OSP Fiber Optic Cable

Installation and Handling Guidelines for Underground and Aerial Applications

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Member of Technical Staff
OFS Customer Support Engineering
Outline

- Cable & Fiber Description
- General Precautions
- Underground Placing Equipment & Materials
- Pulling Tension
- Minimum Bend Radius
- Installation Techniques
- Cable Coiling
- Aerial Span Limitations
- Aerial Placing Equipment
- Placing Methods
- Slack Storage
Fortex™ DT

*Single Jacket Loose Tube Cable*

- Dielectric cable
- Completely dry cable design
- Recommended for duct or lashed aerial applications
- Meets or exceeds Telecordia GR-20, RUS PE-90, and IEC 794-1
- Up to 288 fibers – 12 fibers/tube (2.5 mm tube)
- Up to 432 Fibers – 24 fibers/tube (3.5 mm tube)
Fortex™ DT

Light Armored Loose Tube Cable

- Corrugated steel armor tape & PE jacket
- Completely dry cable design
- Recommended for duct, direct buried or lashed aerial applications
- Meets or exceeds Telecordia GR-20, RUS PE-90, and IEC 794-1
- Up to 288 fibers – 12 fibers/tube (2.5 mm tube)
- Up to 432 Fibers – 24 fibers/tube (3.5 mm tube)
AllWave® Fiber

Zero water peak single mode fiber

- no hydroxyl ions in fiber, so there’s no E-band “water peak”
Cable Installation

- General Precautions

- Observe maximum rated cable tension
- Observe minimum bend diameters
- Avoid excessive cable twist
- Storage Temperature
  - -40°F to 167°F (-40°C to 75°C)
- Installation Temperature
  - -22°F to 140°F (-30°C to 60°C)
Innerduct

- Underground installation (innerduct in conduit)
  - Diameter Ratio $\leq 0.67$
  - Larger diameter innerduct may be required for cable blowing
- Direct buried installation
  - Recommend smooth-wall or ribbed innerduct (not corrugated)
  - Distribution networks: minimum ID = 1.25 inches
  - Long haul networks: minimum ID = 1.5 inches

$$\frac{\text{Cable OD}}{\text{Innerduct ID}} = \text{Diameter Ratio}$$
Cable Lubricants

- Recommended
  - Polywater (American Polywater Corp.)
  - Hydralube Blue (Arnco)
  - or equivalent
- Quantity
  - Based on cable installation length
  - Follow manufacturer’s recommendations
- Do not use detergents (soaps)
  - May cause stress cracking of cable jacket
Cable Installation Equipment
- **Capstan Winch**

- Hydraulic motor used to drive a capstan
- Typical pulling speeds ~ 75 – 150 fpm
- Typical pulling distances ~ 1000 – 2500 ft
Capstan Winch - Precautions

- Pressure gauge displays hydraulic pressure – not cable tension
- Gauge must be calibrated to indicate cable tension
- Hydraulic relief valve needs routine calibration to confirm and/or adjust bypass valve at 600 lb tension
Maximum Pulling Tension

- Maximum Rated Cable Load = 600 lb (typical)
- Maximum installation force must not exceed 600 lb
- Maximum installation force must be controlled using
  - Calibrated capstan winches
  - Breakaway swivels
  - Slack cable loops
Controlling Installation Tension

- **Breakaway Pulling Swivel**

- Attached between pulling tape and cable grip
- Separates at 600 lb load
  - Internal pin breaks at rated load
  - Confirm proper load rating of internal pin
- Should not be pulled over sheaves and/or capstans
  (may weaken pin)
Controlling Installation Tension
- Capstan Winch

- Maintain slack loop on pull-off side of intermediate capstans
  - Prevents additive pulling force of multiple capstans
  - Provides a buffer for adjusting pulling speeds
Minimum Bend Radius

Fortex™ DT cables (loose fiber designs)

- **Under load (during installation)**
  - \( R_{\text{min}} = 15 \times OD \)

- **No load (after installation)**
  - \( R_{\text{min}} = 10 \times OD \)

- **Note:** diameter = 2 × radius, therefore
  - \( D_{\text{min}} = 30 \times OD \) (during installation)
  - \( D_{\text{min}} = 20 \times OD \) (for storage coils)
Controlling Bend Diameter

- Bend diameter is controlled by
  - Using correct diameter capstans
  - Using correct diameter cable sheaves
  - Forming cable storage loops in correct diameter
Cable Storage in Handhole

Minimum inside dimension of hole must be large enough to allow slack coils to be stored without violating the minimum recommended slack coil diameter.

Minimum bend diameter for slack storage: \[ D \geq 20 \times \text{Cable OD} \]
Cable Installation Equipment
- Blowing / Jetting Machines

- Use compressed air to blow cable and drive wheels/belt to push cable
- Typical installation speeds ~ 150 - 200 fpm
- Typical installation distances ~ 3,000 ft
- Requires airtight innerduct couplings
Blowing / Jetting Machines
- Precautions

- Conduct cable slip test per equipment manufacturer’s instructions
- Conduct cable buckling test per equipment manufacturer’s instructions
- Observe maximum operating pressures
- Use proper innerduct inserts & seals
- Use proper cable inserts & seals
- Confirm integrity of innerduct and couplers
- Clean and lubricate innerduct
Cable Installation Techniques

- Single Pull
- Backfeed Technique
- Forward Feed Technique
- Intermediate Assist
Single Pull

- Install entire cable from splice location to splice location in one continuous operation
Figure-8 Method

- Used to increase distance between splice points
- Used when cable length exceeds equipment availability
  - Backfeeds
  - Forward feeds
Figure-8 Method

- Precautions

- When figure 8-ing large heavy cables, use the “Smear Method” for stacking the cable layers
  - Offset the cross-over points in each layer by about 4 inches
  - This will help prevent sheath dents caused by the cable’s own weight

- Limit the height of the figure-8 stack to 2 ft
Figure-8 Method

Standard Figure-8

“Smeared” Figure-8
“Figure-8 Eliminator” Machines

- Figure-8 Eliminator machines are used to automate the figure-8 process.
- Equipment may cause fiber and/or cable damage and is NOT recommended for use with OFS cable.

Cable subjected to a combination of tension, bending, and twisting.
Backfeed Placement

- Position cable reel near mid-point of cable route
- Install first half of the cable using standard techniques
Backfeed Method (cont.)

- Remove remaining cable from reel and figure-8
Cable Backfeed (cont.)

- Access inside end and feed in opposite direction
- Install remaining cable from figure-8 stack to splice location
Forward Feed Method

- Pull slack cable to intermediate manhole
- Figure-8 slack cable on ground
Forward Feed Method (cont.)

- Flip figure-8 stack to access cable end
- Pull cable to splice location
- Can use multiple forward feeds if required
Intermediate Assist

- Use two or more winches to distribute the installation force
Intermediate Assist
Cable Coiling

- Use proper coiling methods to prevent excessive cable twist and cable damage
- Observe minimum storage coil diameter
- Recommended coiling methods
  - Fold-over method
  - Teardrop method
  - Garden Hose method
Summary

- Maximum Pulling Tension = 600 lb
- Minimum Bend Radius (Fortex™ DT cable)
  - During Installation: 15 × OD
  - After Installation: 10 × OD
- Use of cable jetting/blowing equipment is recommended
- Maintain slack loops at capstan winch
- Use of “Figure-8 Eliminator” machines is not recommended and Will Void Cable Warranty
- Eliminate cable twist with proper coiling methods
Aerial Plant Design

- Aerial cable plant must be designed to meet NESC storm-load requirements
  - Ensure public safety
  - Prevent aerial plant from falling down
  - Requires a strength design (does not consider fiber stress)

- Fiber-optic cable plant must also be designed to limit the maximum fiber stress
  - Ensure long-term reliability of the optical fibers
  - Select support strand and span length to limit the fiber stress to acceptable levels
  - Requires a stiffness design (usually the limiting design)
NESC Storm-Load Districts
## NESC Storm Load Conditions

<table>
<thead>
<tr>
<th>ENVIRONMENTAL CONDITION</th>
<th>STORM-LOAD DISTRICT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HEAVY</td>
</tr>
<tr>
<td>Radial Thickness of Ice</td>
<td>0.5 inch</td>
</tr>
<tr>
<td>Horizontal Wind Pressure</td>
<td>4 lb/sq-ft</td>
</tr>
<tr>
<td>Temperature</td>
<td>0 °F</td>
</tr>
<tr>
<td>Constant to be added</td>
<td>0.3 lb/ft</td>
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## Fiber Stress Storm-Load Conditions

Ice, Wind and Temperature Conditions Used for the Stiffness Design of Aerial Fiber-Optic Cable

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# Maximum Recommended Span Lengths

<table>
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<th>SUPPORT MESSENGER</th>
<th>STORM LOAD DISTRICT</th>
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<tbody>
<tr>
<td></td>
<td>HEAVY</td>
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<tr>
<td>1/4 inch EHS</td>
<td>400 ft</td>
</tr>
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Fortex® DT Loose Tube Cables
Pre-Construction Planning

- **Determine Splice Locations**
  - Insure that the splice location is accessible
  - Plan splice locations at corner poles to simplify cable installation

- **Determine Cable Lengths**
  - Include slack cable for splicing
  - Determine the length and quantity of maintenance coils

- **Determine the Installation Method**
  - Stationary Reel Method
  - Moving Reel Method
Aerial Cable Placing
- Tools & Materials

Aerial Line Truck
or Bucket Truck

Cable Trailer
or Reel Carrier

Cable Winch
Aerial Cable Placing - Tools & Materials

Cable Stringing Blocks

Radios

Cable Guide
Aerial Cable Placing
- Tools & Materials

- Pull Rope
- Pulling Swivel
- Pulling Grip
- Snow Shoes
Aerial Cable Placing
- Tools & Materials

Cable Lasher
Lashing wire
Lashing Wire Clamps
Stationary Reel Method

WINCH
CABLE BLOCKS
ROPE
PULLING GRIP & BREAKAWAY SWIVEL
QUADRANT BLOCK
STRAND
COMMUNICATION
COMMUNICATION
Stationary Reel Method

1. Install cable blocks on pole line
2. Install pull rope through cable blocks
3. Pull cable through cable blocks
   - Observe maximum cable tension
   - Observe minimum bend radius of cable
4. Lash cable to support messenger
Stationary Reel Method

- Precautions

- Use sufficient number of stringing blocks to support the weight of the cable
- Use a cable guide to support the cable at the messenger
- Use adequately sized cable blocks at corner poles
- Use non-metallic pull rope
- Use tension-limiting pull winch (or break-away swivel)
- Pull cable at a safe, steady speed to avoid surging
- Maintain constant radio communications
Aerial Installation Methods

- Moving Reel Method

- Cable reel driven along pole line, cable lifted up to strand and lashed in a one-step installation
- Does not require cable blocks or pull lines
- Most efficient placing method
Moving Reel Method

- Precautions

- Must have unobstructed access to support messenger
- Position reel carrier 30 to 50 ft in front of cable lasher
- Keep reel carrier closely aligned with support messenger
- Do not feed cable through roller fairlead (aerial line truck only)
- Monitor reel rotation and prevent surge
- Do not use brake on cable reel
Slack Storage
- Snow Shoes

ADSS FIBER OPTIC CABLE
Slack Storage
- Storage Coils
Questions?

- For further information, please contact Howard Kemp
  hkemp@ofsoptics.com

- Or visit our website at www.ofsoptics.com

- Or call OFS Customer Care
  1-888-FIBER-HELP (888-342-3743)
  (1-770-798-5555 from outside the USA)