KINGDOM OF CAMBODIA

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# ELECTRICITE DU CAMBODGE

## TECHNICAL POLICY

## EDC-TP-005

## LV Aerial Bundled Conductors Overhead Lines Construction

May 2023

**ELECTRICITE DU CAMBODGE**

| Version | Date | Technical Specification Name | Authorized by : (name and signature) |
|---|---|---|---|
| 1.0 | May, 2023 | LV Aerial Bundled Conductors Overhead Lines Construction | AUN HEMRITH |

| Version | Drafted/reviewed by | Verified by | Approved by | Date |
|---|---|---|---|---|
| Draft1 | AD | | | July 2017 |
| Draft 2<br>Final 1 | AD<br>AD | | | Dec 2021<br>Nov 2022 |
| Final 2 | AD/EDC | | | Feb 2023 |
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# Content

# LV Aerial Bundled Conductors Overhead Lines Construction

## 1 General Provisions

### 1.1 Scope of Application

The execution of Low Voltage Aerial Bundled Conductors Overhead Distribution construction works is subject to this policy.

However, are not applicable the provisions which not comply with the provisions of a contract between EDC and a contractor where the specific provisions prevail, in non-conformity coming from a derogation, explicit or not, or a divergence of interpretation.

### 1.2 Designation of the Parties

In this document, Electricité du Cambodge is designated by EDC and the company responsible for the construction work by the term: Contractor.

### 1.3 Documents Submitted to the Contractor by EDC

In case the OHL studies are already carried out, EDC provides the Contractor with the complete studies file including at least:

- the map (flat plan and cross section drawing etc.,)
- the study of the line on a line profile only in case there is soil level difference of more than 10 m between any point of the overhead line.
- the plot map with the precise indication of the pole positions, and the identification of neighboring buildings, roads, rivers, other lines, etc... in particular if they are underground;
- the pegging book with the details of the materials and equipment to be implemented
- the list of owners and operators with the reference numbers of the corresponding parcels

This file is accompanied by the authorization to construct and the table of ABC (aerial bundled conductors) sagging and tension in accordance with the temperature of installation.

Finally, EDC gives the contractor a copy of all maps and drawings (calk or AutoCAD ©) included in the study file.

The contractor then takes responsibility for the good conservation of these calks. In the event of deterioration, their restoration or replacement will be at his own charge.

In the event the studies are not yet carried out, it is of the Contractor responsibility to carry out those studies as per the EDC requirements.

The contractor shall then get the EDC approval for the studies he carried out.

# 2 Distribution of Supplies and Work between EDC and the Contractor

## 2.1 Supplies

### 2.1.1 Supplies Provided by EDC

Supplies when provided by EDC are specified in the contract or order.

### 2.1.2 Contractor Supplies

All supplies that are not explicitly provided by EDC are provided by the Contractor. The equipment: poles, LV ABC as well as all mechanical and electrical accessories must be approved by EDC and been strictly in accordance with EDC technical specifications (EDC-DTS-....) requirements.

## 2.2 Works Done by the Contractor

They Include:

1. The resumption of alignments and the check for errors, omissions and obvious contradictions;
2. The materialization of the implantation of the supports on the ground according to plot plan and eventually the Line profile;
3. The execution of the works of tree pruning and felling before the work construction starts;
4. Receiving and unloading at destination, storage, handling, transportation and lay-off of equipment and supplies of any kind necessary for the construction of the overhead line.
5. The transport, handling, storage and lifting of poles,
6. Assembling and installation of all mechanical ABC accessories,
7. Unwinding, tensioning and sagging of ABC, including installation of mid-span pre-insulated junction sleeves sets, if necessary;
8. Installation of all connection for the main ABC
9. Installation of the "Danger of Death" plates and all other nameplates as well as pole reference plot plan number if requested,
10. The making of complete neutral earthing and any earthing improvements;
11. Loading and transport at the locations designated by EDC of the unused or recovered equipment
12. All work shall be carried out even after completion of the line in order to ensure that the installation meets all prescriptions of the regulations in force, and that the commitments made with the owners and operators, and which the contractor had knowledge, are respected;
13. The special arrangements necessary, for example, for the implementation of road crossings, waterways, railways, power lines and telecommunications, overhanging houses. Etc.;
14. The settlement of the instantaneous damages provided for in paragraph 19 of this document.

It is recalled that this list is not exhaustive. The Contractor shall perform all work not explicitly mentioned, and bear all constraints arising from the complete construction of the line, which must be ready for a full commissioning under normal operating conditions.

# 3 Organization of Work

## 3.1 Reconnaissance of the Line Path

During the examination of the documents handed over by EDC or after some surveys and topographical surveys that the contractor is required to make on the field for the normal performance of the work

entrusted to it, the Contractor shall notify EDC Errors, omissions or obvious contradictions and, in particular, if the pole height is insufficient to hold the ABC at the minimum ground clearance or neighboring facilities indicated in the General Requirements of Electric Power Technical Standard of the Kingdom of Cambodian (PROKAS) in force.

The Contractor is liable for errors, omissions or manifest contradictions that must not escape to person "skilled in the art" if he did not report them to EDC in due course.

Then the contractor will bear the additional costs incurred in connection with travel and modifications of the supports. The delays which may result will be charged.

## 3.2 Delivery and Receipt of Equipment

The Contractor shall, in due time, approve the quantities of equipment provided by EDC (if any).

Receipt and verification of equipment is contradictory between EDC and the contractor at the place of delivery and minutes of receipt shall be sign by both parties.

Handling and transport from EDC warehouse to places of delivery, storage and guarding of the equipment supplied by EDC are at the expense of the contractor.

## 3.3 Mounting of Equipment

The contractor ensures that the received equipment allows correct assembly.

He remains responsible for EDC that the assembly of the equipment used by him, which would not conform to the type laid down by EDC and which he omitted to report EDC upon receipt.

## 3.4 Updating / As-Built of Final Documents

Within a maximum of two months after the completion of the work, the contractor must rectify the various existing plans and documents in order to make them conform to the characteristics of the completed network.

The Contractor delivers to EDC the original calks or AutoCAD © drawing as well as two complete files. Those files shall be considered as "as built drawings".

## 3.5 Safety and Accident Prevention

All work shall be undertaken with close attention to high standards of safety to works, the public, and to the Employer's and other owner's plant equipment.

### 3.5.1 Safety and Risk of Third-Party Accidents

The Contractor shall manage on its own cost and responsibility all the necessary measures to avoid traffic or third party's accident.

Indeed, a significant part of the work is to be performed in villages or near roads. This work may lead to risks of third party's accident. Also, the phasing of implementation and the method of work will be absolutely established right from the start of work in consultation with the Employer, the authorities managing the public space and the roads and representatives of neighborhoods so that all precautions are taken (public information, signage, barriers, lighting, temporary detour traffic, if necessary, etc...) to reduce traffic disturbances and accidents of the population.

### 3.5.2 Safety of Employees

All of the Contractor's personnel shall be effectively trained and competent in safe working practices that must be adhered to at all times. All personnel shall be issued with and use at all time's relevant personal and work gang related safety equipment that shall be maintained in good order and condition by the Contractor.

The contractor will mandatorily provide all personal protective equipment (helmet, gloves, safety shoes, safety belts or harnesses, specific protections, etc. ...) to its field staff, but also to temporary staff that it may need to be employed.

Similarly, as responsible for the security of its staff, the Employer will provide all the collective protection equipment such as absence of voltage indicators, earthing and short circuit, warning danger banners, etc.

It will also ensure that individual and collective protective equipment is utilized and checked periodically.

# 4 Technical Conditions of Implementation

## 4.1 Poles, Guys Foundations and Pole Erection.

Refer to technical Policy: EDC-TP-008: Poles and guys (stays) implementation.

# 5 Anchor Dead End and Guys

Anchor dead ends and guys shall be installed before the conductors are installed. The alignment and tension of the guy wires shall be such as to ensure that the guys correctly carry the design loads and that pole are plumb at the completion of the works. The guying equipment shall be in accordance with the requirements of EDC-DTS-MV016 EDC standard.

# 6 Neutral Earthing

All neutral earthing is implemented as per the requirements of General Requirements of Electric Power Technical Standard of the Kingdom of Cambodia and as per EDC-TP-002- EARTHING for MV and LV distribution networks technical policy and annexes.

## 6.1 Repartition of LV Neutral Earthing

### 6.1.1 Distance from the MV/LV Substation Mass Earthing

In case of **complete** MV underground network from the HV/MV substation to the distribution substations, as this network is not subject to atmospheric current (surges) and if the global earthing value of the whole MV network is less than 1 Ω, the LV neutral earthing can be connected to the distribution substation mass earthing. Anyway, other LV neutral earthings must be installed as per figure 1.

In case the MV network is overhead, as this one is subject to be hit by a stroke, the LV neutral earthing **shall NOT be connected to the MV/LV substation mass/arresters earthing**. So, in order to avoid electrical coupling between mass and LV neutral earthing a minimum distance depending of the soil resistivity shall be applied as follow:

| Soil resistivity (Ω.m) | ≤ 300 | ≤ 500 | ≤ 1000 | > 1000 |
|---|---|---|---|---|
| Distance (d) in meter | 8 | 16 | 24 | To be studied case by case |

Distance between LV Neutral Earthing

At the minimum, a LV neutral earthing must be done according the following conditions:

- In more than one point if the length of the LV feeder exceeds 100 meters
- with a minimum average number of earthing of the LV neutral of one for 200 meters of feeder network.

In practice, the LV neutral is earthed at the following locations:

- to the first pole after the MV/LV substation;
- at all the network ends;
- to each star point or tap line;
- close to major customer connection nodes.

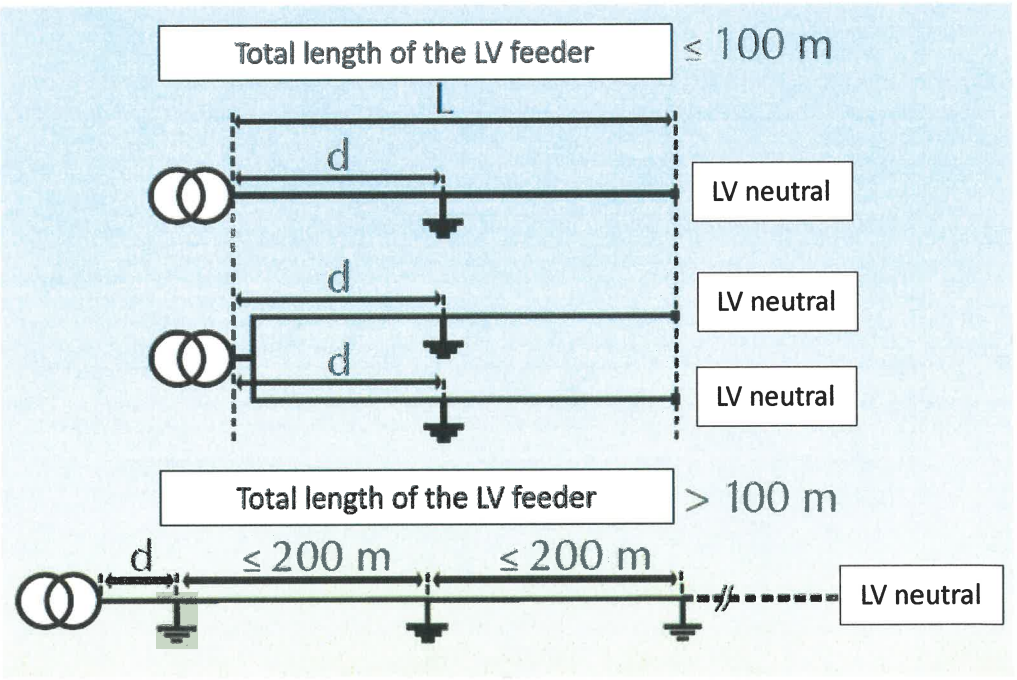



Figure 1: Distance between LV neutral earthing

## 7 Installation of LV Aerial Bundled Conductors (ABC)

The object of the present chapter is to describe and detail:

- methods,
- personnel and equipment resources,

for the installation of low voltage aerial bundled conductors.

It is especially intended for those responsible for the work of teams carrying out these operations; it also concerns study and supervision personnel.

## 7.1 Basic Principles

Muscular effort required by the workers must preferably be applied at ground level (see Figure 2). Effort expended by a fitter must not exceed 50 daN ; this effort corresponds to the mechanical strain of a 3x70 mm² + 1x70 mm², LV ABC for a span of 50 meters with a sag of 6 meters.

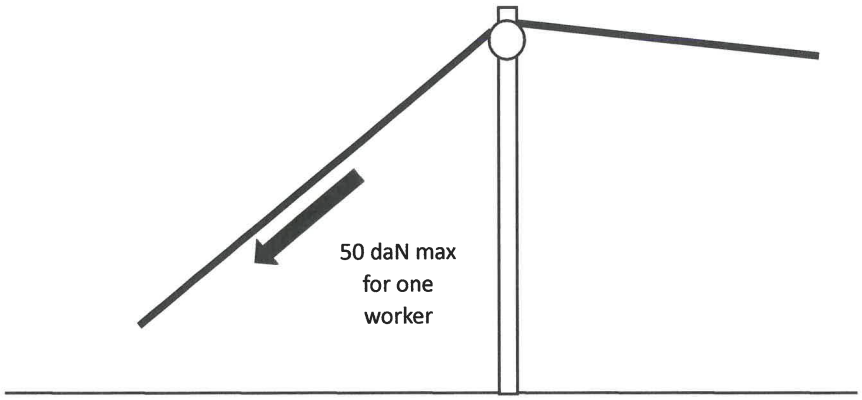



Figure 2: Maximum effort required by the workers

- Climbing the poles must be reduced to the minimum.
- In the course of work, if it turns out that abnormal strain is likely to be exerted on the poles, the team leader must account for this and guy ropes must be used.
- Tools are studied and sized to meet efforts applied during installation of the bundles.
- Reminder: The center of gravity of exertion applied to a pole must be at least 0,25 from the top.

## 7.2 Terminology

### 7.2.1 LV ABC

All three phase conductors in 3/4 hard aluminum, of 70 mm² or 150 mm² cross-section, insulated in black chemically crosslinked polyethylene, twisted around a neutral bearer conductor in aluminum alloy of 70 mm² cross-section also insulated in crosslinked polyethylene.

The ABC cable and all mechanical accessories are conformed to the requirements of EDC-DTS-LV001 and LV002.

### 7.2.2 Span (Figure 2)

Horizontal distance " *a* " between two consecutive poles.

### 7.2.3 Cable Sag (Figure 2)

Vertical distance "*f*" between the middle of a straight-line AB linking the two fixation points of the ABC and the point of contact of the parallel to AB.

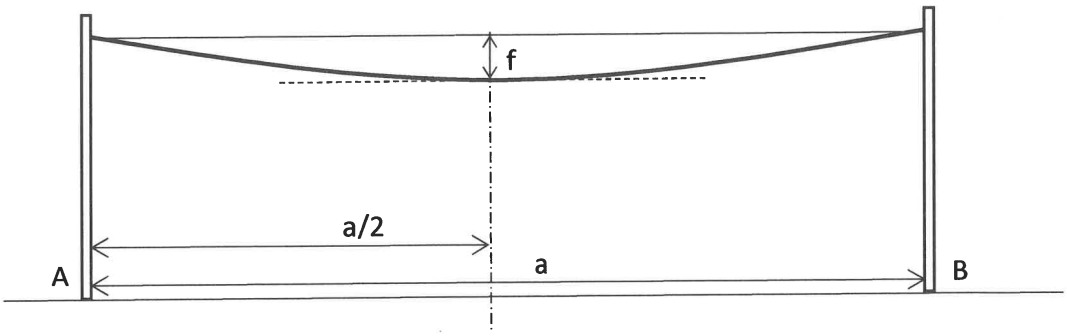



Figure 3: Conductor Sag and Span representation

### 7.2.4 Line adjustment

For correct tension ABC adjustment, the traction to be applied and the sag to be respected are defined in the following tables:

| Adjustment parameters for 3x70mm²+ 70mm² Neutral | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Span length (m) | Neutral mechanical tension (kN) | | | | | Sag (m) | | | | |
| | 20°C | 25°C | 30°C | 35°C | 40°C | 20°C | 25°C | 30°C | 35°C | 40°C |
| 20 | 1.78 | 1.34 | 1.12 | 0.98 | 0.88 | 0.15 | 0.199 | 0.239 | 0.273 | 0.303 |
| 25 | 2.23 | 1.67 | 1.40 | 1.23 | 1.10 | 0.188 | 0.249 | 0.298 | 0341 | 0.378 |
| 30 | 2.50 | 1.94 | 1.63 | 1.44 | 1.30 | 0.240 | 0.311 | 0.368 | 0.417 | 0.461 |
| 35 | 2.50 | 2.05 | 1.77 | 1.59 | 1.45 | 0.327 | 0.400 | 0.461 | 0.515 | 0.564 |
| 40 | 2.50 | 2.13 | 1.89 | 1.71 | 1.58 | 0.427 | 0.501 | 0.566 | 0.624 | 0.677 |
| 45 | 2.50 | 2.20 | 1.98 | 1.82 | 1.69 | 0.540 | 0.616 | 0.683 | 0.744 | 0.801 |
| 50 | 2.50 | 2.25 | 2.05 | 1.90 | 1.78 | 0.667 | 0.743 | 0.813 | 0.877 | 0.936 |

| Adjustment parameters for 3x150mm²+ 70mm² Neutral | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Span length (m) | Neutral mechanical tension (kN) | | | | | Sag (m) | | | | |
| | 20°C | 25°C | 30°C | 35°C | 40°C | 20°C | 25°C | 30°C | 35°C | 40°C |
| 20 | 1.78 | 1.58 | 1.43 | 1.32 | 1.23 | 0.250 | 0.282 | 0.311 | 0.338 | 0/362 |
| 25 | 2.23 | 1.97 | 1.78 | 1.64 | 1.53 | 0.312 | 0.353 | 0.389 | 0.422 | 0.453 |
| 30 | 2.50 | 2.24 | 2.05 | 1.90 | 1.78 | 0.399 | 0.445 | 0.487 | 0.525 | 0.561 |
| 35 | 2.50 | 2.31 | 2.15 | 2.02 | 1.91 | 0.544 | 0.590 | 0.633 | 0.674 | 0.712 |
| 40 | 2.50 | 2.35 | 2.22 | 2.11 | 2.01 | 0.710 | 0.757 | 0.801 | 0.843 | 0.883 |
| 45 | 2.50 | 2.38 | 2.27 | 1.17 | 2.09 | 0.899 | 0.946 | 0.991 | 1.034 | 1.076 |
| 50 | 2.50 | 2.40 | 2.40 | 2.23 | 2.15 | 1.109 | 1.157 | 1.203 | 1.247 | 1.289 |

### 7.2.5 Installation Section

Part of network between two anchorages. An installation section may comprise one or more spans.

### 7.2.6 Installation Table

This gives, for each installation section, taking into account the ambient temperature, the tensile effort to be applied to the neutral bearer of the bundle to obtain the adjustment sought.

It can be established with software such as CAMELIA or other and figures on the construction project of the civil engineering. Example (See Figure 4)

| INSTALLATION TABLE | | | |
|---|---|---|---|
| **Type ABC: 3 x 70 mm² + 1 x70 mm² N** | | | |
| Temperature | Tensile effort in daN | | |
| | Section N° 1 | Section N°2 | Section N°3 |
| 5 | 299 | 219 | |
| 10 | 280 | 216 | |
| 15 | 264 | 214 | |
| 20 | 249 | 211 | |
| 25 | 235 | 209 | |
| 30 | 223 | 206 | |

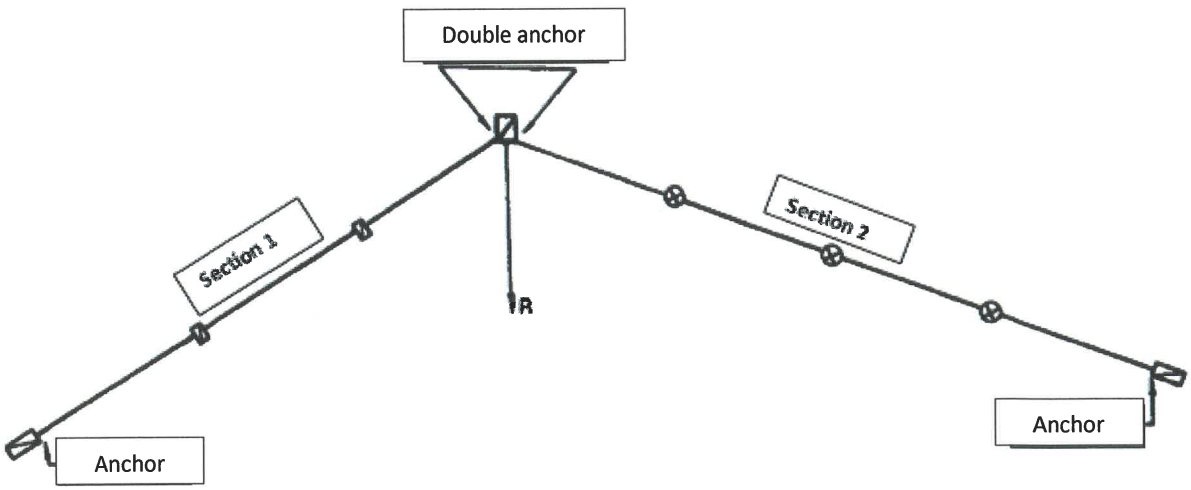



Figure 4: Example of line with 2 sections

## 7.3 Unrolling

### 7.3.1 General Principle

Unrolling of the bundle is generally made under mechanical tension.

Nevertheless, it may be carried out manually for the 3 x 70 $mm^2$+ 70 $mm^2$ N and 3 x 150 $mm^2$ + 70 $mm^2$ N ABC in the case of site work limited to several hundred meters with maximum spans of 50 meters.

### 7.3.2 General Rules

#### 7.3.2.1 Disposition of cable drum

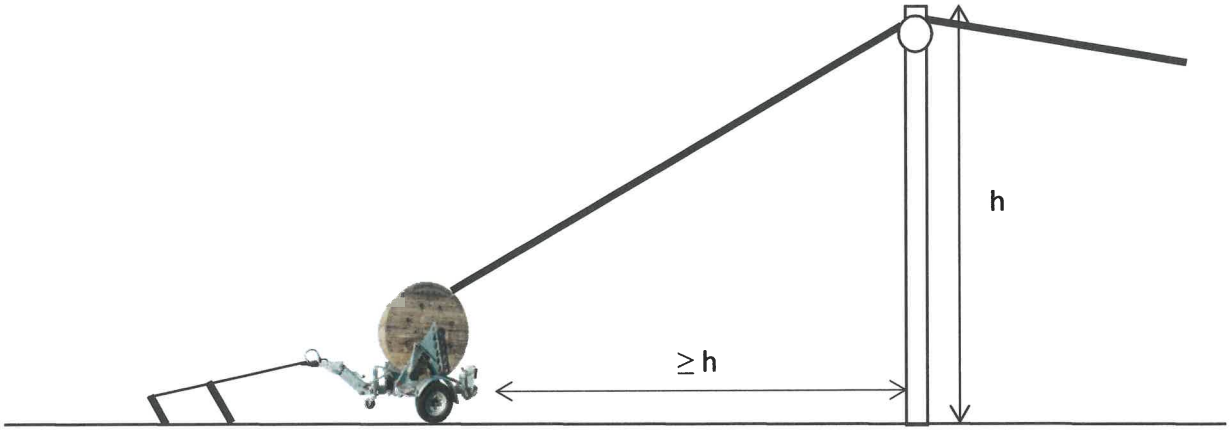



Figure 5: Minimum distance drum unrolling from the pole ( ≥ h )

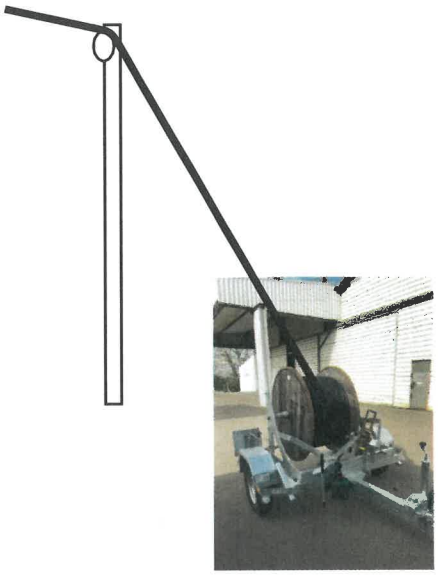


Figure 6: The drum is aligned with poles in order to avoid any rubbing of the bundle on the pole

The drum is placed preferably next to the pole on which final adjustment will be made.

- The drum is placed at a distance from the pole at least equal to the height (h) of this pole (See Figure. 5).
- It is off-set from the line axis, on the pulley payout side to avoid any rubbing of the bundle on the pole (See Figure. 6)
- In the case of pronounced slopes, the cable drum is placed at the highest point, on a cable drum trailer with mechanical drum braking system (See Figure 7).

Figure 7: Cable drum trailer with mechanical drum braking system

### 7.3.3 Unrolling Conditions

- The bundle must not drag along the ground during payout operations.
- Drum rotation is controlled by a technician, and the brake applied if necessary.
- Passage of obstacles (telephone cable layers, road crossings, etc.) require special supervision
- Payout is made smoothly.
- As soon as the last layer appears, the technician in charge of control of the cable drum, ensures that the cable end is fixed to the cable drum to avoid the bundle slipping off.
- At a minimum of three spires from the end, the bundle is held back (See Figure 8).

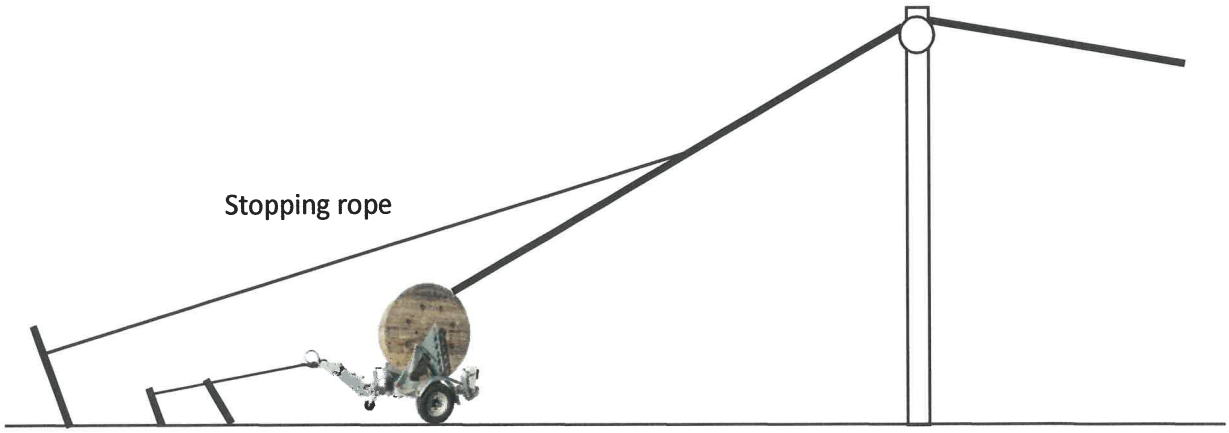



Figure 8: Unrolling conditions

### 7.3.4 Unrolling Equipment

#### 7.3.4.1 Unrolling pulleys

Figure 9: Sample of unrolling pulleys

The pulleys are fixed on the poles in such a way that the bundle is more or less at the level of the suspension bracket.

The purpose of this device is:

- to facilitate positioning on clamps in the case of alignments,
- and to avoid upset adjustment when positioning angle clips

#### 7.3.4.2 Pulling cord

- A polyester cord, 10 mm in diameter and 30 meters long for manual payout,
- Plaited polyamide cord, 12.7 mm in diameter and 300 meters long for mechanical winch payout.

#### 7.3.4.3 Link between cord and bundle

The link between cord and bundle is made up of a set (See Figure 10) comprising of:

- a metal cable support sleeve fixed on the cord, intended to remove any knot which weakens cord resistance;
- a metal cable support sleeve on the neutral bearer;
- a sprocket wheel;
- a sleeve in synthetic material covering the bundle. It eases passage in the pulleys and allows the payout to a point near the naked live LV conductors.

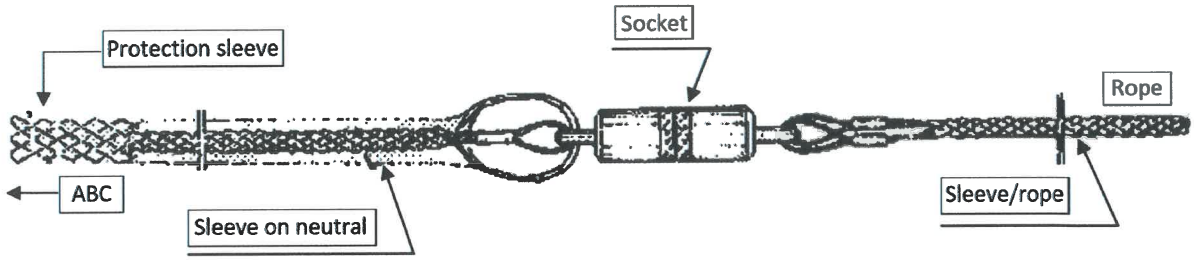



Figure 10a: The link between cord and bundle is made up of a set

Figure 10b: Sample of set

### 7.3.4.4 Capstan

Use either:

An electric or engine powered capstan fitted to certain work lifts (trucks), or a removable capstan.

Figure 11a: Engine powered capstan

Figure 12b: electric powered capstan

### 7.3.5 Manual Payout

#### 7.3.5.1 Domain of application

This method is applicable for 3 x 70 mm² and 3 × 150 mm² bunched conductors on work sites limited to several hundred meters with spans of less than or equal to 50 meters, without any major obstacle to be crossed in full span.

This payout is made by a minimum of five technicians:

- One in charge of the cable drum,
- The others to ensure payout operations.

#### 7.3.5.2 Position of cable drum

The drum is placed on a cable-drum trailer (See figure 12). Practices such as drum rolling or contact roller drums are not recommended.

Figure 13: Cable drum trailer

#### 7.3.5.3 Rotation direction of drum

Payout of the bundle is made from the top of the drum (See Figure 13).

Figure 14: Rotation direction of drum

### 7.3.5.4 Breaking of the cable drum

On fairly flat ground, a fitter can break the drum manually without any special device.

On the contrary, a cable-drum trailer with a mechanical drum braking system could be used.

### 7.3.5.5 Payout

Payout is made using a cord, 10 mm diameter, about thirty meters long, anchored to the bundle by means of a sleeve covering the whole bundle. This cord, previously passed through the payout pulleys, is pulled by the technicians at ground level.

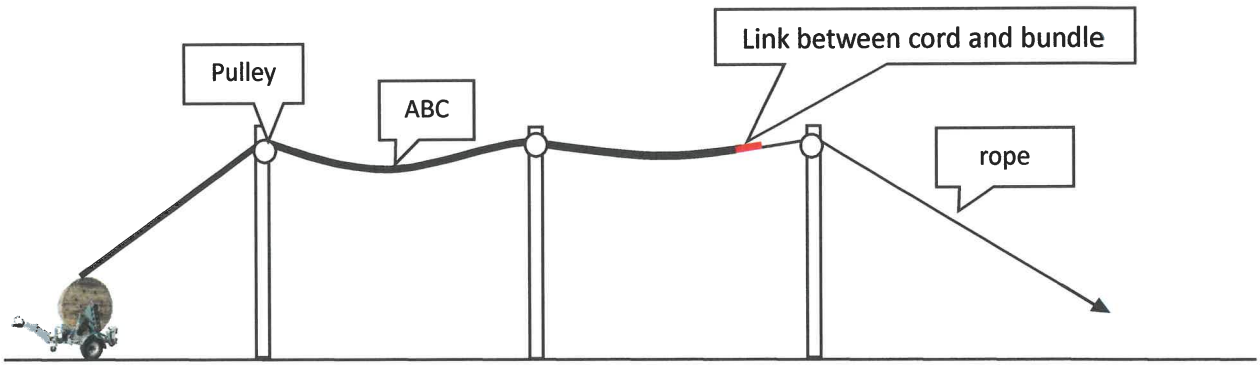



Figure 15: LV ABC cable laying

### 7.3.5.6 Completion on the first anchorage

The anchor clamp is positioned, at ground level, on the neutral messenger, taking into account the length necessary for the electric connection.

Payout cord is fixed near to the anchorage clip to facilitate anchoring on the bracket (See Figure. 15).

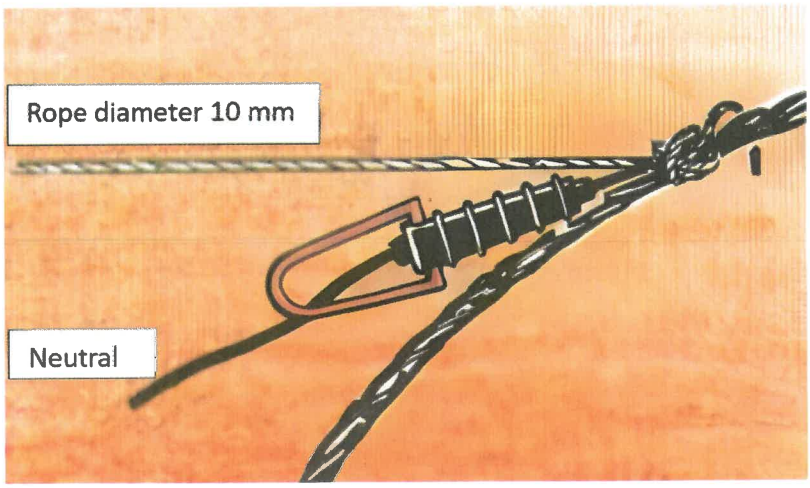



Figure 16: Rope attaching to facilitate anchoring on the bracket

The technician, on the ground, pulls the bundle to the top of the pole using the payout cord.

A technician clips the anchor clamp on the pole bracket, and removes the pulley.

### 7.3.6 Mechanical Payout (Payout under mechanical tension)

#### 7.3.6.1 Domain of application

This method is applicable in all cases.

This is recommended every time the team has a cable-drum trailer with mechanical drum braking and a capstan, at its disposal.

This payout may be made by three technicians:

- One in charge of the cable-drum,
- One in charge of the capstan,
- One overseeing payout operation.

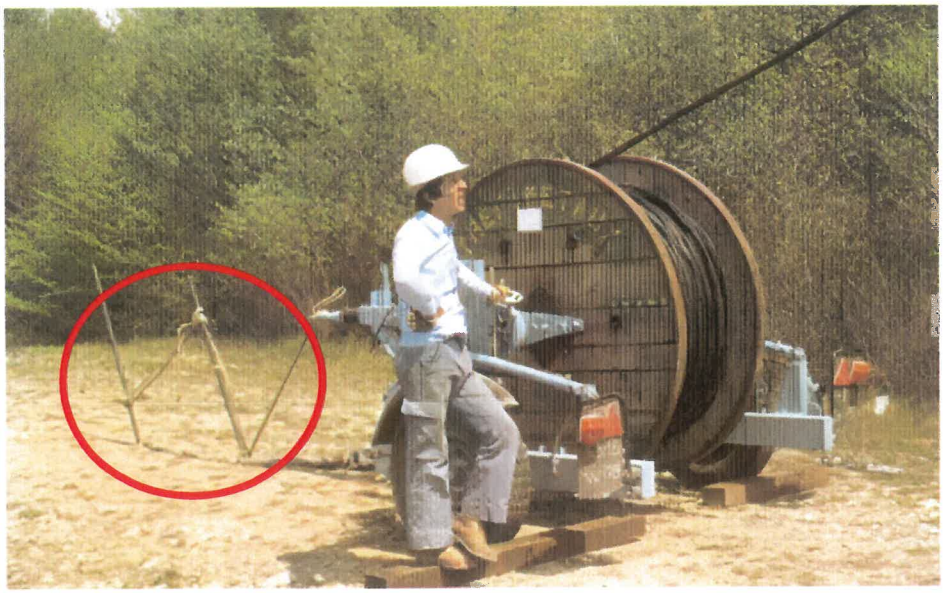
#### 7.3.6.2 Position of the cable drum

The drum is placed on a cable-drum trailer, fitted with a system of progressive drum braking.

This trailer must be immobilized:

- either by guy ropes with two strong pegs with a holding force > 200 daN (See Figure. 16 a),
- or by fixture to a lorry hook or to a pole (See Figure 16 b). The lorry must be immobilized by at least two wedges.

In the case of mechanical payout, practices such as: contact roller drum, pulling by lorry or drum rolling, are **strictly forbidden**.



(a)

(b)

Figure 17: Position of cable drum

### 7.3.6.3 Rotation direction of drum

Bundle payout is made from the top part of the drum to avoid the bundle dragging on the ground (See Figure 17).

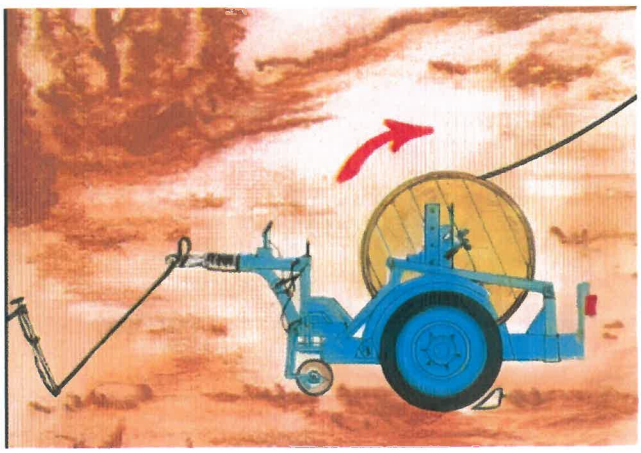


Figure 18: Rotation direction of drum

### 7.3.6.4 Capstan position

The capstan is placed on or after the last support, whenever possible, at a distance equal to or greater than the height of this support (See Figure 18).

The cord must be more or less perpendicular to the capstan axis, if necessary, using a return pulley.

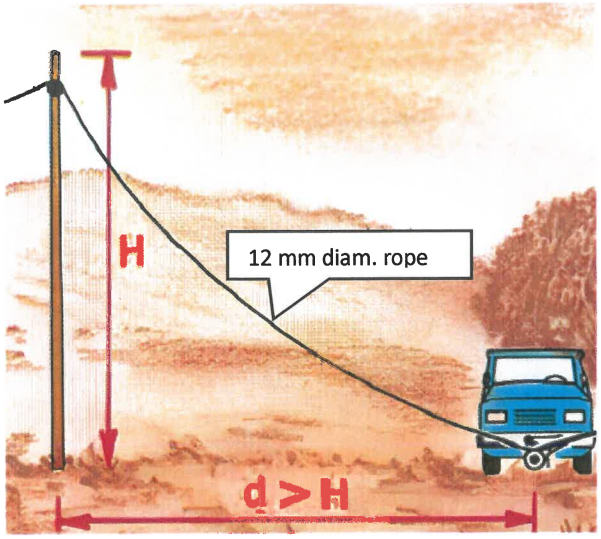



Figure 19: Capstan position

**Payout:**

Payout is as follows:

- on the poles, position pulleys and passage of capstan payout cord towards cable drum
- on the cable drum, fix the cord to the bundle using the link as a whole
- On the capstan, reel the cord on the head stock; the number of spires is at maximum three in order to limit the tensile force to about 200 daN.

During payout of the bundle:

- no one must stay on the poles;
- the technician in charge of the capstan recovers the cord in a suitable recipient (for example, a 100 liter bin) ;
- the technician in charge of the cable drum adjusts braking force depending on sag of the bundle, and by following instructions that he has been given.

The team leader:

- checks that the cord circulates normally and that nothing obstructs passage of the sleeve and bundle in the pulleys,
- oversees passage of obstacles,
- coordinates action of the men in charge of the capstan and the cable drum.

Upon completion of payout, when the bundle has passed the last pulley by sufficient length for the electric connection, the system is immobilized by:

- blocking the cable drum using the braking system,
- blocking the capstan cord.

#### 7.3.6.5 Completion of first anchorage

To accomplish the first anchorage, it is necessary to adjust the ABC tension to enable positioning the anchor clamp as indicated in Figure 19.

Come along clamp without teeth inside jaws in order to avoid damaging LV neutral insulation

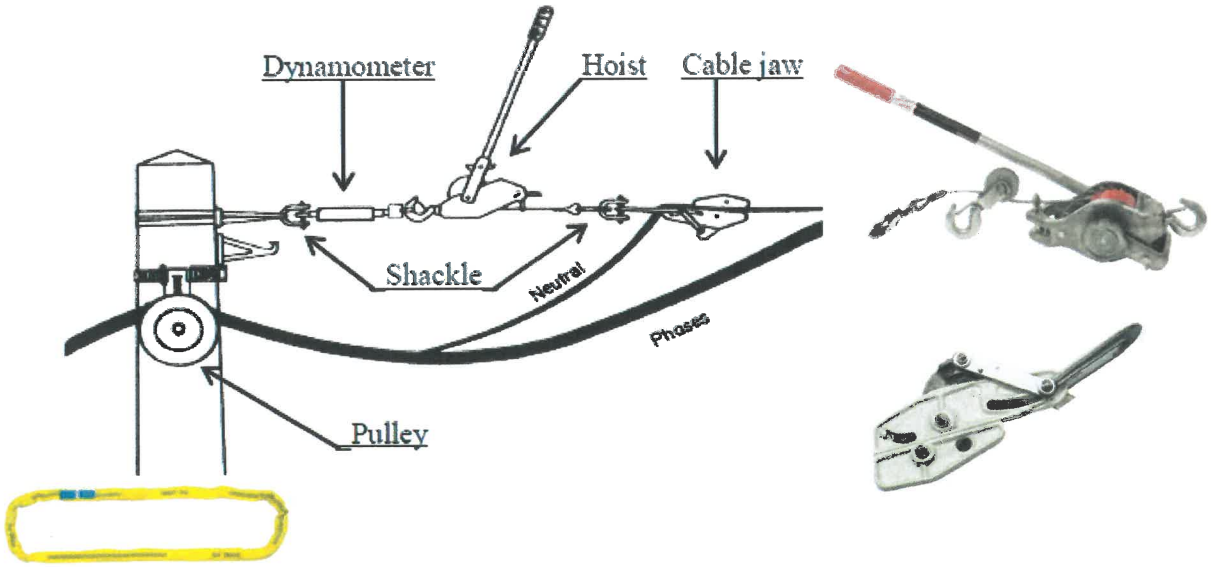



Figure 20: adjustment of the ABC tension to enable installation of the anchor clamp

### 7.3.7 Adjustment

#### 7.3.7.1 General principles

- Tensile force is measured using a dynamometer.
- The forces to be considered are indicated in the installation table attached to the installation drawing.
- These forces can of course be converted in conductor sag depending on the span.
- The calculation rule for LV twisted network is in fact of great assistance.

#### 7.3.7.2 Equipment necessary for adjustment

- Dynamometer: Remember that this device is a fragile measurement device. It is not used when conductors are adjusted using the height of sag on the span.
- Thermometer: The temperature to be considered for the adjustment is the temperature of the cable. This can be assimilated to the ambient temperature on site, measured in the shade.
- Mechanical hoist > 500 daN (or cord hoist 550 daN).
- Come along for ABC without teeth inside the jaws.
- Ties

#### 7.3.7.3 Method of adjustment

Adjustment on an end pole. (a single installation section)

After pre-adjustment of the installation section network, the tension device is installed according to the diagram below (See figure. 20).

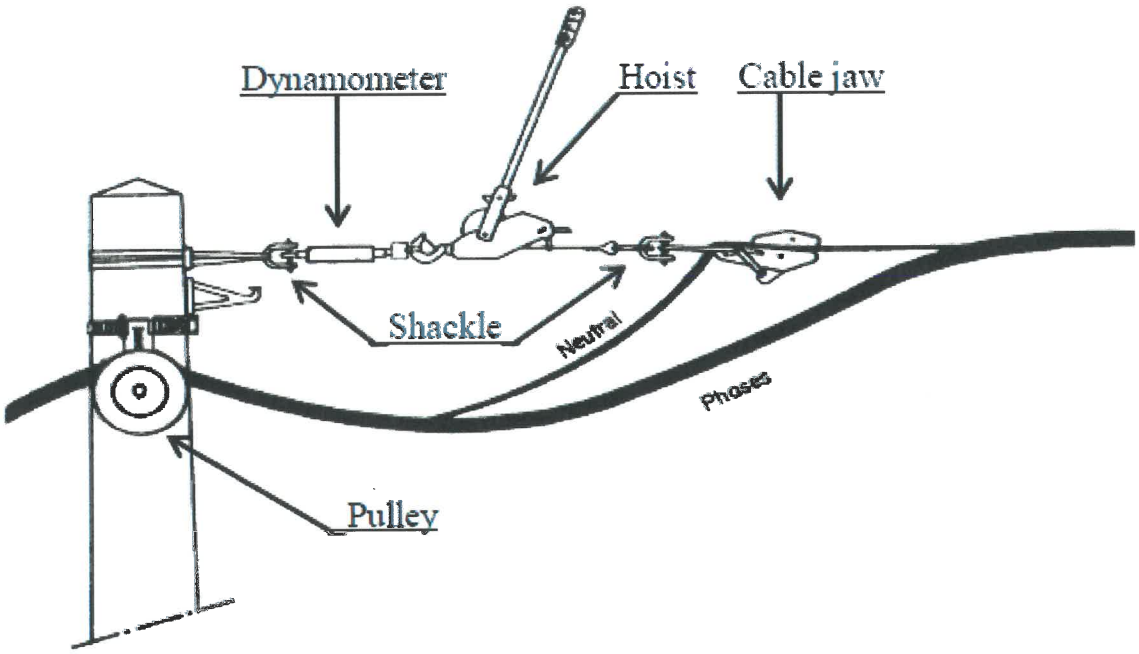



Figure 21: Tension line adjustment method

Figure 21: Dynamometer

To adjust the ABC and place the anchor clamp on the neutral bearer, proceed as follows:

- stretch the bundle until the required tensile force is reached on the dynamometer or until the required sag.
- mark position of the clamp on the neutral bearer conductor (using adhesive tape, for example).
- place the anchorage clamp on the previously marked position;
- exert extra tension to facilitate positioning the clip on the bracket;
- place the clamp on the bracket;
- release and remove tension device;
- cut the bundle conductors to length required;

- remove payout pulley.

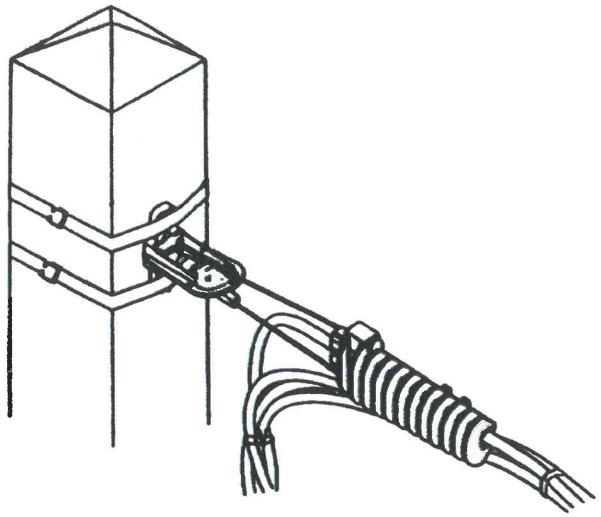
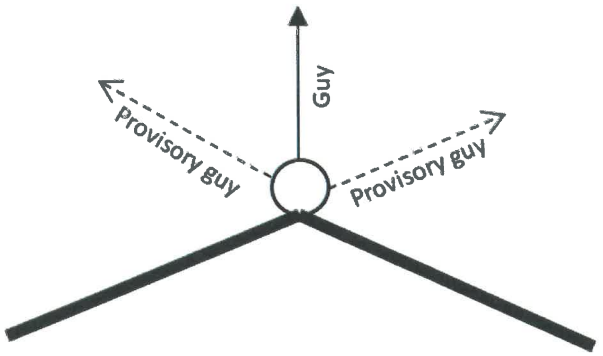


Figure 22: Single anchorage

### 7.3.7.4 Making a double anchorage (several installation sections)

When the line has several installation sections, adjustment is made in several stages.

Poles in double anchorage shall be provisory guyed in order to avoid too high mechanical constraint on the pole.




#### 7.3.7.4.1 Pre-adjustment

Payout is made over the whole length of line and, as the first anchorage has been made, the bundle is stretched using a tension device placed on ground at the end of the line.

The purpose for making this pre-adjustment visually is to obtain slightly lower tension than adjustment of the first installation section.

#### 7.3.7.4.2 Adjustment of the first installation section

Adjustment of the first installation section is made at the first double anchorage

This operation requires the positioning, on the double anchorage support, of an integrated return pulley hoist, according to the diagram Figure 23.

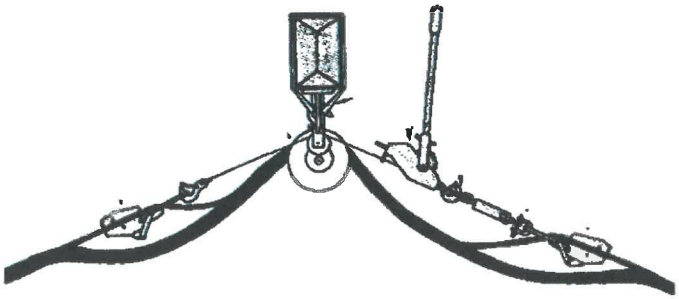


Figure 23: Adjustment of the first installation section

If the forces are approximately balanced, it is generally not necessary, in this case, to attach the pole with provisory guys.

To adjust the bundle and place the anchorage clips on the neutral bearer, proceed as follows:

- act simultaneously on the two tension devices (one at the end of the line, and the other at the double anchorage point) to obtain at the same time adjustment of the first installation section and the necessary « slack » for making the double anchorage (See Figure. 24);
- mark the positioning of the anchorage clips;
- place the anchor clamps by exerting extra force to facilitate hooking the clips on the bracket;
- release the tension device at the double anchorage point;
- remove equipment (hoist, pulley, etc..).

N.B. : for the re-entering angle double anchorages, the method is identical.

The other installation sections are adjusted in the same manner. The last anchorage is adjusted as is indicated, as if there was only a single installation section.

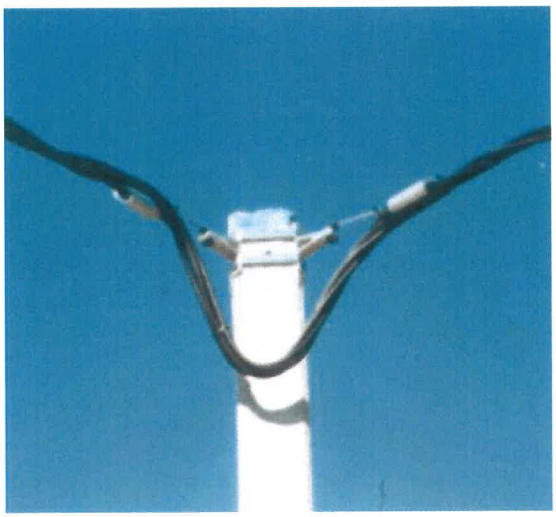


Figure 22: Double anchorage

For a double anchor system, it is necessary to differentiate between an anchor on a stopping pole and that on a line up pole.

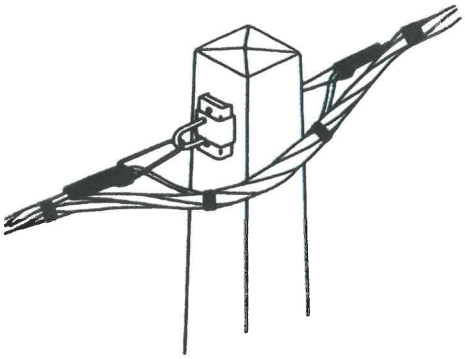


Figure 25a: Double anchorage on stopping pole

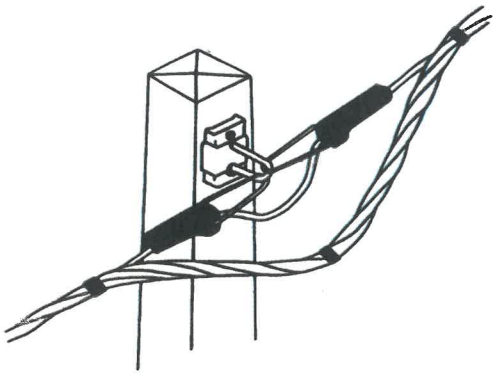


Figure 25b: Double anchorage on line up pole

### 7.3.7.5 Neutral messenger positioning on suspension clamp

The use of suspension assemblies is confined to outward angles < 50 degrees and to re-entrant angles < 30 degrees. In the latter case, it is worthwhile passing the cable on the other side of the pole to obtain a protruding angle.

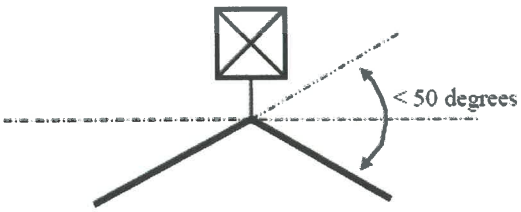



Figure 26a: Protruding angle

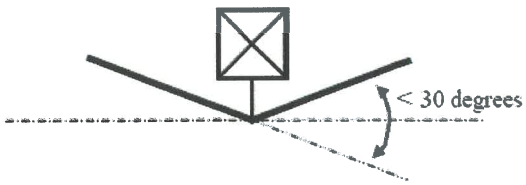



Figure 26b: Re-entrant angle

#### 7.3.7.5.1 Alignment without difference in level

Placing neutral messenger on the clamp is done by hand.

NB : it is forbidden to raise the bundle by maneuvering the aerial lift if any. Use of conductor's separator tool will help a lot for installing neutral inside the suspension clamp.

Figure 27: Conductor's separator

### 7.3.7.6 Angle and alignment with difference in level

When angles or alignment are leads to dificulties to install the neutral inside the suspension clamp by hand, the following method applies :

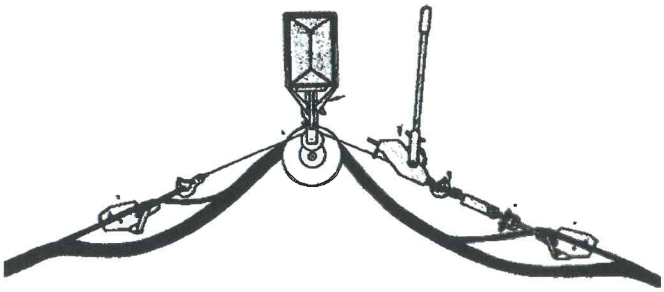


Figure 23: Angle or alignment with difference in level installation tools

The neutral can be easily installed inside the suspension clamp.
After suspension clamp locking, two polyamide binding ties of 8 or 9 mm large are installed around the bundle on each side of the clamp and one on the clamp for attaching the phases onto the clamp.

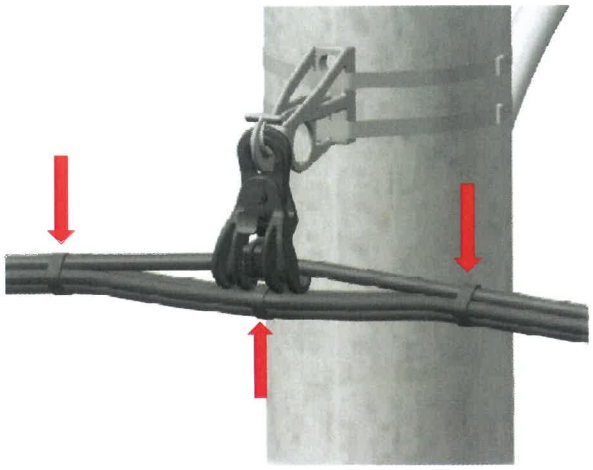


Figure 29: ABC installed in suspension Clamp with 3 binding ties

## 8 The LV Insulation Piercing Connectors

This equipment is defined by EDC-DTS-002 Technical specification. It gives, on construction, effective dielectric resistance of 6 kV, as well as perfect water tightness.

On the other hand, no live section is accessible.

Technology retained to facilitate installation is simultaneous tightening (and piercing) on the main and tap conductors.

Figure 30: LV insulation piercing connector (IPC)

After installation of IPC, the tap ABC must be firmly attached on to the main ABC using 8 or 9 mm binding polyamide ties in order to avoid that ABC vibrations destroy the connections inside IPC.

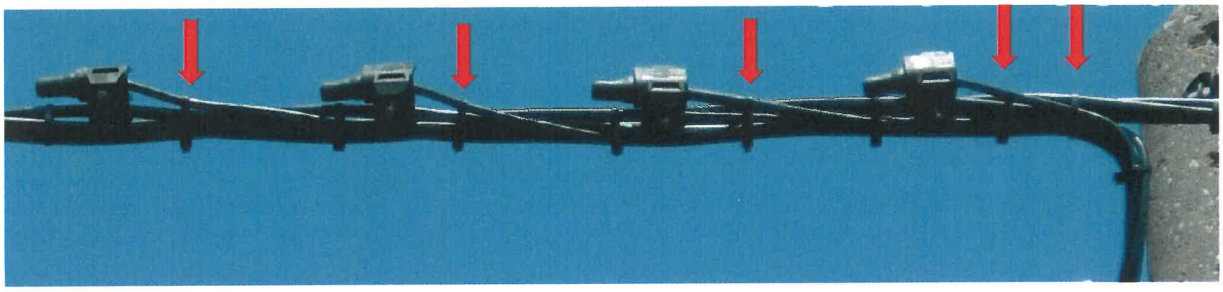


Figure 31: binding ties installed on ABC near IPC

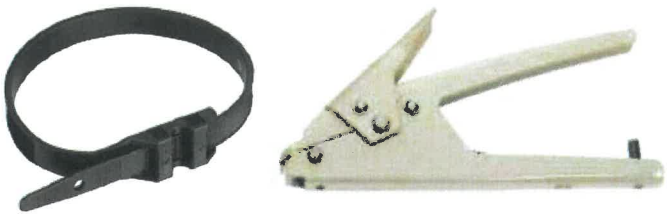


Figure 32: Polyamide binding tie and installation tool

## 8.1 Installation of Insulation Piercing Connectors (IPC)

Refer to EDC-TR-002- LV ABC IPC and pre-insulated lugs and junction sleeves installation. Near IPCs, the tap conductor shall be firmly attached onto the main ABC using polyamide ties (figure 32). This avoid conductor's vibrations to destroy the connection after several months or years.

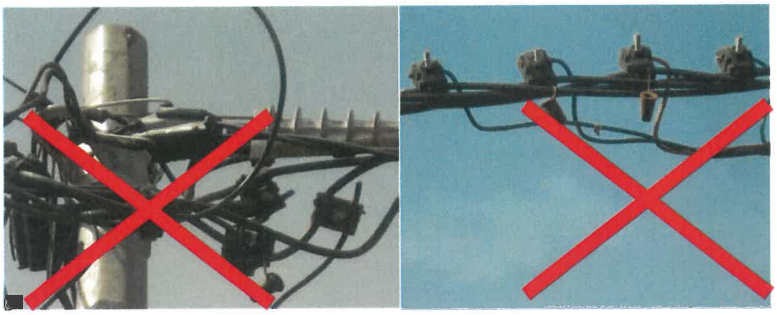


Figure 33 Very bad Installation of insulating piercing connectors (IPC)

## 8.2 Neutral Earthing of LV Network

Neutral earthing connection on ABC is done using IPC.

Refer to EDC-TP-002 Technical data sheet N° 19: First pole after substation LV neutral earthing

In case the LV neutral earthing is not the first pole of the LV feeder immediately after the substation, a tinned C connector replaces the coupling measuring point.

# 9 Mid span junctions and pre-insulated lugs

Refer to EDC-TR-002- LV ABC IPC and pre-insulated lugs and junction sleeves installation.