OPTICAL FIBER CABLE
GENERAL OUTSIDE PLANT DESIGN CONSIDERATIONS

Contents

(continued)

Contents, continued

GENERAL

Purpose

This practice provides:

- Design guidelines for optical fiber cable Outside Plant (OSP) Engineering.
- Unique considerations inherent in optical fiber cable design.

Reason for Reissuing

This practice is reissued to update optical **fiber cable information.**

Responsibilities

Since most optical fiber cables are high priority, heavy traffic facilities. OSP Engineering and Construction duties are most important. The following chart outlines these responsibilities:

WHO DOES IT	WHAT HAPPENS
OSP Engineering	• Carefully selects the best possible cable route. • Considers the terrain. environment, obstacles. and distance. • Chooses a route with the foliowing installation technique priorities: 1. Underground. 2. Buried. 3. Aerial. • Consults with the transmission engineer to ensure that total fiber facility loss does not exceed fiber link loss budget. • Determines splice point locations. • If necessary, provides a communications system (i.e.. separate copper cable, hardware, radio, or optical talk sets). This allows: - Splicers to communicate with the office/end testers to optimize splice loss. - Instant communications which enhance repair operauons. • To ensure a timely and well-built facility, consults with appropriate construction personnel when either: - Unique situations arise. - Additional expertise is required.
OSP Construction	To successfully install optical fiber cable, closely coordinates and cooperates with: • OSP Engineering. • Other involved departments.

References

Other jprcatices referenced in this practice include:

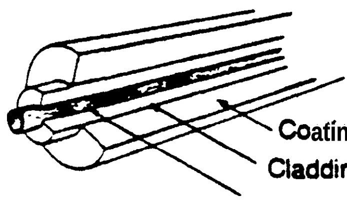
FOR INFORMATION ABOUT. .	SEE TELOPS PRACTICE.
Cable Bonding and Grounding Joint and Nonjoint Construction	605-100-100.
Installing Subduct for Underground Optical Fiber Cable	624-622-000.
Placing Aerial Optical Fiber Cabie	624-627-000.
Placing Optical Fiber Cable Underground	624-628-000.
Placing Buried Optical Fiber Cabie	624-629-000.
Central Office Grounding Systems - Engineering Applications	795-805-071.
Long Pulls of Underground Cable - Engineering Specifications	911-400-073.

DEFINITIONS

Terms

Some of the terms and definitions that appiy to fiber optics are:

TER,M	DEFINITIOh'
Attenuation	A **measure** of the decrease in energy transmission (loss of iight) expressed m decibel (dB). in optical fibers, attenuation is pwnarily **due to absorption** and scattering losses..
Cladding	A glass covering over the core that helps contain the light signal (see the illustration below).
Coating	A layer of composite plastic material covenng the fiber to **provide** mechanical protection (see the **illustration** below).
Core	The glass **central** region in an optical fiber that provides the means for **transmitting** light.



Decibel

The standard unit used to express the ratio of two power **levels**. In communications it expresses either a gain or loss in power between the input and output devices.

THIS LOSS...	IS A DECREASE IN POWER OF APPROXIMATELY. ..
3.0 **dB**	50%
2.0 **dB**	37%
1.0 **dB**	20%
0.5 **dB**	11%

(continued)

Terms, continued

TERM	DEFINITION
Microbend	Local discontinuities on a microscopic scale resulting from mechanical stress on a fiber which induce additional attenuation.
Multimode	A fiber that allows more than one mode to propagate. One type of fiber with a core size of 25-100 microns.
Operating Wavelength	The light wavelength at which a system is specified, normally expressed in nanometers (nm). Most single mode fibers can operate at 1.300 nm or 1.550 nm (see the Optical Spectrum Chart on Page 7).
Optical Link Loss Budget	The total losses allowed for satisfactory operation of an optical fiber system (see the following example):

LINK NHWD-WPACM-XF — BIT RATE 405 Mbps

WAVELENGTH 1310 nm — FIBER TYPE Single Mode

REGEN TYPE NEC 405 MB

EQUIPMENT LOSS:

A. Receiver Level at 10^{-11} BER	-36.0
B. Avenge Transmitter Level	- 3.5
C. ILD Reflection Loss	0.5
D. Connectors Loss (4 X 1.1 dB)	4.4
E. WDM Filter and Connectors Loss	5.0

CABLE LOSS:

F. Multimode Dispersion Loss	
G. Chromatic Dispersion Loss	1.0
H. Splice Loss (7 x 0.25 dB)*	1.8
I. Fiber Loss (7.842 km X 0.50 dB/km)	3.9
LINK MARGIN	15.9

This span required 10 dB attenuators.

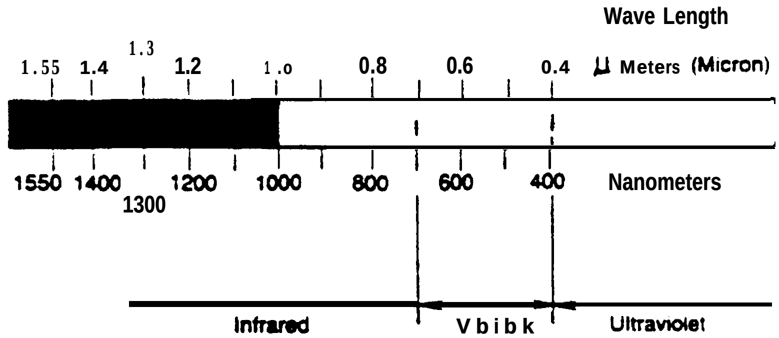
* Includes pigtail and field splices.

NOTE: The above link loss budget is an example only. Transmitter levels, receiver levels, connector and splice losses, etc., vary depending on the manufacturer and the splicing method.

(continued)

Terms, continued

TERM	DEFINITION
Optical Spectrum Chart	The illustrauon below shows an optical spectrum chart:
Pigtails	Small single fiber cords used to terminate optical fiber cables at Central Offices (COs) or regenerators. Each has a: • Connector at one end to interface the equipment. • Bare fiber at the other end for splicing to a fiber in the main cable.
Single Mode	A fiber that supports the propagation of only one mode. One type of low-loss optical fiber with a very small core (8 microns). The size of the core radius approaches the wavelength of the source; consequently, only one mode (path of light) is disbursed.
Spot Size (Mode Field Diameter)	Mode field diameter is the diameter of the spot of light transmitted in a single mode fiber. This spot extends into the cladding.



Metric Conversion Chart

Since many manufacturers express measurements in metric units, the following conversions are useful to OSP engineers.

The conversions are:

- Kilometer (km) X 3,281 = feet.
- Meter (m) X 3.281 = feet.
- Centimeter (cm) ÷ 2.54 = inches.
- Millimeter (mm) ÷ 25.4 = inches.
- Newton (N) X 0.2247 = pounds.
- Kilogram (kg) X 2.2046 = pounds.

Background Information

The glass fibers that convey light (lightwaves) as an information carrier are called optical fibers.

As pan of fiber optic systems. optical fibers are ideal for the broad band width requirements of digital transmission. Consequently. optical fiber cable is used to accommodate the increasing presence of digital switching and transmission.

in the simplest terms. a fiber optic transmission system consists of a:

- Light source (laser or LED).
- Transmission medium (optical fiber).
- Light detector (photodetector).

The source must emit light at a wavelength that glass fiber can carry with minimal loss. The detector must:

- Be highly sensitive to the transmitted wavelength.
- Respond to rapid light pulses originated at the digital source.

Bit Rate and Voice Channel Capacity

The following chart represents the associated bit rate and voice channel capacity common to most systems:

BIT RATE	DS-1	VOICE CHANNELS	DS-3
45 Mbps	28	672	1
90	56	1.344	2
135	84	2.016	3
405	252	6,048	9
565	336	8.064	1'
1.2 Gbs	672	16.128	24
2.2	1.344	32.256	48

Optical Attenuation

The optical attenuation in a fiber determines the distance a light signal can travel before the signal must be regenerated. Several mechanisms in optical fibers produce signal attenuation. The most important ones are:

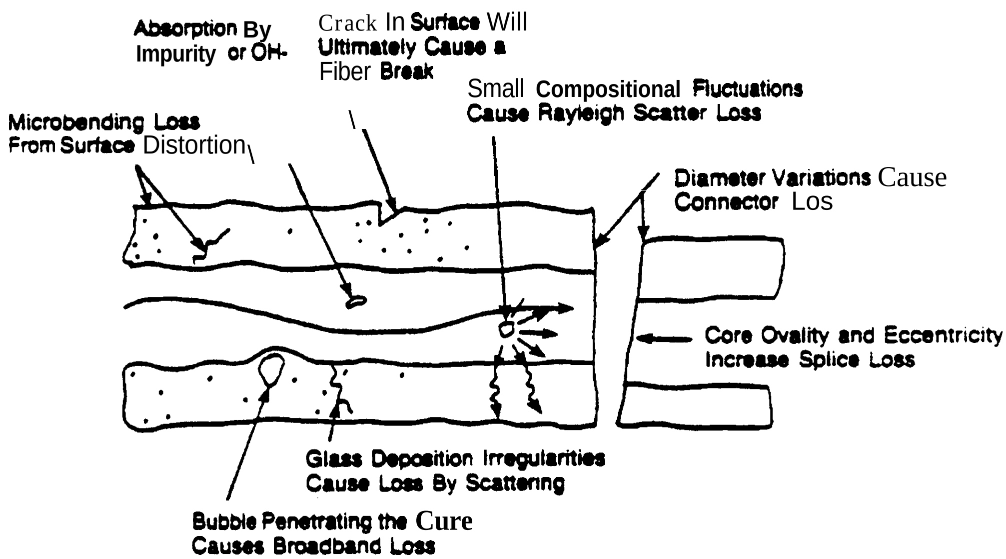
- Rayleigh scanering.
- Absorption.

Influences which contribute to attenuation characteristics are:

- Preform processing conditions.
- Impurities in the fiber.
- Fiber variance imperfections.
- Microbending.
- Microbubbles.

The maximum attenuation of each single mode fiber within a cable, when normalized to a length of 1 km. at λ = 1.300 nm, will be in the range of 0.4 dB/km to 0.8 dB/km.

The illustration below demonstrates the influences which contribute to attenuation.



Cabling Optical Fibers

Optical fibers must be coated and cabled to protect them from external forces. This is necessary because optical fibers:

- Remain brittle.
- Art subject to losses caused by microbending and cracking.

(continued)

Cabling Optical Fibers, continued

The cable sheath must protect the fibers from:

- Abrasion and tensile loads during cable installation.
- A hostiie environment (i.e., moisture and temperature extremes).

Provide optical fiber cables with characteristics, makeup, and handling performance which allow installation:

- In all kinds of OSP environments.
- Using standard equipment and procedures with few modifications.

Diameter Sizes

Optical fiber cables are usually small, normally less than 0.7 inches outside diameter. This allows iong cable reel lengths to be manufactured and installed.

Reel lengths:

- Of 2 km are commonly installed.
- Up to 6 km or more may be installed.

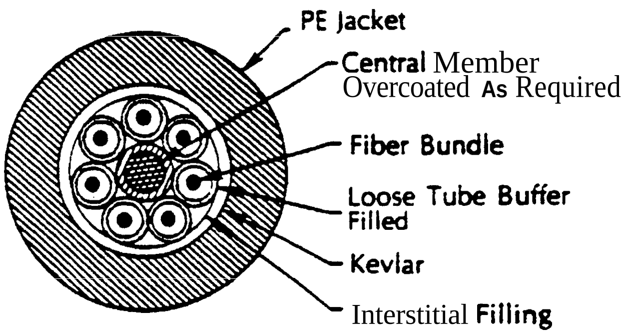
Cable Design and Cross-Section

Cabies for general use:

- Are of a loose buffer design.
- Contain the coated fiber in an oversized "buffer tube." Both the fibers and buffer tubes are color coded.
- May include an integral metallic shield if required for buried applications.

NOTE: Cables may contain more than one fiber per buffer tube and more than one buffer tube per cable.

The following drawing illustrates a typical cable cross-section:



Fiber Count and Buffer Color Code

The following table shows the current standard fiber count and buffer color code sequence.

GTE FIBER CABLE MAKE-UPS

SINGLE MODE

BUFFER COLOR
BUFFER NUMBER

FIBER COUNT	BL 1	OR 2	GR 3	BR 4	SL 5	W 6	R 7	BK 8	Y 9	V 10	P 11	A 12
	NUMBER OF FIBERS PER BUFFER TUBE											
4	2	2	-	-	-	-	-	-	-	-	-	-
8	4	4	-	-	-	-	-	-		-	-	-
12	4	4	4	-	-	-	-	-	-	-	-	-
16	4	4	4	4	-	-	-	-	-	-	-	-
20	8	8	4	-	-	-	-	-	-	-	-	-
24	8	8	8	-	-	-	-	-	-	-	-	-
28	8	8	8	4	-	-	-	-	-	-		
32	8	8	8	8	-	-	-	-	-	-	-	
36	8	8	8	8	4	-	-	-	-	-	-	
40	8	8	8	8	8	-	-	-	-	-	-	-
44	8	8	8	8	8	4	-	-		-	-	
48	8	8	8	8	8	8	-	-		-	-	-
72	8	8	8	8	8	8	8	8	8	-	-	-
96	8	8	8	8	8	8	8	8	8	8	8	8

NOTE: The fiber color code within each buffer tube is the same color sequence as the buffer color code listed above.

Fiber Splicing

The objective of fiber splicing is to:

- Connect the cores of the fibers being spliced.
- Allow as much light as possible to be coupled from one fiber to the next.

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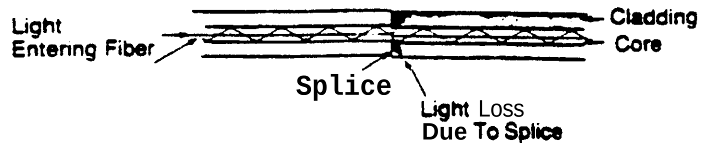
Fiber Splicing, continued

If light leaves the core, it travels in the cladding and is no longer a part of the usable light signal.

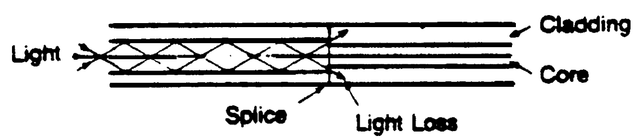


Splice Loss

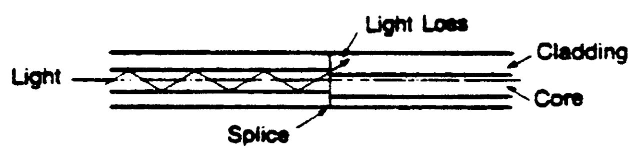
The following chart explains how splice loss can be affected by factors controlled by the:

- Fiber manufacturer.
- Cable spiker.

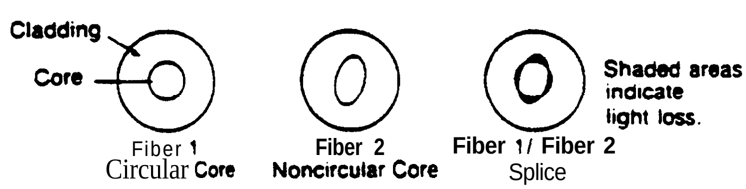
THE...	CAN CAUSE INCREASED SPLICE LOSS THROUGH..
Manufacturer	• Different core diameters.



- Cores not centered in the fiber.



- Noncircular cores.



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Splice Loss. continued

THE..	CAN CAUSE INCREASED SPLICE LOSS THROUGH..
Cable Splicer	• Fiber ends that are improperly cleaved before splicing, including:

- Angled ends.

- End spurs.

- Fractured or chipped ends.

NOTE: A properly cleaved end should be square.

• Not keeping the fiber ends clean.

NOTE: The fiber ends must be free of dust or other panicles that can block light from being coupled from one fiber to the next fiber.

Design Considerations

Some different aspects of optical fiber facility design are:

- Extended section lengths - fewer splice points.
- Additional lap for splicing.
- Splice location considerations.
- Tension limit (typically 600 pounds).
- Consideration of the number of fibers per buffer for future deployment and splicing configurations.
- Minimum bending radius:
  - Ten times the cable diameter when the cable is not under tension.
  - Twenty times the cable diameter when the cable is under tension.

CENTRAL OFFICE AND REMOTE SITE ENGINEERING

Introduction

Area OSP Engineering and Equipment Engineering must conduct a joint survey Of the CO and the remote site to determine the best cable route to follow from the vault (or cable entry point) to the optical terminal equipment.

The cable route is indicated on the OSP work order with the appropriate footages shown.

Cable Routing Guidelines

The following guidelines for proper route selection serve most conditions:

- Do **not use power** cable runways to support optical cables.
- Install a new runway or conduit to support the planned optical fiber cable if an office:
  - Is equipped with a cable grid only.

    AND/OR

  - Does not have available existing cable troughs/runways.
- Optical fiber cables may be routed with high frequency (CXR) cable.
- Take care to avoid a route that would stack future cables (in excess of 150 pounds) on top of fiber cables.
- Observe the fiber cable's minimum bending radius. Check the manufacturer's recommendation if in doubt.
- Coil 100 feet of slack cable in the cable vault for restoration.

Fire Protectton Requirements

When placing optical fiber cable within the confines of a CO, put the cables inside a fire retardant conduit (rigid or flexible) for:

- Fire protection requirements.
- Mechanical protection.

Grounding Optical Fiber Cabie Sheaths

Metallic optical fiber **cable sheaths** must be grounded to the cable vault ground bar as close as possible to the cable entrance. If metallic conduit is used, it must be grounded to the metallic sheath and connected to the vault ground bar.

NOTE: **Refer** to Teiops Practice 795-805-071.

SUBDUCT ENGINEERING

introduction

Subduct tubing is:

- Made of extruded, smooth-wall, coilable polyethylene.
- Ordered on individual reels or in loose coils.

Subduct primarily provides multiple raceways within a conduit system designated to contain optical fiber cable. Multiple raceways arc provided:

- To allow maximum use of the larger **conduit** while preventing damage to new or existing cable(s) during cable installation or removal.
- For use in **aerial** installations (see Telops Practice 624-627-000).

Placing Subduct

Assign ducts in the same way as copper cables. In one vacant 3½- or 4-inch conduit you can install:

- A maximum of four 1-inch (inside diameter) subducts.
- A minimum of three 1-inch (inside diamerer) subducts.

When placing subduct:

- Do not allow the pulling length of underground subduct to exceed 1.500 feet.
- Have additional personnel at pull-through manholes to:
  - Help guide the subduct into the opposing duct.
  - Alert the pulling personnel in the event of a mishap.
  - Help with lubricating.
- Use a 15-inch minimum bending radius during installation.
- Avoid conduit offsets. (Conduit offsets are changes of levels within a manhole. handhoie. or pull box).

NOTE: GTE Telops Practice 624-622-000 provides methods and techniques for placing underground optical fiber cable subduct.

During placing operations. the following is not recommended. but:

IF YOU MUST. .	THEN . . .
Place optical fiber cable in occupied ducts	The ducts must be large enough to accept a 1-inch subduct plus the existing cable.
Bury subduct	Use rigid ABS. PVC. or heavy-walled polyethylene conduit.

Identifying Subduct

Subducts may be ordered with a color code system to readily identify multiple ducts in one ductline.

To help distinguish subduct. the construction print must include placement information such as:

- Duct assignment.
- Length of the subduct to be left at each cable feed manhole.

  NOTE: This subduct extends out of the manhole and acts as the cable guide.

- Construction notes identifying a 15-inch 'minimum bending radius for subduct during installation.
- Possible problem areas (e.g., severe bends. dips, conduit transpositions. etc.).
- A subduct section numbering scheme, if the subduct is ordered to cut lengths.
- Subduct tacking position (e.g., on or under the cable racks, on walls. ceiling. etc.).
- Subduct identification (if required).

New Conduit Systems

Consider all conduit systems as possible fiber optic and copper routes. Design the systems for both.

Determine the manhole spacing by the pulling tension calculations for the largest copper cable expected (set Telops Practice 91140473).

When pianning a new conduit system to accommodate optical fiber cables and copper cables. keep in mind that the overall quantity of 4-inch conduits may be reduced if up to four passageways are provided within one main conduit space.

NOTE: These passageways can be achieved by placing three to four l-inch subducts within a standard 4-inch conduit.

UNDERGROUND CABLE ENGINEERING

Introduction

WARNING: Measurement accuracy is critical since optical fiber cable has longer reel lengths. For instance, a one percent error in a 2 km (6,562 feet) measurement can result in a shortage of 20 meters (66 feet).

A well organized and carefully designed plan is more essential with optical fiber cable than with conventional communication cables, because fiber optic cabie spiking and installation requirements arc unique.

When placing optical fiber cable in unoccupied underground ducts:

- Select ducts containing subducts.
- Place three or four polyethylene, l-inch or 1 Winch (inside diameter) subducts in 3 ½- or 4-inch ducts.

NOTE: Telops Practice 624-628-000 covers placing optical fiber cabie underground.

Developing an Engmeenng Design Construction Print

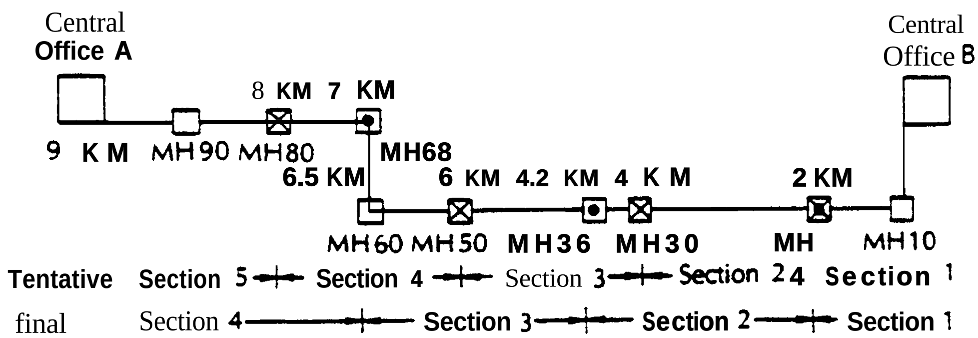
Use the following procedure to develop an engineering design construction pnnt:

STEP	DEVELOPING AN ENGINEERING DESIGN CONSTRUCTION PRINT
1	Lay out a sketch of the route showing such things as: • Wail-to-wall measurements. • Manholes. • Ninety degree bends. • Sweeps. • Dips.
2	Determine the tentative splice locations based on standard 2 km section lengths. Be sure to allow for sufficient length for: • Racking in pull-through manholes. • Slack at splice points. • CO cabling. NOTE: Consider future branch splice needs when determining present splice locations. so that branch splices will not require new cable openings.
3	Reduce the number of splices where there arc excessive bends, sweeps, and dips by: • Shortening the cable section. • Planning for "figure 8" installations. • Balancing out the cable elsewhere in a pull that allows for additional length.

An Engineering Design Construction Print

The following is an example of an engineering design construction pnnt:

SECTION	TENTATIVE LENGTH (X)	FINAL LENGTH (o)
1	2.0 km	2.0 km
2	2.0 km	2.2 km
3	**2.0 km**	**2.8 km**
4	2.0 km	2.0 km
5	1.0 km	—



1. Layout **2.0 km sections**.
2. **Section 4 has two 90° bends.** Make splice in MH68 rather tban **MH80**.
3. The field survey **revealed**:

   a. MH30 to be too congested for splicing. **MH36 is** a better choice.
   b. MH36 to **MH60** is a good straight run-no dips or bends. Make one **selection**.
   c. **MH10** and **MH60** can be "**figure 8**" locations.

Field Survey

Once a tentative plan is complete, conduct a field **survey** of the route with appropriate construction **personnel**. The survey must **include**:

AN INSPECTION OF. . .	TO...
Splice **and pulling** locations	Determine if traffic/parking **problems** exist close to the manhole.
Splice manholes	Ensure that adequate space is **available** for splicing and racking.
The entire route	Determine if conditions exist that could change the tentative design.

(continued)

Field Survey, continued

Include a selection of cable reel setup locations which allow adequate space for:

- Cable trailers.
- Trucks.
- "Figure 8's" of cable for split reel pulling.

Based on the results of the survey, make any necessary adjustments to the reel lengths. If any reel is shortened. lengthen another section or sections to avoid creating additional splices.

Reel Cut Lengths

The reel cut length should be the total of the following:

- All wail-to-wall lengths.
- The amount for racking in all pull-through manholes.
- The slack loop length at splice points (typically 50 feet on each end).
- The lap required for splicing (both ends of the reel) - 3 meters (10 feet).
- CO cabling.

NOTE: Consider additional manpower requirements associated with longer pulling lengths.

Notes for Construction Prints

In addition to standard information, the following notes should be included on the engineering design construction prints. The:

- Location for setting up the cable reel.
- Minimum bend radius of the cabie to be installed.
- Maximum pulling tension of the cable.
- Reel lengths in both feet and meters.
- Warning and cable identification markers required in each manhole.
- Requirements for cabie guards (e.g., split duct. flex tubing) in pull-through manholes.

DIRECT BURIED CABLE ENGINEERING

Trenching Method

The plowing method is preferred for burying optical fiber cables; however, local conditions may dictate trenching. When the trenching method is chosen, consider placing a conduit in the same trench to accommodate future cables.

NOTE: Telops Practice 624-629-000 covers placing buried optical fiber cable.

Base the decision to place the conduit on the following criteria:

- Requirements for a future relief cable.
- The available right-of-way for future trenching.
- Emergency restoration.
- A cost comparison between trenching future cable and placing a conduit to accommodate future cable.

NOTE: Include the cost for pulling subduct and future cable into the conduit.

Splicing

A well-planned engineering design construction print is essential to ensure that:

- The designated number of splice points are not increased from the initial design requirements.
- Splice points are spaced to coincide with designated reel lengths.
- Suitable splice locations are selected.

NOTE: Since attenuation is a critical consideration. keep the number of fiber splices to a minimum.

Choosing a Splice Location

When choosing a splice location. look for a location that is:

- Accessible.
- Safe for employees and the general public.

NOTE: Direct buried splices are allowed, but not preferred. They are not easily accessible. Consider placing a small hand hole to allow future access.

Avoid a location that:

- Is vulnerable to damage by vehicular traffic and vandalism.
- is subject to flooding or standing water.
- Has a number of obstacles, such as:
  - Railroads.
  - Highways.
  - Pipelines.
  - Driveways.
  - Parking lots.

NOTE: Burying cable in these areas makes it difficult to meet the overall loss budget.

Cable Construction

For direct buried placement, the cable construction must contain a steel shield for:

- Protecting the cable core against punctures caused by:
  - Hand tools.
  - Gnawing animals.
- Locating purposes.

NOTE: When required, split duct may be used for additionai protection. Split duct should always be used when placing fiber optic cables in sharp. rocky. shale-like conditions.

Placing Cable

Place fiber optical marking tape with the cable (approximately one foot below ground level) to lessen its chances of being accidentally damaged with a digging machine.

Allow for additional cable lengths at burled splice locations to:

- Bring the cable out of the spiicc pit.
- Place the cable in a location suitable for splicing.

Bond and ground the metallic shield at all splice points. This ground must:

- Obtain a resistance of 25 ohms or less.
- When avaiiabic. be attached to the power company multiground neutral (MGN).

NOTE: When the installation technique is changed from buried to aerial or underground, it is not necessary to change the type of cable.

Soil Cover

The recommended soil cover for buried cable is:

- Maintain a cover of 48 inches, unless otherwise specified on the engineering design construction prints.

- When at least 30 inches of cover is not provided, you must provide additional cable protection consisting of pvc conduit or:

  - Concrete encasement.
  - Other suitable material.
  - Polyethylene subduct.

Sizing Pedestais and Handholes

Size pedestals and handholes to:

- Maintain the minimum bending radius.
- Contain the splice case and slack cable.

Ordering Considerations

Consider the following when ordering optical fiber cable:

- The measurements between splice points.
- Splicing overlap - 3 meters (10 feet) at each end.
- The amount of cable required for "out-of-pit" splicing - typically SO feet at each end.

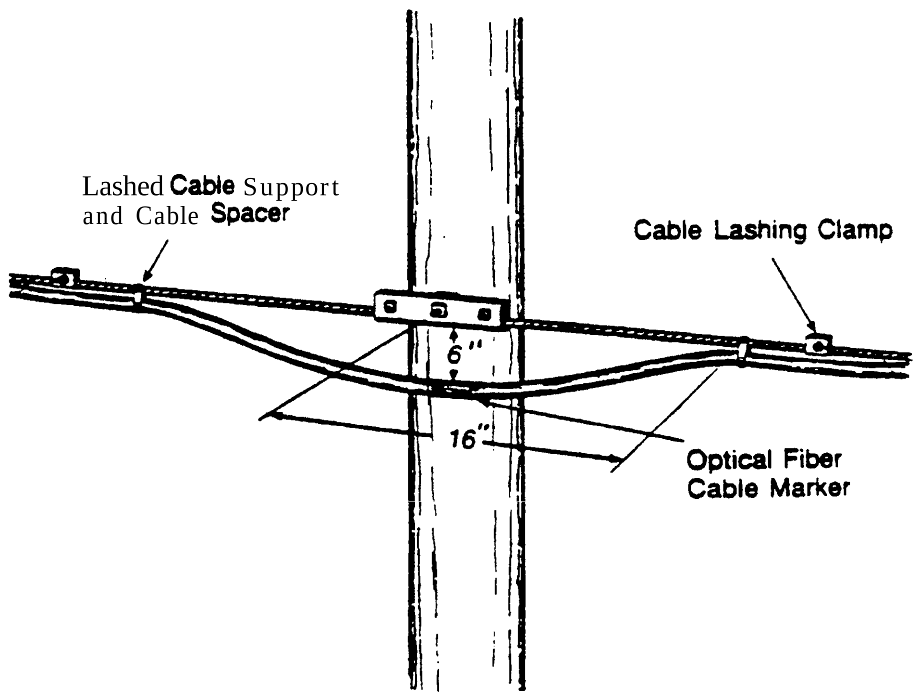
Introduction	**The aerial method** of placing optical fiber cable should be the "last choice" of installation methods. However. aerial placement **may be the only** realistic means of construction due to either: • Terrain or construction conditions. • Economic reasons. NOTE: Telops Practice 624-627-000 covers aerial placing of optical fiber cables. When possibie. design optical fiber cable to occupy the uppermost position of the poie line. The appropriate messenger is a 6M or 1/4-inch diameter strand. Unusual loading conditions may require using iarger messengers. **NOTE:** Use **the** specifications in existing Telops Practices to design and install **the** strand.
Placing Considerations	Placing aerial subduct must be considered for: • Providing additional mechanical cable protection. • Pulling slack for maintenance purposes. • Easy cable installation. • Preventing pole changeouts by lashing subduct to existing copper cable. Aerial subduct must be manufactured with special ultraviolet (UV) inhibitors. NOTE: Ground the messenger according to Telops Practice 605-100-100.
Lashing Optical Fiber Cable	CAUTION: Do not lash together optical fiber cable and copper cable on the same strand. The differences in the **expansion** and contraction coefficients of the two cable types result in undue stress to the fibers. Fiber cables may be lashed together. The single lashing method of cable construction is appropriate when attaching cable to the messenger. However, local conditions and preferences may make double lashing necessary NOTE: Telcos will decide whether to single or **double lash the cable.**
Dielectric Cable	An all-dielectric cable is preferred for aerial installations. However, local conditions may preclude this recommendation. Such conditions include: • Aerial crossings/inserts in buried mutes. • Areas requiring squirrel (or other wildlife) protection. • Hunting-.
Metallic Cable	When placing metallic optical **fiber cable (buried type) on** a pole line. bond the metallic shield and ground it: • Using MGN when possible. • At all splice **points.** Bonds between the metallic members and the supporting strand should be spaced no more than 1.25 miles (2.02 km) when the inductive effects of nearby power tines are not computed. If separation between bonds exceeds 1.25 miles or there are complicated power exposures, the power **environment must be examined** by an electrical protection engineer. In no case should bonds be spaced more than 3.0 miles (4.83 km) apart.

Construction Design

In aerial construction design, allow approximately 6 inches of excess cable at every pole as an expansion loop for normal expanding and contracting.

NOTE: This is not required when subduct is placed.

On the construction drawing, make a note to have the construction forces place warning markers at each pole.



A well-planned engineering design construction print ensures that:

- Suitable splice locations are selected.
- The designated number of splice points are not increased from the initial design requirements.
- Splice points are spaced to coincide with designated reel lengths.

Engineering Considerations

When choosing locations, look for:

- Clear pole space.
- Easy entrance and exit.
- Public areas.
- Areas accessible to:
  - Splicing vehicles.
  - Tools.
  - Test equipment.

Avoid locations involving:

- Employee safety hazards.
- Private property.
- Intersections.
- Congested aerial plant.
- Trees.

NOTE: **Provide** enough area to accommodate a splice enclosure.

Completing Splicing

It may be necessary to provide additional cable at aerial splices so the splice can be made on the ground. After completing the splice, the cable can be either:

- Coiled and attached to the strand.

  OR

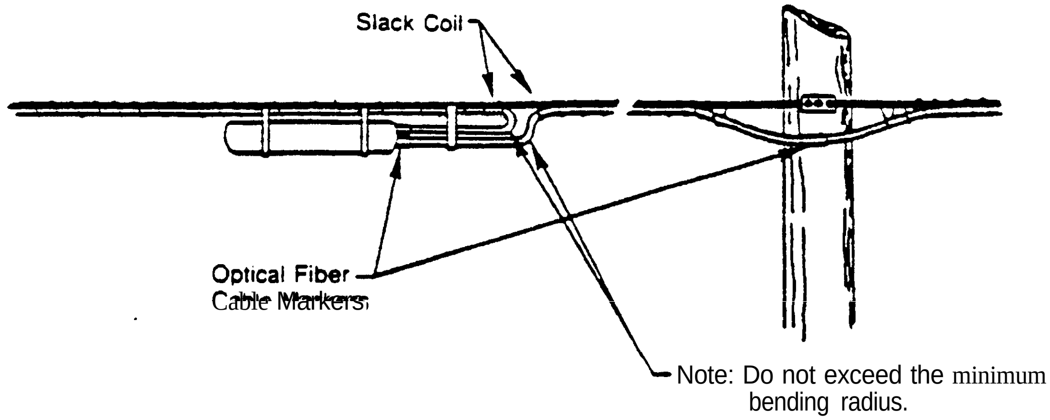
- Placed in an optical storage enclosure.

The straight splice and butt splice/enclosure arrangements allow the splice to be made either on the ground or in the air.

(continued)

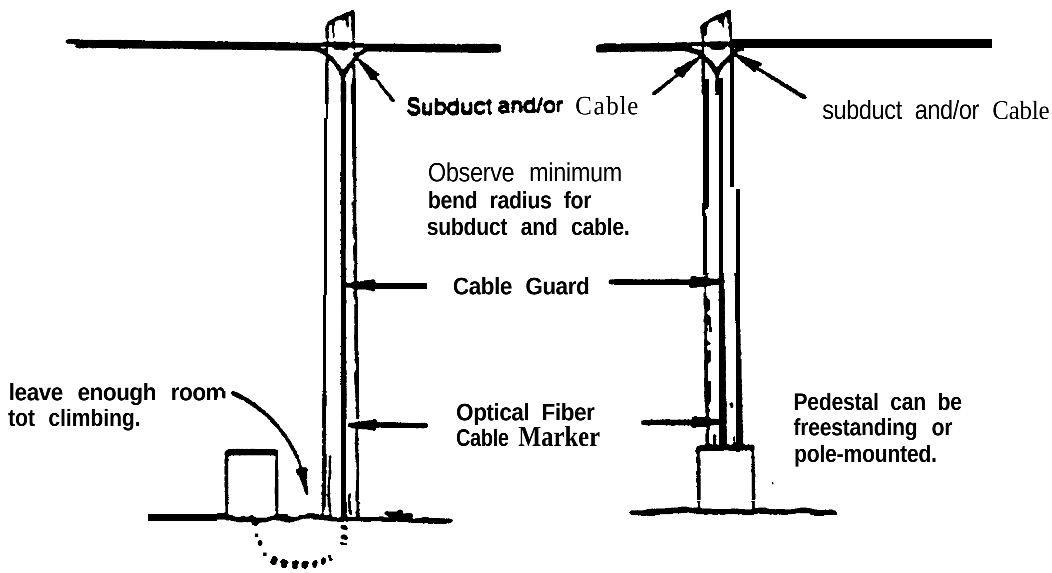
Completing Splicing, conunued

The following illustrauon shows a butt splice configuration with slack stored on the strand:



NOTE: The distance between the pole and splice closure is determined by the amount of cable required for the splice to reach the ground. Multiple coils are not recommended.

The following illustration shows a butt splice with slack stored in a pedestal splice with pedestal:



NOTE: The pedestal may be freestanding or pole-mounted.

Ordering Considerations

Consider the items in the following list when ordering optical fiber cable. The:

- Measurement between splice points.
- Splicing overiap.
- Amount of cable required for on-ground splicing.
- Expansion loop at each pole.
- Slack loop for maintenance (optional according to local Telco practice).