Guideline for OSP Copper Plant Installation and Splicing

OSP Copper Installation

Cable Placing

When placing OSP copper cable, all applicable saftey practices must be in place before starting any installation. Please follow all OSHA, state and local safety procedures when working aloft or in road right of ways.

Individuals who place OSP copper cable deal with cable attributes and placing procedures that are straight forward and are generally understood throughout the communication industry. These attributes must be taken into consideration when placing cable in aerial, direct buried, conduit/duct bank or other underground environments. As indicated in the preceding engineering information, they are critical in the planning stages of any project.

Installation Categories

- Duct (Conduit)
  - Manhole Systems
  - Vaults
  - Cable pulled into conduit
- Direct Buried
  - Open Trench
  - Plow
  - Directional Bore
- Aerial
  - Lashed
  - Self-Support

Installation Considerations

- Soil Conditions - Some soils are not suitable or economical for certain installation methods.
- Future use- Conduit generally allows easier placement of future cables.
- Separation from power cables and minimum depth requirements - Reference applicable electric and safety codes.
- Conduit must accommodate cable bending radius limits.
- Existing conduits must be rodded or slugged to ensure a clear path for the cable.
- Breakaway swivel recommended – rated for maximum cable installation tension.

Diameter

Conduit must be sized to accommodate the diameter of the cable and allow for other factors such as bends and pulling eyes.

When pulling eyes are installed add .5 inches to the cable diameter to determine the proper conduit size.

How to Calculate Conduit Fill

Refer to Technical Guideline TG016.

Weight

Copper cable is heavy! Equipment appropriately rated to handle a loaded cable reel is essential for safety reasons and to prevent damage to the cable. For instance, a 900 pair cable weighs approximately 2180kg /4806 lbs. on a standard reel containing 381m / 1,250' of material.

Copper Plant Minimum Bend Radius

Of major importance when placing cable in any one of the three environments is to maintain the proper bend radius. Exceeding the recommended bend radius can severely damage the cable being placed by:

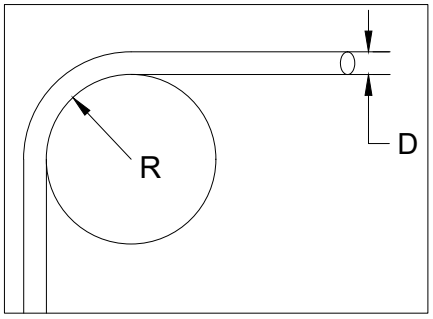
- Kinking the cable jacket and underlying shield. If severe enough the conductor insulation can be damaged.
- Tearing the cable jacket.
- Splitting the cable jacket and if severe enough, loss of shield continuity can result.

Outside Plant Copper-Conductor Cable
The recommended minimum bending radii for installation of outside plant copper cables are:

- Cable diameter x 12 for single shield tape designs
  - Examples: SEALPIC®, CUPIC®, GOPIC®, ANxA, BxxA, BxxG types
- Cable diameter x 15 for dual shield tape designs
  - Examples: CASPIC®, ANxW, KxxH, BxxH types
- Cable diameter x 10 for designs without shields
  - Examples: SANSPIC® types
- Cable diameter x 15 for designs with flat shields bonded to the cable jacket

- Examples: CELFIL, Canadian ALPETH, SEALPAP

Refer to Technical Guideline TG009 for more information.



D = cable diameter and R = bend radius

Cable Pulling Consideration

In placements involving cables of considerable weight or substantial friction between the cable and conduit, the cable should be lubricated to reduce the friction. This is an aid in preventing damage to the cable due to friction. The friction coefficient varies with the composition of the conduit material. When we speak of lubrication for the cables, we are talking of synthetic lubricants specifically manufactured for this purpose. Petroleum based lubricants can cause deterioration of the cable jacket. Only water based synthetic lubricants specifically manufactured for cable installation such as Poluwater are recommend for use. See Polywater® Lubricants Selection Page for more details @ https://www.polywater.com/

Pulling tension

- When pulling copper cable (or wire), tension must be applied to all elements of the cable. Pulling on just the sheath can stretch, tear, or pull it away from the core. Conversely, pulling solely on the core can pull it out of the sheath. In either case, care must be taken to avoid damage to the conductors. The recommended method for ensuring that the tension is applied to all elements is by using a pulling eye. While mesh-type pulling grips may be suitable in some applications, they do not apply tension to all elements and should be used with caution.
- The maximum allowable pulling tension is the greatest pulling force that can be applied to a cable during installation without risking damage to the conductors. Other influences including, but not limited to, sheath type, insulation type, filled vs. air-core, length of pull, and number of bends in the installation are not factored in. The maximum allowable pulling tension is an absolute value based on the tensile and elongation properties of the copper conductors.
- All that is needed to correctly calculate maximum allowable pulling tension is the number and size of the conductors, along with a formula known as TANK.

- T = A • N • K
  - Where: T = Maximum allowable pulling Tension in pounds
    A = Cross-sectional Area of the conductor in circular mils1
    N = Number of conductors sharing the tensile load2
    K = Constant (K) = 0.008 pounds/circular mil
- In SUPERIOR ESSEX cables, the following values should be used for A:

Wire Size (AWG)	Cross-Sectional Area (Circular Mils)
19	1289
22	625
24	396
26	250

1 A circular mil is the cross-sectional area occupied by a circle that is 0.001 inches in diameter. This is equal to 7.85 x 10-7 in2. For any given conductor diameter, the area in circular mils is calculated by dividing the area in square inches by 7.85 x 10-7.

2 When using a pulling device that shares the tensile load across all conductors, N = pair count x 2. For OSP cables, a factory installed pulling eye that applies tension to all pairs is assumed. If tension is only applied to some of the pairs, adjust conductor count accordingly.

Example:

Calculate maximum allowable pulling tension for a 22 AWG, 1200 pair SUPERIOR ESSEX outside plant cable:

T = 625 x (1200 x 2) x 0.008

T = 12,000 pounds

Refer to Technical Guideline TG010.

Direct Buried Cable

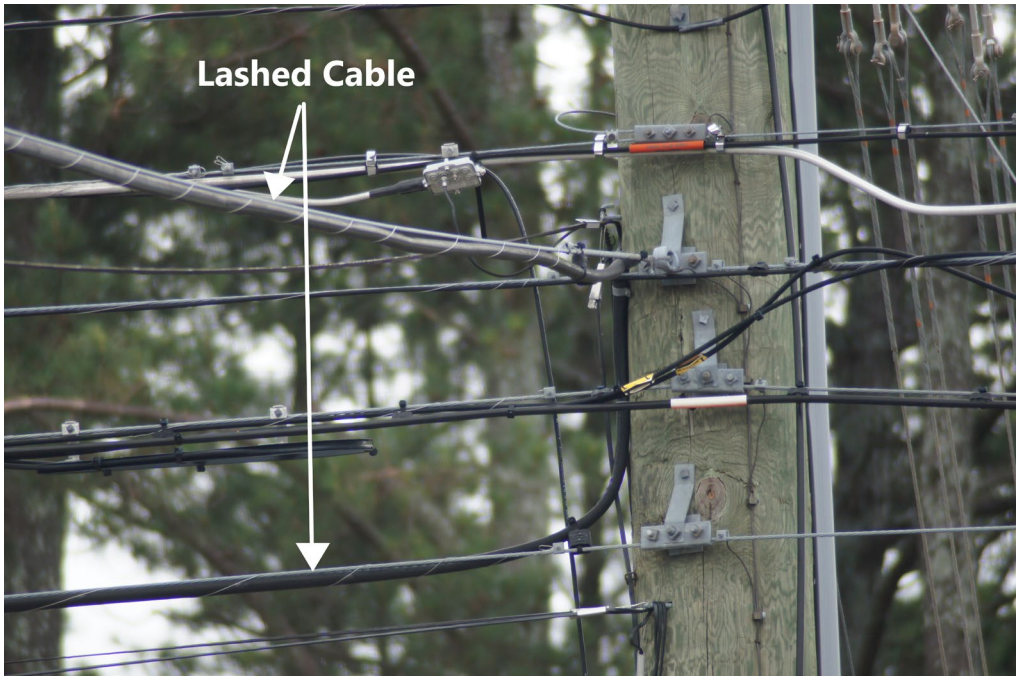
- Open Trench
  - Dig, Place & Cover
- Plow
  - Cuts into the earth, places the cable and covers in one step
  - Specialized equipment
- Directional Bore
  - Bore hole (tunnel) for cable
  - Eliminates surface disturbance
  - Specialized boring equipment

Buried Cable Installation Considerations

- Secure approved right of way needed to install buried cables (road right of way or easements).
- Soil Conditions - Some soil not suitable or economical for direct bury.
- Separation from power cables and minimum depth requirements - Reference appropriate electric and safety codes.
- Adhere to bending radius and tensile load limits.

Aerial Cable

- Lashed
  - OSP cable secured to an independent support messenger by wrapping a lashing wire around both in a spiral manner.
  - Multiple cables can be lashed to a single messenger dependent on design capacity.
- Self-Support
  - OSP cable containing an integrated support messenger. The same principle applies for copper and fiber installation methods.
- Refer to TG043-Figure8-Install-Guide.



Aerial Self-Support Cable

- SEALPIC-84
  - SEALPIC-84 Cables have an air core design and are suited for aerial installations. SEALPIC-FSF-84 has a filled core providing protection from water intrusion.
  - The core and support member (messenger) lay parallel to each other forming a cross-sectional "figure 8."
  - The support messenger is an integral part of the cable sheath, yet readily available for gripping, pulling and tensioning.

SEALPIC®-84

SEALPIC®-FSF-84

Pair Count	AWG (mm)
6	22 (0.64)
12	22 (0.64)
25	22 (0.64)
6	24 (0.51)
12	24 (0.51)
25	24 (0.51)
50	24 (0.51)
100	24 (0.51)
200	24 (0.51)
300	24 (0.51)

Aerial Cable Installation Considerations

- Attachment height to pole must maintain proper clearances.
- Separation from power cables according to separation rules - Reference applicable electric and safety codes.
- Attachment hardware and support messengers commonly available from national distributors.
- Storm Loading – Self Support Cable - Refer to Technical Guide TG052 for more details.

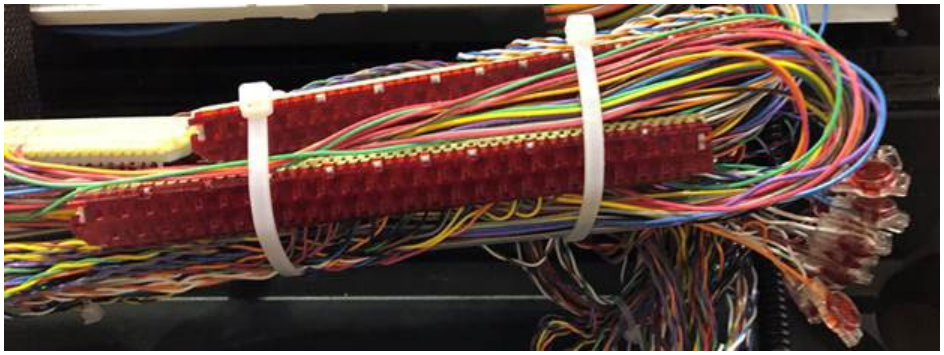
OSP Copper Cable Splicing

- Select the appropriate length or loop for splicing.
- Select proper closure and mark proposed sheath opening(s) on cable.
- Remove sheath, shield and core wrap.
- Secure core to prevent split or misidentified conductors.
- Place binder group identification markers. If wire or plastic ties are used for this purpose do not secure too tightly to avoid weakening the conductor insulation.
- Install shield bond connectors and place temporary or permanent bond across the splice opening. If the shield is coated with Mylar (blue, green or white) be certain that the shield bond connector has sharp buds on the surface in contact with the Mylar to ensure penetration of the Mylar and to secure electrical contact with the metallic shield.
- Determine if splice is to be inline or fold-back. Prepare conductor length accordingly.
- Select splice connectors to be used – individual (Corning Presslok™ UR or UY connectors) or modular – dry or filled 25 pair splicing modules. Select the proper connector for the cable gauge being spliced.
- Note: Within 25 pair cable groups each conductor has a specific twist length throughout the cable. With the migration of service offerings to data services, it is important to maintain the pair twist as the conductors are placed in the connectors or splice modules. It is not necessary to "over twist" the pairs (do not make Category 6 cable twists), just maintain the natural twist of the conductors as they came from the manufacturer.
- Typically, Corning Presslok™ are used for smaller cable pair counts from 1-100.
- Practice good housekeeping.
- Use the proper tools for all work operations.

Cable Bonding and Grounding

For more information on OSP Bonding and Grounding refer to Technical Guide TG113.

Types of Copper Splicing Methods



Example of 25 pair splicing modules and individual spliced pairs with Corning Presslok™ connectors

Corning offers several types of splicing rigs utilizing both the MS2 Super-Mini and the MS2 Super Mate splicing modules. Each can handle two 25-pair cables or binder groups, allowing for 50 wire ends being connected simultaneously. Modules are available for straight/bridge and half-tap splicing.

Please visit the Corning website for more details and user guides for specific splicing tools and products.

Copper Testing and Troubleshooting

Cable Acceptance Testing

With the ever-increasing need for enhanced services such as data and video, it is important to attain the required quality of outside plant. Cable acceptance testing is an important element in achieving this quality.

There are many copper cable test units available from Fluke Networks, Tempo Communications and others. Please refer to their reference manuals and user guides for more detailed information regarding testing of copper Communication Cables.

Cable assurance tests ensure that:

- The engineered design of a cable is achieved during construction.
- The expected transmission quality of the overall circuit meets or exceeds system specifications and objectives.

Testing and Troubleshooting

Cable parameters commonly evaluated and typical defects noted during acceptance testing:

• Conductor continuity	• Open conductor
• Grounds	• Tip/Ring shorted to ground
• Shorts/Crosses	• Tip/Ring shorted to adjacent conductor
• Insertion Loss	• High resistance splice • Improper loading • Incorrect cable gauge • Bridged tap
• Insulation Resistance	• Defective Insulation • Wet splices
• Loop Resistance	• Wrong gauge wire in the loop • Longer or shorter loops than designed
• Noise Metallic	• Resistance unbalance • Power line influence • Open bonds/grounds
• Open-End Impedence	• Bridged Tap • Open Conductors • Resistive Fault (short, ground, etc.)
• Power Influence	• Power System Harmonics • Poor Bonding/Grounding • Lack of cable shield continuity • Proximity to aerial single-phase power lines (60Hz noise)

- Resistance Unbalance
  - Poor or corroded slices
  - Wet Cable
  - Bridged Taps
  - Defective Load Coil
  - Bird nests, cobwebs, rodents
- Shield Continuity
  - Open cable bonds

Technical Support

For more information, please contact Technical Support.

Technical Support - 877-263-2818

Email - tech.support@spsx.com

Technical Guides can be found at superioressexcommunications.com under the Resources tab.