

INSTALLATION OF AERIAL FIBRE OPTIC CABLES

1. "FIGURE EIGHT" FIBRE OPTIC CABLES
2. LASHED TYPE FIBRE OPTIC CABLES
3. ADSS (All Dielectric Self Supported fibre optic cables)
4. OPGW (Optical Ground Wire)

The installation methods for fibre optic cables are largely the same as those with conventional copper cables.

It is, however, important to observe the limiting values for the cable, given by the cable manufacturer, such as:

- * minimum bending radius
- * maximum pulling force
- * minimum installation temperature
- * crush strength of the cable

These may be considerably different from those of the copper cable.

Loads that exceed the ratings may increase attenuation in the fibres up to the point of causing fibre breaks. The fibres may break immediately or after some time. The damage may not be visible on the outside of the cable. The cable may seem intact, while in fact the fibre is stretched, or there are microfissures which may cause an early break.

Aerial cables are typically filled with jelly. These cables are normally provided with a metal laminate,(aluminum foil or corrugated steel tape), to protect them against moisture. (The cable can also be non-metallic). The jelly prevents the passage of water in longitudinal direction while it at the same time protects the fibres.

In general where end-pull or distributed pull methods are used the various methods as in underground duct installations to protect the cable from excessive strain during installation may also be employed for aerial cable. It is also important that proper guiding equipment is provided at positions where sharp changes of direction occur.

It is important when installing aerial optical fibre cable lengths to make proper arrangement for an adequate extra length of cable at a pole position for testing and jointing. This length at each end of cable must be sufficient to enable construction of joints at a convenient work position and it may be necessary to allow extra length for ground level operations.

Aerial installation is perhaps the most economical alternative when existing lines of poles can be used.

1. "FIGURE 8" FIBRE OPTIC AERIAL CABLES.

- * **Easy and fast to install**
- * **Span lengths up to 100 m and more**
- * **Allows high fibre counts**
- * **Installation in telecommunication pole lines**



These cables are self supporting cables with an integrated messenger wire in the cable sheath.

The messenger gives the cable a sufficient tensile strength and resistance to strain.

The messenger is normally a galvanized 7-wire messenger, 7x 0.7 mm up to 7x2.12 mm or more, depending on the dimension of the cable. In non-metallic cables the steel messenger is replaced by a single fibre reinforced plastic rod (FRP).



The cable constructions have been designed to provide for a stable attenuation of the fibres in a wide temperature range (+70°C...-45°C). The figure 8 cable is suspended onto poles, made of wood, metal or concrete.

The pole span is typically 50....100m, but also longer spans may be built.

The cable sag is adjusted according to engineering specifications and is secured by the suspension clamps on poles and by dead-end clamps at the ends of the aerial line.

The same mounting accessories may be used with fibre optic cables as with traditional copper cables. However the splice closures are usually mounted on the poles.

The appropriate accessories are mounted on the poles before the cable is laid. The cable is spread out under the poles directly from the truck, if possible. A crawler tractor with a cable trolley can be used in difficult terrain, or the cable can be spread out by manpower.

At the end of the line, the cable is lifted up on the pole, positioned and tightened properly, and fastened to the hangers. Drawing rolls are used on the poles when the cable is drawn, to avoid its rubbing against the pole or the hanger.

The sag of the cable is dependent on the temperature and the pole distances.

To avoid, as well as possible, defects caused in the sheath by e.g. wind, rime or ice load, the following advises should be followed:

- * The best hanger for an aerial figure 8 cable is one that allows both longitudinal and transverse movement of the cable.
- * It is also recommended to separate the messenger from the cable by cutting the neck over a length of 50 ...60 cm at the hanger, to prevent damages by oscillation or vibration.
- * It is also recommended to twist the cable axially by 5...10 turns on every second pole, to prevent swinging of the cable.

2. LASHED TYPE FIBRE OPTIC CABLES.

- * **The same cable might be used both for aerial- and underground installation.**
- * **Span lengths up to 100 m and more**
- * **Allows high fibre counts**
- * **Installation in telecommunication pole lines**



The cable construction is similar to Duct- or Direct buried cables. The cable is lashed with aluminum- or steel-wire to a separate, pre-installed, messenger wire. Installed on wooden, steel or concrete poles. The pole span is typically 50....100m.

The cable can be lashed by hand or with special lashing equipment. If the line contains both aerial and direct buried section the same cable could perhaps be used for both applications.

Where lashing to pre-tensioned messenger wire is employed the optical fibre cable must be constructed to withstand lashing. The lashing-wire tension must be controlled.

3. ADSS (All Dielectric Self Supporting fibre optic cable)

- * **Non-metallic cable**
- * **Can be installed in power-lines**
- * **Allows high fibre counts**
- * **Allows high span lengths**
- * **Conducting when wet or polluted!**





The ADSS cable can be installed in existing power lines and it is a complementary to Optical Ground Wires.

Can be installed with standard types of accessories, e.g. spirals, dampers, but needs separate support constructions.

Standard conductor installation equipment can be used. The installation is quite simple due to flexibility and low weight of the cable. Installation speed app. 2...4 km/day/team.

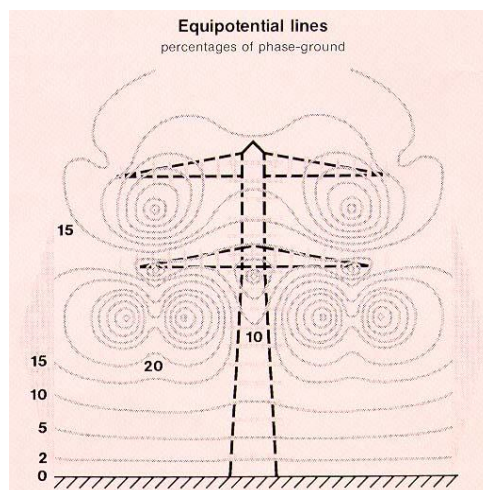
During installation of the ADSS cable it can be considered to be non-conducting and sometimes can be installed without disconnecting the line (if regulations allow).

During service these cables become semi-conducting because of pollution on the surface and the hydrophilic nature of the jacket material. They may temporarily become significantly conducting because of humidity or moisture and thus have to be considered as conducting cable affected by electric fields. This fact should be considered during maintenance.

Splicing is normally carried out at ground level and the cable dressed up the support and housed at a height beyond the reach of the public. Alternatively the joint may be housed in an underground chamber.

In the event of cable damage the complete span must be replaced as mid-span joints are not practical or recommended.

It is however very important to calculate the electrical field and induced voltage and analyze the clashing behavior to find the optimum fixation position of the cable in order to reduce the exposure to tracking and/or corona effects.



A particular phenomena of an installed ADSS cable is the "dry banding effect". This is due to the uneven drying of a dampened polluted cable where the electric stress is presented over a short distance of the dried part of the cable, causing local arcing and heating which may erode the cable sheath and strength member, leading to mechanical failure.

The ADSS cables effectively separate the telecommunication and power supply systems, a particular attractive feature when considering maintenance and repair to either system. With suitable planning, the cables can be installed without interference to the power supply.

4. OPGW (Optical Ground Wire).

- * **Two function aerial conductor (optical fibres are embedded into a conductor)**
- * **Can be installed in the same way as normal ground wire**
- * **Allows high fibre counts**
- * **Allows high span and delivery lengths**
- * **Easy and fast maintenance**

OPGW conductors are normally installed at the top of the overhead line support structure and thus subjected to aeolian vibration, wind induced galloping, ice and wind loads, lightning strikes and maybe also ground fault currents.



Therefore it is essential that the constructor use fittings, accessories and installation methods approved by the OPGW manufacturer.

OPGW is designed to operate continuously at ambient temperatures which can vary from -50°C to $+80^{\circ}\text{C}$.

All the cable components have to withstand temporary high temperatures caused by ground fault currents and wiring, especially the outer layer, which has to withstand lightning strike induced heat.

The duration of the lightning strike (including all its components) is in most cases less than 0.5 ms. The thermic effect is thus only in a small area at the conductor surface. In a high energy strike, aluminum or aluminum alloy wire is more liable to immediate breakage than aluminum clad steel wire.

As most of the strikes happen at the poles, the preformed fittings are a good protection for OPGW. Damage resulting from lightning strikes is not considered to be a high risk.

OPGW can be installed the same way as normal ground wire (unless the manufacturer has stated otherwise). Scratching of the aluminum coated strands should be avoided in order to prevent corrosion.

The splicing of the fibres can be done either on the ground or at the top of the support structure. Some extra length is needed if the splicing is done at ground level but the splicing is easier to carry out.

The lengths installed depends on the line route, maximum length the manufacturer can deliver and the maximum pulling force allowed. In most cases however 3...5 km length is optimum. The longer the length the less splices and joint closures are needed.

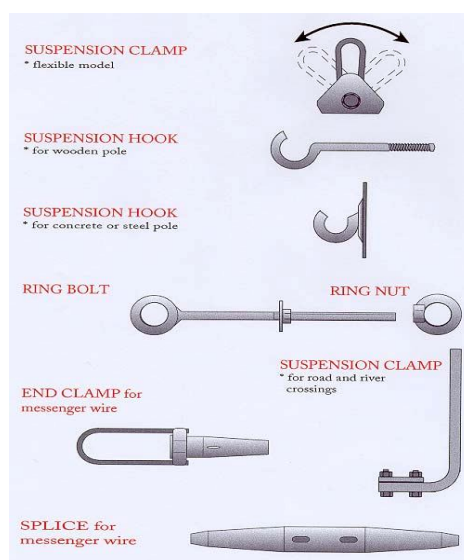
If OPGW is damaged (by lightning in very rare cases or by vandalism) the whole span should be replaced.

It may be good practice to monitor the attenuation of spare fibres from time to time (say, every 2-3 years). This will enable early detection of impending failure of a link before disruption to the service occurs.

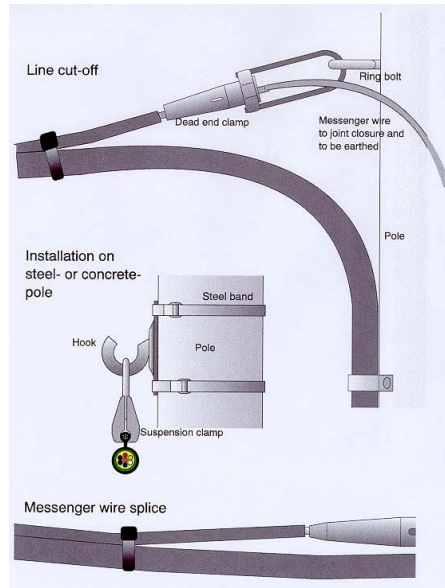
OPGW is at its best when installed as new line or when old ground wire has to be changed. OPGW is also considered to be the most proven reliability fibre optic cable for Power Utility usage. When doing the cost comparison it has to be remembered that the existing ground wires and even support structures have to be changed anyway sooner or later.

Appendix

Typical installation accessories for "figure 8" fibre optic aerial cable



Installation examples of "figure 8" fibre optic aerial cable



Installation "hints" for "figure 8" fibre optic aerial cable

