.

Step by step instructions for correct installation of ACCC® Conductor splices are covered in ACCC® Installation Training, are available for free download on the CTC Global website and are packaged with each splice hardware kit.

Splices may be assembled on the ground, but assembly in the air is preferred to reduce potential conductor damage due to improper handling. Splices are never allowed to be pulled through sheaves.

E. Bowing of Fittings

During compressions, care must be taken to keep both ends of the termination (deadend or splice) in line with the center line of the press dies. The aluminum becomes quite pliable as it nears maximum compression and as little as one (1) kilogram (2.2 pounds) of force on the free end can cause a slight bend at the compression. Several bends in a row result in a bowing or “banana” shape of the ideally straight assembly. Rotate the assembly 180° in the dies every two compressions to help keep the assembly straight as compressions proceed.

Slight bowing may be corrected during subsequent original compressions. During the compression cycle, and ONLY during this period, it is possible to exert light pressure to correct bowing from prior compressions. Again, one to two (1 - 2) kilograms is sufficient, for 2 to 5 compressions. Check often with a straight edge if needed. Do not stand or sit on the end - too much pressure can cause hairline fractures.

An alternative method to prevent bowing may be used: assemble the collet, housing, and eyebolt per the instructions, and then connect the eyebolt to the insulator bells. Measure the distance between the housing and the aluminum strands (should be 50mm or two (2) inches). Then slowly release partial tension on the grip. The measurement may grow; up to total of 100mm or four (4)

inches is permissible. This partial tension will assist in keeping the assembly straight during compressions.

Maximum allowable bowing is one-half ($\frac{1}{2}$) conductor diameter for deadends and one (1) conductor diameter for splices. Measure by placing a straight edge from end to end of the fitting and measure at the point of maximum bow. Some utilities have different minimum requirements. Use the more stringent straightness requirement.

Never attempt to straighten a bowed fitting after it has been compressed. This can cause micro cracks in the work-hardened aluminum which can lead to eventual mechanical failure of the fitting.

F. Sagging Procedures

Tension grips should be placed a minimum of 4 meters (13 ft.) from the end of the insulator to provide working room to install the deadend hardware and avoid birdcage. Install a split rubber hose over the conductor to protect the aluminum from the rigging. Use small ropes to fasten the free end of the conductor to the rigging.

The fully annealed aluminum used for ACCC® Conductors (except ACCC® AZR Conductor) requires small but important modifications to sagging procedures. The annealed aluminum elongates under tension load (creeps) much more quickly than aluminum alloys found in conventional conductors. To allow for this higher creep rate, one of the two following sagging procedures must be followed:

1. Preferred Sagging Procedure

- Step 1 Connect the soft side dead-end and apply at least 90% of initial sag chart tension, but DO NOT EXCEED initial sag chart tension.
- Step 2 Allow the conductor to remain at this tension for at least 10 hours or overnight. If sagging must be completed the same day, then subtract 5° C (9° F) from the conductor temperature in the sagging chart.
- Step 3 After 10 hours or after the temperature adjustment has been made, apply sag chart initial tension and install the hard side dead-end.



For bundled applications, sub-conductors must follow these steps within 15 minutes of one-another OR use the following Alternate Sagging Procedure.

2. Alternate Sagging Procedure

This optional, alternate procedure may be used for bundled applications when sub-conductors have not been pulled simultaneously or brought up to the target sag within 15 minutes of each other.

- Step 1 Assemble and connect the soft-side dead-ends and apply AT LEAST 90% of initial sag chart tension to all sub-conductors, but DO NOT EXCEED initial sag chart tension.
- Step 2 After the last conductor of the bundle has been pulled into position, allow ALL the sub-conductors in the bundle to remain at this 90% tension for AT LEAST 72 hours after initial sag chart tension has been applied to the LAST sub-conductor pulled. (See section XI.B for extended time in sheaves.)

Step 3 After a minimum of 72 hours re-apply sag chart initial tension, mark and install the hard side dead-ends.

Step 4 Make final adjustments to match sag of all sub-conductors using turnbuckles or sagging links.

XI. Auxiliary Hardware, Clipping, Spacers

A. Auxiliary Hardware



All fittings and auxiliary hardware in contact with ACCC® Conductor while in service must be rated for ACCC® temperatures and approved by CTC Global for use with ACCC®. The current list of approved hardware, manufacturers, and part numbers may be found on the CTC Global website: <https://www.ctcglobal.com/accc-hardware-suppliers-parts-database/>

B. Clipping

IEEE 524 recommends the total time that conductors are allowed to remain in the stringing blocks, from installation until clipping, should not be more than 72 hours. If high winds are experienced while the conductor is in blocks or the 72 hour time limit is exceeded, the conductor should be inspected (especially where the conductor makes contact with the stringing blocks) for damage to determine if any of the strand wires were flattened or broken from winds buffeting the conductor while sitting in the blocks. There is also the potential that conductors sitting in the blocks under tension and without dampeners may be subjected to Aeolian vibration damage.

Conductor hose or tie-downs can help prevent conductor damage from wind.

C. Spacers

Small sag differences between sub-conductors in bundled applications can be visible and detract from the appearance of a good installation. Keep weight loads on sub-conductors even during the installation of spacers and follow spacer installation instructions exactly.

D. Spacer Carts



Devices supporting personnel (spacer carts or buggies, baker boards, ladders, or working platforms) must never create a conductor angle greater than 8° (6° for ULS) where the equipment touches the ACCC® Conductor.

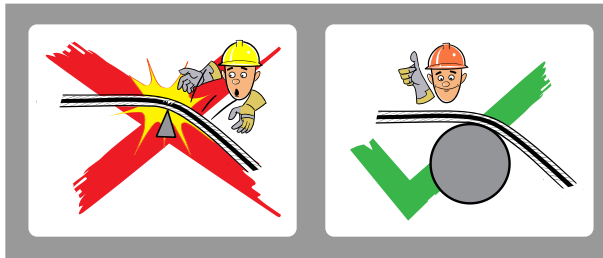
XII. Do's and Don'ts



These are not the only don'ts. All of the don'ts that apply to installing any bare overhead conductor also apply! These five don'ts are specific to ACCC® Conductor:

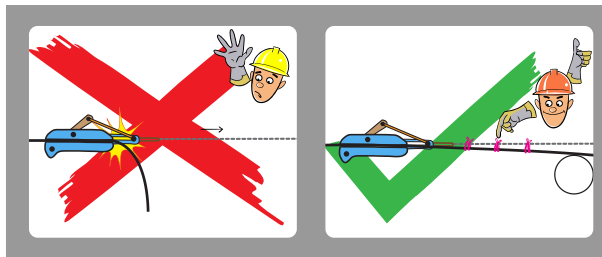
1. DON'T OVER-BEND!

Don't allow the conductor to contact surfaces that present sharp angles or small diameters.

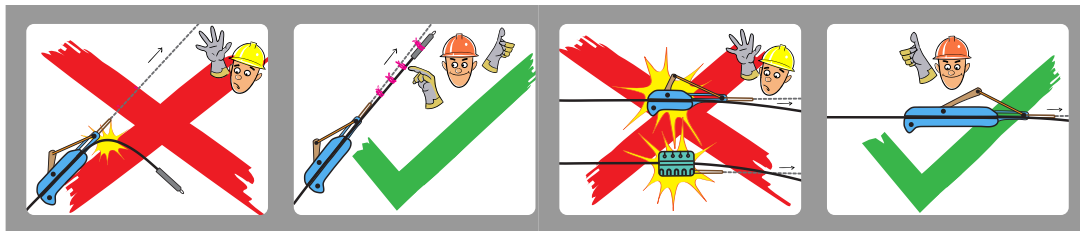


2. Tension Grip DON'Ts:

Don't allow the conductor tail or the deadend to fall or droop unsupported while handling the conductor. If the tail is not controlled, it will damage the core at the back of the grip.

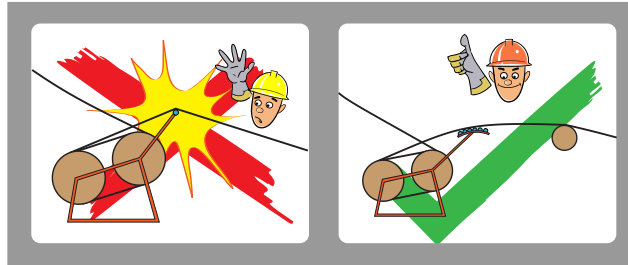


Don't allow the conductor tail or the deadend to fall or droop unsupported while handling the conductor. If the tail is not controlled, it will damage the core at the back of the grip. Don't use pocketbook grips or short-jaw parallel jaw grips.



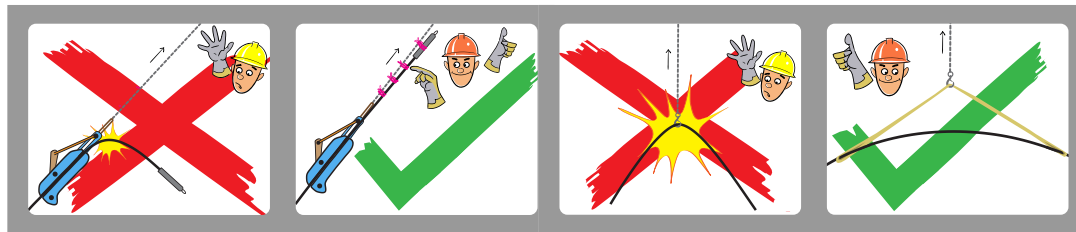
3. Fairlead DON'T:

Don't let ACCC Conductor run hard against any roller of the fairlead. Always use a tensioner feed sheave (meeting minimum sheave diameter requirements) between the payout reel and tensioner to guide the conductor into the middle of the tensioner fairlead opening.



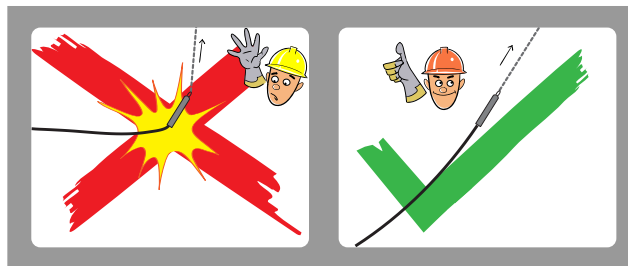
4. Handling DON'T:

Don't hoist or handle the conductor in any manner which causes a sharp bend in the conductor.



5. Termination DON'T:

Don't allow a sharp bend where the conductor exits the termination hardware. Hoisting conductor or deadend without paying attention to this area can damage the core at that point.



Appendix A – Minimum Bending Diameters

ACCC® Conductors (Includes AZR versions where applicable)

ACCC® Core Diameter		International Name	ASTM Name	Minimum Sheave Working Diameter		Minimum Tensioner Bull Wheel Diameter	
millimeters	inches			millimeters	reference inches	millimeters	reference inches
5.97	0.235	Skadar Rijeka Silvassa Helsinki Copenhagen Rovinj Gdansk Zadar	Linnet Oceanside	511	20.1	1000	39.4
7.11	0.280	Reykjavik Casablanca Lisbon	Oriole Laredo Hawk	610	24	1200	48
7.75	0.305	Jalpur Glasgow Amsterdam Cordoba	Waco Dove	650	25.6		
8.13	0.320	Brussels	Grosbeak	700	27.6		
8.76	0.345	Oslo Stockholm Warsaw Hamburg Milan Vienna Prague Bangkok Paris	Irving Lubbock Galveston Piano Corpus Christi Cardinal El Paso Bittern	800	31.5		
9.53	0.375	Leipzig Calgary Dublin Kolkata Rome Budapest Mumbai Munich Dhaka	Amarillo Drake Arlington Fort Worth Beaumont				
9.78	0.385	London Antwerp Madrid	San Antonio Dallas Lapwing				
10.54	0.415	Monte Carlo Vancouver Warwick Toronto Mahakam Bordeaux Berlin Athens	Curlew Houston Falcon Bluebird	880	35		

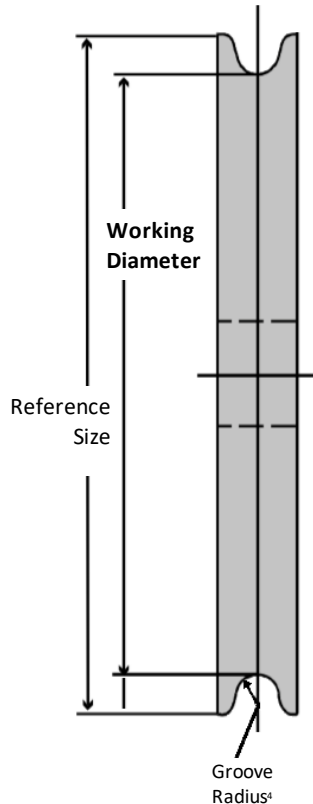
ACCC® ULS Conductors (Includes AZR versions where applicable)

ACCC® Core Diameter		International Name	ASTM Name	Minimum Sheave Working Diameter		Minimum Tensioner Bull Wheel Diameter	
millimeters	inches			millimeters	reference inches	millimeters	inches
8.76	0.345	ULS Galway ULS Oslo ULS Warsaw ULS Stockholm ULS Hamburg ULS Milan ULS Prague ULS Warsaw ULS Vienna ULS Paris	ULS Irving ULS Lubbock ULS Galveston ULS Piano ULS Corpus Christi ULS El Paso ULS Bittern ULS Cardinal	1020	40	1500	59
9.53	0.375	ULS Leipzig ULS Calgary ULS Kolkata ULS Dublin ULS Rome ULS Budapest ULS Mumbai ULS Munich ULS Dhaka	ULS Drake ULS Arlington ULS Fort Worth ULS Amarillo ULS Beaumont	1200	48	1600	63
9.78	0.385	ULS London ULS Antwerp ULS Madrid ULS Algiers	ULS Dallas ULS San Antonio ULS Lapwing				
10.54	0.415	ULS Mahakam ULS Monte Carlo ULS Ganga ULS Warwick ULS Vancouver ULS Bordeaux ULS Toronto ULS Berlin ULS Athens	ULS Curlew ULS Houston ULS Falcon ULS Bluebird				

Notes:

1) Diameters above are WORKING diameters, measured at bottom of groove, see page 2

Appendix A – Minimum Bending Diameters (continued)

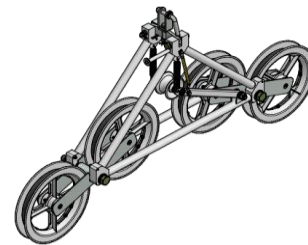
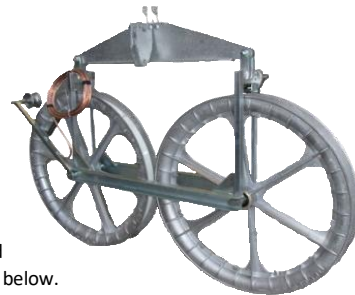


NOTES

- 1) Minimum Working Diameter is **REQUIRED** for first and last structure, and structures where stringing path is other than structure to structure (ex: where a splice is made on the ground and then let up).
- 2) Minimum Working Diameter is **RECOMMENDED** for tangent structures. Smaller tangent sheave sizes may be considered where conductor stringing angles are less than 10° and tension is less than 20% of conductor rated tensile strength (RTS).
- 3) Tandem Minimum Working Diameter blocks are **RECOMMENDED** for conductor stringing angles of 30° or more.
- 4) ULS Conductors: Minimum Working Diameter is **REQUIRED** for all structures.
- 5) Groove Radius is **REQUIRED** minimum 0.55 times conductor diameter.
- 6) Smooth groove surface condition is **REQUIRED**. Neoprene, nylon, or urethane groove linings are **RECOMMENDED**.
- 7) All Sheave Blocks are **REQUIRED** to be rigged and pivot in the plane of the conductor path.

MULTIPLE ROLLER ARRAYS

- 1) All roller Arrays are **REQUIRED** to be rated for loads.
- 2) All roller Arrays are **REQUIRED** to be rigged and pivot in the plane of the conductor path.
- 3) Tandem (2-roller) arrays with **UNDERSIZED** rollers are allowed up to the tensions and one-half of the angles listed in 5) and 6) below.
- 4) 4-roller arrays are **REQUIRED** with pivoting 2-roller sub-frames.
- 5) 4-roller Arrays are **ALLOWED** substitute for Minimum Working Diameter for ACCC® Conductors:
 - a) 52° conductor angle and up to 15% RTS
 - b) 36° conductor angle and up to 20% RTS
 - c) 32° conductor angle and up to 25% RTS
- 6) 4-roller Arrays are **RECOMMENDED** for ACCC® ULS conductors up to:
 - a) 32° conductor angle and up to 15% RTS
 - b) 28° conductor angle and up to 20% RTS
 - c) 25° conductor angle and up to 25% RTS



Revision History

Revision	Release Date	Description
A	April 2020	Replaces WI-750-070 (Chapter 1 General Guidelines) WI-750-071 (Chapter 2 Safety) WI-750-072 (Chapter 3 Training) WI-750-073 (Chapter 4 Reel Handling and Storage) WI-750-074 (Chapter 5 Site Considerations and Set-ups) WI-750-075 (Chapter 6 Required Equipment) WI-750-076 (Chapter 7 Stringing / Pulling) WI-750-077 (Chapter 8 Terminations, Sagging, and Suspending)
B	July 2020	Appendix A (M181005-62-A Replaced by M181005-62-B)
C	May 2023	Add to Introduction: <i>"Individual utilities or contracts may include restrictions or requirements not covered or more stringent than in these guidelines. Where these do not conflict, they should take precedence over the guidelines."</i> Add to Introduction: Grounding sentence and reference Renummer Section IV Storage to Section IV A Add Section IV (was V) B: Drum Handling Add to Section VI (was VII) A: <i>"When unapproved hardware is used on ACCC Conductor, please note the hardware section of Installation Training is eliminated and any associated ACCC Conductor Warranty is invalidated."</i> Add to Section VI (was VII) C, Paragraph 2: <i>"...and on the trailing end for multiple drum pulls."</i> Replaced Section VI (was VII) F: <i>"when needed,"</i> with: <i>"than other conductors;"</i> Add Section VI (was VII) H: InfoCore Insert Section VII (was VIII) G: TDZ Change Section VII E to recommend against neoprene sheave liners Section VII (was VIII) H (was G): Reduced from 10° to 8° Add to Section VIII (was IX) D: <i>"Sheave block support rigging is always required at line angle structures. The rigging must be adjustable and adjusted during the pull to keep the conductor in the bottom of the groove as weight and tension changes will change the plane of the conductor path."</i> Remove from Section IX (was X) E: <i>"...can cause distortion of the reel flanges and lead to permanent reel damage. It can also..."</i> Add to Section X (was XI) G: <i>"Use TDZ, section 0"</i> Add Section X D: Splices / Mid-Span Joints Add Section X E: Bowing of Fittings Removed "ACCC® Conductor Specifications F-750-315" from referenced documents Replaced Appendix A with M181005-62 D
D	February 2025	- Added Section VII D: Special Tools for Core Retainer, Core Rings, TDZ, and AZR Hammer Tool. - Revised Section VIII.A Tensioner Placement.