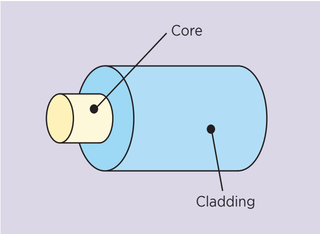
Basic Information

Basic Information on Optical Fibers/Cables

Here're the tips useful to know about the optical

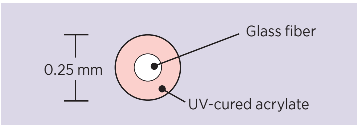
Construction of Optical Fiber

An optical fiber for the telecommunication is made of glass designed to guide light along its length by total internal reflection. The glass fiber has nominal diameter of 125 µm (0.125 mm) and covered with plastic jacket for protection to form 250 µm or 900 µm in diameter. The central part of the glass fiber which guides light is called "core" and the "cladding" around it has lower refractive index than the "core" to confine the guided light. Silica glass is fragile; therefore, it is covered with a protective jacket. There are three typical coatings for the optical fiber.



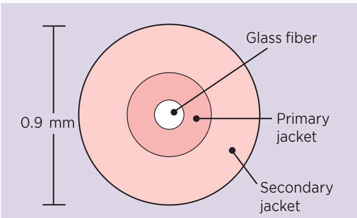
Primary Coated Fiber

This is covered with a UV cured-Acrylate to a diameter of nominal 0.25 mm. Since it has an extraordinary small diameter, it has a superior capacity to fit a large number of fibers into a cable and is used widely.



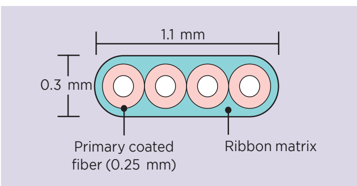
Secondary Jacketed Fiber

Or tight or semi-tight buffered fiber. This is optical fiber covered with thermoplastic to a diameter of 0.9 mm. Compared to 0.25 mm fiber, it is stronger, easier to handle and is widely used in LAN wiring and other small fiber-count cable.



Ribbon Fiber

Ribbon fiber provides an excellent way to boost the productivity of connector assemblies and facilitates mass fusion splicing for greater productivity. The ribbon is composed of 4,8 or 12 colored fibers for fiber counts as great as 1000. The fibers are encapsulated by a UV-acrylate material which can be easily removed with standard strippers for mass splicing or easily peeled apart for single fiber access. Ribbon can be spliced at once with mass –fusion splicer and easy for identification in high fiber-count cable.



Fiber Categories

Here's the most common description of the varieties of telecommunication fibers.

MMF (multimode fiber)
- OM1 or MMF(62.5/125)
- OM2/OM3 (G.651 or MMF(50/125))

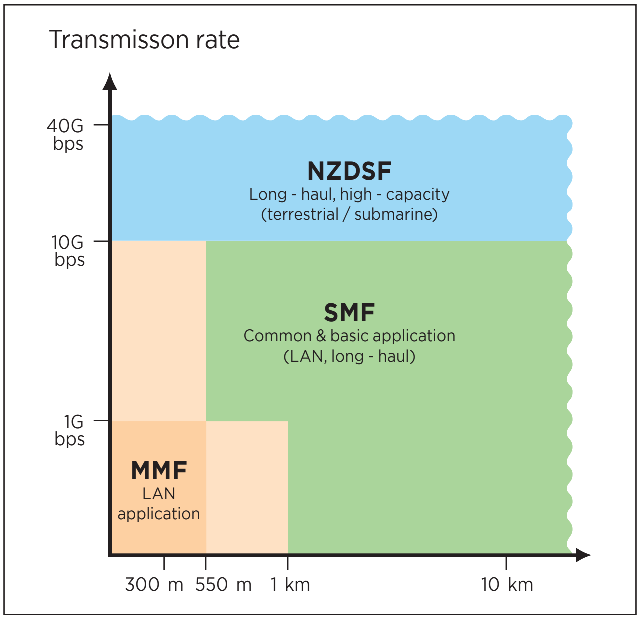
SMF (single-mode fiber)
- G.652 (dispersion non-shifted SMF)
- G.653 (dispersion shifted SMF)
- G.654 (cut-off shifted SMF)
- G.655 (NZDSF)
- G.656 (low dispersion slope NZDSF)
- G.657 (bending insensitive SMF)

Technically you can use any fibers for FTTx as far as the optical budget allows, but the most common application for FTTx shall be by G.652 and G.657.

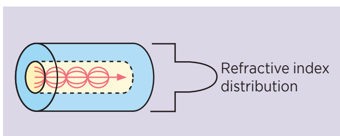
G.651 (multi mode fiber)

Multi mode fiber (MMF) is used for communication over short distance, such as LAN and datacenter. MMF classified M1 to M4 according to ISO/IEC. Each bandwidth and distance is defined as follows.

	Bandwidth	1Gb/s Link	1Gb/s Link	10Gb/s Link	10Gb/s Link
	850/1300 nm	1000BASE-SX	1000BASE-LX	10BASE-SR	10BASE-LX4
OM1	200/500	275 m	550 m	33 m	300 m
OM2	500/500	550 m	550 m	82 m	300 m
OM3	1500/200	1000 m	550 m	300 m	300 m
OM4	3500/500	1100 m	550 m	550 m	300 m



ITU-T G.651 is another name for OM2/OM3 or MMF(50/125). ITU-T recommendation does not have OM1 or MMF(62.5/125) which is still popular in US. The core of MMF(50/125) has a refractive index profile gradually changing from the center of the core to the cladding, which enables multiple of transmission light (mode) travel with nearly the same velocity.



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G.652 (dispersion non-shifted SMF)

It is the most common SMF in the world. It is tuned to minimize the dispersion (which gives the deformation to the signal) around the wavelength at 1310nm. You can use 1550 nm wavelength window for the shorter distance or with the dispersion compensating fiber or module. G.652A/B is the basic SMF and G.652C/D is the category for Low-water-peak SMF.

G.653 (dispersion shifted fiber)

It is designed to minimize the dispersion at around 1550nm where the optical loss is the smallest.

G.654 (cut-off shifted fiber)

Official name for G.654 is “cut-off shifted fiber”, but it is better known as low attenuation fiber. Sumitomo Electric’s Z Fiber™ has the world record of 0.154 dB/km.
Thanks to this low attenuation the major application for G.654 is in the submarine and terrestrial long-haul application such as 400km reach without repeater.

G.655 (NZDSF)

NZDSF is short for NZDSF for wide band transport fiber. G.653 has designed to have zero dispersion at 1550nm, but G.655 has positive or negative dispersion intently. The reason for that is to reduce the undesirable effect of the non-linear phenomenon which interfere with the adjacent wavelength in DWDM system. The first generation NZDSF such as PureMetro™ has smaller dispersion of around or less than 5ps/nm/km to make the dispersion compensation easier. On the other hand the second generation NZDSF such as PureGuide™ has larger dispersion of around 10ps/nm/km to enhance the DWDM capacity to double.

G.656 (low-slope dispersion NZDSF)

It is a kind of NZDSF which has stricter requirements on the dispersion slope which enables to guarantee the DWDM performance in wider wavelength range.

G.657 (bending insensitive fiber)

This category is introduced to specify macrobending performance, which sports implementation in FTTH and access network.
G.657.A is fully compliant with ITU.T-G.652 specification, on the other hand, G.657.B is required higher macrebending performance but not necessary to comply with G.652.

	10 mm	7.5 mm	5 mm
G.652 compliant	G.657.A.1	G.657.A.2	
G.652 not required		G.657.B.2	G.657.B.2

Classification of Techniques Used for Optical Fiber Connection/Splicing

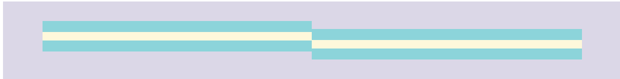
Optical fibers are joined either by fusion/mechanical splice, which is a permanent joint, or by connectors, which can be disengaged repeatedly. Optical connectors are used mostly at joints that need to be switched for optical service operation and maintenance reasons, while permanent joints are in use mostly in other applications.

Mechanisms of Light Loss at Optical Fiber Joint

When joining optical fibers, the opposed cores must be properly aligned. Optical fiber connector/splice loss occurs mostly in the following manner.

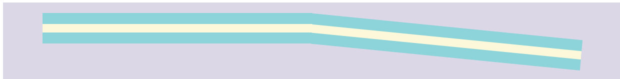
(1) Poor concentricity

Poor concentricity of joined optical fibers causes a connector/splice loss. In the case of general purpose single-mode fibers, the value of connector/splice loss is calculated roughly as the square of the amount of misalignment multiplied by 0.2. (For example, if the light source wavelength is 1310 nm, misalignment by 1μm results in approximately 0.2 dB of loss.)



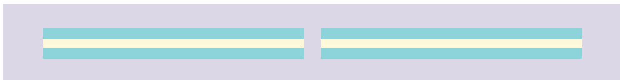
(2) Axial run-out

A connector/splice loss occurs due to an axial run-out between the light axes of optical fibers to be joined. For example, it is necessary to avoid an increased angle at fiber cut end when using an optical fiber cleaver before fusion splicing, since such an angle can result in splicing of optical fibers with run-out.



(3) Gap

An end gap between optical fibers causes a connector/splice loss. For example, if optical fiber end faces are not correctly butt-joined in mechanical splicing, a splice loss.



(4) Reflection

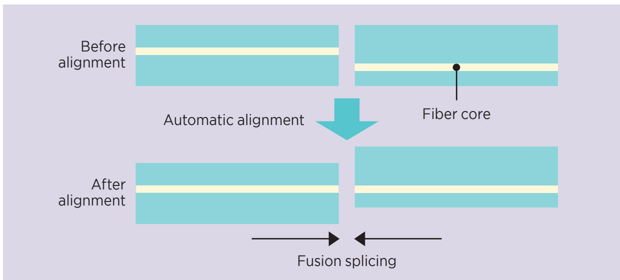
An end gap between optical fibers results in 0.6 dB of return loss at the maximum due to the change in refractive index from the optical fiber to the air. Cleaning optical fiber ends is important for optical connectors. In addition, the whole optical connector ends should be cleaned because loss can also occur due to dirt between optical connector ends.

Classification and Principles of Fusion Splices

Fusion splicing involves the melting and joining of optical fibers using heat generated by an electric arc between electrodes. Fusion splicing is classified into the two methods, as follows.

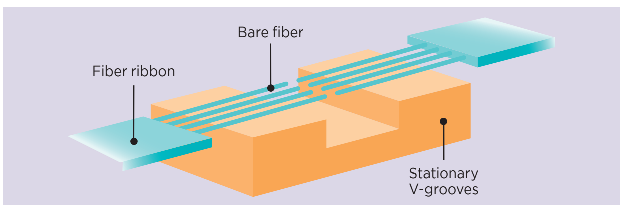
(1) Core alignment method(core alignment)

Optical fiber cores observed with a microscope are positioned with the help of image processing so that they are concentrically aligned. Then, an electric arc is applied to the fiber cores. The fusion splicer used has cameras for observation and positioning in two directions.



(2) Stationary V-groove alignment method (cladding alignment)

This fusion splicing method uses V-grooves produced with high precision to position and orient optical fibers and utilizes the surface tension of melted optical fibers for alignment effects (cladding alignment). Splices made by this method achieve low loss thanks to the recent advancement of optical fiber production technology, which has improved the dimensional accuracy regarding the placement of core. This method is primarily used for splicing a multi-fiber cable in a single action.



Basic Information

Basic Information on Optical Fiber Connection/Splicing

Notes on Fusion Splicing

Fusion splicing procedures comprise
(1) the fitting of a fiber protection sleeve, (2) removal of cover layers, (3) fiber cleaning, (4) fiber cleaving, (5) fusion splicing, and (6) reinforcing the splice.

(1) Fitting of Fiber Protection Sleeve

The fiber protection sleeve is used to protect optical fibers exposed at the splice. Make sure that one of the optical fibers is passed through the protection sleeve before fusion splicing.

(2) Removal of Cover Layers

Using a jacket remover, remove the cover layers to expose the fiber glass.
Notes:
* After cover layer removal, off-cuts are present in the jacket remover. Remove off-cuts from the jacket remover and clean the blade.
* To remove cover layers from a fiber ribbon, use a heated jacket remover. For successful removal, warm the cover layers for about 5 seconds before removal.

(3) Fiber Cleaning

After cover layer removal, clean the fiber glass with alcohol.
Notes:
* Debris of cover layers if remaining on the fiber glass can cause poor concentricity in fusion splicing or increased splice loss. Clean the glass fiber thoroughly.
* In the case of a multi-fiber cable, fiber ends may stick together due to alcohol, causing defective cleaving of fibers. Flip lightly with a finger to spread out the fibers.

(4) Fiber Cleaving

Follow the optical fiber cleaver operating procedure to cut the fiber.
Notes:
* The loss characteristic of a fusion splice depends on the cleaving. To reduce cleaving defects, clean the fiber holder and blade of optical fiber cleaver on a regular basis.
* Keep the cleaved end of an optical fiber away from an object including your fingers to eliminate the causes of defective splices.
* Avoid scattering fiber off-cuts.

(5) Fusion Splicing

Fusion-splice optical fibers following the operation manual of the fusion splicer.
Notes:
* Dirt in the V-grooves or clamp of a fusion splicer can cause an unusual light loss due to poor concentricity. Clean the fusion splicer thoroughly.
* It is possible to detect faulty conditions of cleaved end if pre-splicing inspection capability with dual-axis observation is available.
* If the fiber has a curl, lightly squeeze the fiber with fingers to remove the curl. The placed fiber should bend downward.

(6) Splice Reinforcing

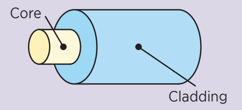
Cover the optical fiber splice with the fiber protection sleeve. Reinforce the fiber with the sleeve on the heater.
Notes:
* Avoid bending or twisting the fiber when moving it so as not to break the fiber.
* Position the fiber protection sleeve so that its midpoint is close to the center of the splice.
* When placing the reinforcement, make sure that the glass fiber is straight.

Optical Fiber Terms

Core diameter

A parameter of multimode optical fibers. It represents the diameter of the circle that best approximates the circumference of the core region. The smaller the value of the core diameter, the broader the services band. Fibers commonly used today have a core diameter of 50μm

Optical fiber structure



Mode field diameter (MFD)

A parameter of single-mode optical fibers, MFD corresponds to the diameter of the spread of electric field distribution in propagation mode (light path). Light usually passes through the core region. However, in the case of a single-mode optical fiber, the light leaks into the cladding region. Therefore, single-mode optical fibers are specified by MFD rather than core diameter. MFD is slightly greater than the core diameter. The smaller the MFD, the higher the required accuracy of alignment for connection/splicing. Furthermore, the larger the MFD difference of two joined fibers, the greater the connector/splice loss.

Cladding diameter

The diameter of the circle best approximating the cladding surfaces. The larger the cladding diameter difference of two joined fibers, the greater the connector/splice loss.

Cable cutoff wavelength

A parameter of single-mode optical fibers. An optical fiber cannot be a single-mode fiber if it is used at a wavelength shorter than the cable cutoff wavelength, which is determined by optical fiber structure, involving refraction index distribution and core diameter.

Proof test

Screening is a technique intended to remove the glass defects of a fiber and improve its structural reliability. A given level of elongation strain is applied to the overall length of an optical fiber to break the fiber at its low-strength section. The screening level is the value of the elongation strain. The higher the value of screening level, the higher the reliability of the optical fiber.

Transmission loss

Transmission loss is a value that indicates the decrease of optical power of light propagating between two points of optical fiber. It is expressed as follows:

$$\alpha = -(10/L)\log(P2/P1)$$

where, L: cable length
P1: incident power
P2: transmitted power

The transmission distance becomes short when transmission loss grows.

Transmission band

A parameter of multi-mode optical fibers. The transmission band is the frequency at which the magnitude of the baseband transfer function decreases to a specified value (6 dB). In other words, the value indicates to what frequency the signal is transmitted without distortion. The higher the transmission band, the higher the usable transmission frequency, hence larger-capacity transmission.

Zero-dispersion wavelength

A parameter of single-mode optical fibers. At the zero-dispersion wavelength, the wavelength dispersion decreases to zero. Transmission at a wavelength of a large absolute value of wavelength dispersion results in greater dispersion and therefore higher optical pulse distortion. Optical fibers designed so that the zero-dispersion wavelength is about 1310 nm or 1550 nm are known as the general-purpose SM or the dispersion-shifted optical fiber, respectively.

Zero-dispersion slope

A parameter of single-mode optical fibers. The zero-dispersion slope represents the gradient of dispersion at the zero-dispersion wavelength. In general, the greater the zero-dispersion slope, the higher the absolute value of dispersion at any wavelength.

Basic Information on Optical Fiber Connection/Splicing

Cable-Related Terms

Maximum permissible tension

The maximum tension means that an optical cable is allowed to undergo during installation. It should be remembered that the maximum permissible tension does not mean the cable is capable of sustaining the tension constantly after installation.

Maximum permissible bending radius

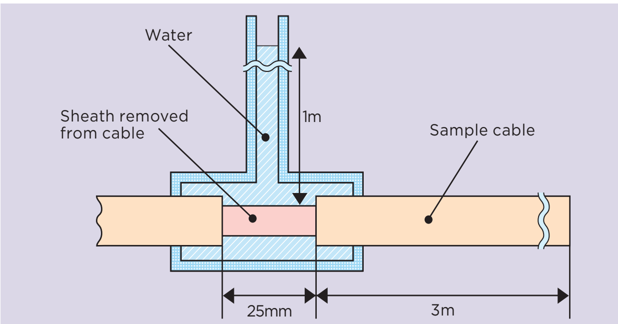
The maximum radius is defined that a fiber-optic cable can be bent. The maximum permissible bending radius applicable during installation differs from that applicable after installation. In general, when a fiber-optic cable is installed, maximum permissible bending radius is about 20 times the cable outside diameter. After installation, it is about 10 times the cable outside diameter.

Operating temperature range

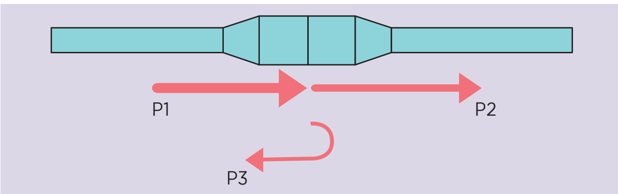
The operating temperature range shows suitable environment for fiber-optic cable installation. In general, the operating temperature range of a cable designed for outdoor use is within -20 to +60°C.
With a cable designed for indoor use, this range is about -10 to +40°C.

Waterproof property

In general, fiber-optic cables installed underground are required to be waterproof. While various test methods are used, Sumitomo Electric adapts the method shown below.



Optical Connector Terms



Connector loss

Optical loss from one of two joined fibers to the other.
The connector loss is expressed by the following equation.

α = -10log(P2/P1) (dB)

P1: optical power immediately before connection

P2: optical power immediately after connection

The greater this value, the larger the optical power decrease, hence the shorter the transmission distance.

Return loss

The ratio expressed in decibels of the power of the light entering a connector to the power of the light reflected from the connected end face.
The return loss is expressed, as follows.

α = -10log(P3/P1) (dB)

P1: optical power immediately before connection

P3: power of light reflected from connection

The higher the value, the weaker the power of reflected light, hence the lower the noise level.

Ferrule polishing method

The connection characteristics of a connector differ depending on the ferrule polishing method adopted.

Terms Related to Optical Termination / Junction Box and Closure

Dustproof waterproof property

In general, optical termination / junction boxes and closures are required to be protected from foreign matter and water leaks (principally for outdoor applications). IP codes specified in JIS C 0920 or IEC 60529 are used to indicate protection classes.

Protection Index

IP □□ : International Protection
- Second characteristic numeral (degree of protection against the ingress of water)
- First characteristic numeral (degree of protection against the ingress of foreign matter)

Characteristic Numeral		Degree of protection (brief description)	Recommended installation
First characteristic numeral	0	Not protected.	
	1	Protected against foreign matter of 50mm diameter and greater.	
	2	Protected against foreign matter of 12.5mm diameter and greater.	Indoor
	3	Protected against foreign matter of 2.5mm diameter and greater.	Indoor
	4	Protected against foreign matter of 1.0mm diameter and greater.	Outdoor
	5	Dust-protected	
	6	Dust-tight	
Second characteristic numeral	0	Second characteristic numeral Not protected.	
	1	Protected against vertically falling water droplets.	
	2	Protected against vertically falling water droplets when enclosure is tilted up to 15°.	
	3	Protected against water sprayed at an angle up to 60° degrees on either side of the vertical.	Aerial
	4	Protected against water splashed from any direction.	Aerial
	5	Protected against water jets.	
	6	Protected against powerful water jets.	
	7	Protected against the effects of temporary immersion in water.	Under ground
	8	Protected against the effects of continuous immersion in water.	
X		Protection degree not specified.	

Code examples

IP54 : Dust-protected and protected against splashing water

IP3X : Protected against foreign matter of 2.5 mm diameter and greater.
Protection against water not specified.

IPX7 : Protection against foreign matter not specified.
Protected against the effects of temporary immersion in water.

Basic Information

Notes on Optical Cable Selection and Installation

The following are points to bear in mind when selecting suitable optical cables for a specific application and installation location and for proper installation work.

Selecting a basic optical cable structure (recommended structure)

Long-Haul

- **Underground trunk line**
  - ■Ribbon slotted-core cable (helical)
  - ■SZ slotted-core ribbon cable

《Note》
Secure optical fibers* when using a ribbon slotted-core cable (helical) along railroad tracks or in other places where strong vibrations can cause fibers to move.

FTTH

- **Overhead trunk line**
  - ■SZ slotted-core ribbon cable

《Note》
Drop cables have a simple structure for limited use on subscriber premises. They are less strong than slotted-core cables and therefore not suitable as a trunk line.

- **Premises**
  - ■Small-fiber-count slack aerial cable
  - ■Drop cable

《Note》
Small-fiber-count slack aerial cables are suitable for joining fibers of different diameters.

LAN

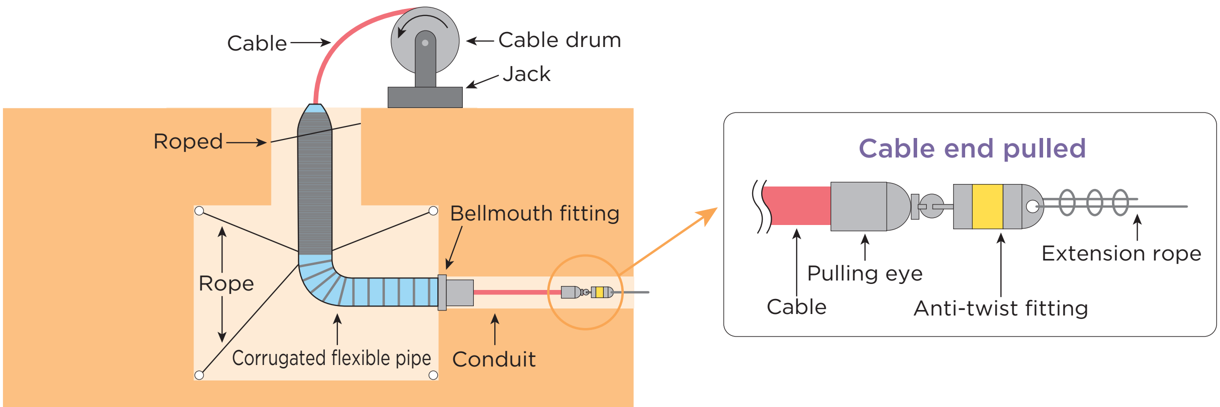
- **Vertical wiring**
  - ■SZ slotted-core ribbon cable
  - ■Distribution cable
  - ■Core-and-strands cable

《Note》
SZ cables are suitable for high-fiber-count applications, while distribution cables are suitable for low-fiber-count applications.

- **Horizontal wiring**
  - ■Distribution cable
  - ■Indoor cable
  - ■Cord

* Securing fibers means fastening fiber ribbons and slotted spacers with an adhesive or the like.

Example underground trunk installation method



■Attach a pulling eye or other similar fitting on one end of the optical cable.

■Use an anti-twist fitting or the like, as shown above right, to avoid twisting in the optical cable during installation.

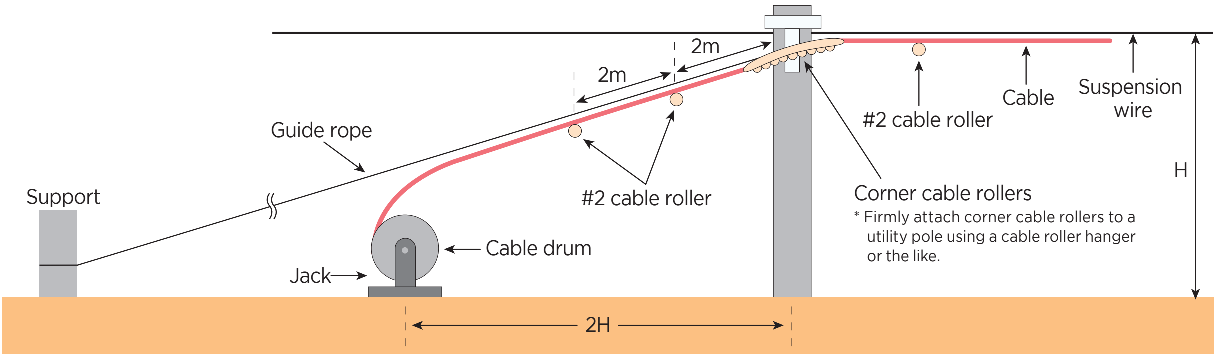
■Place the cable drum right above the opening of the conduit, as shown above left, in order to unwind the cable in a smooth curve from the drum. When unwinding, take care so as not to twist or form a kink in the cable. Moreover, use a corrugated flexible pipe and a bellmouth fitting to protect the cable.

■To lay an optical cable over a long distance, pull the tension member instead of the cable sheath and monitor the tension in the cable to avoid over-tension. Over-tension can result in detaching the pulling eye or squashing the cable. The maximum allowable tension differs according to the cable type, and specifications are given for individual cables. For more detailed information, refer to the relevant specifications.

■For installation along railroad tracks or in other places where strong vibrations can cause fibers to move, use a ribbon slotted-core cable (helical) with fibers secured or an SZ slotted-core ribbon cable.

Notes on Optical Cable Selection and Installation

Example overhead trunk installation method



- Use an anti-twist fitting or the like to avoid twisting in the optical cable during installation.
- Hanger rollers tend to cause twisting in the cable for structural reasons. If you are using hanger rollers, use them with the utmost care during the installation of a long cable since hanger rollers are likely to affect the cable in such installation.
- Place the cable drum 2H or more apart from the utility pole (H: cable roller mounting height), as shown above, to avoid sharp bends in the optical cable. It is recommended to use an 11-wheel cable roller with a 300 mm corner radius to avoid squashing the cable during installation.
- To lay an optical cable over a long distance, pull the tension member instead of the cable sheath and monitor the tension in the cable to avoid over-tension. Over-tension can result in detaching the pulling eye or squashing the cable. The maximum allowable tension differs according to the cable type, and specifications are given for individual cables. For more detailed information, refer to relevant specifications.
- If it is unavoidable to use a ribbon slotted-core cable (helical), always secure the fibers in order to prevent them from moving due to vibration after installation.
- Figure 8 cables need to be twisted once every 10 m or so to reduce vibration caused by winds.

Example on-premises installation method

- When installing a cable, it is important to monitor tensions in the cable and bend radii to ensure they are within the limits.
- When installing a drop cable onto subscriber premises, the suspension wire must be anchored.
- When securing the suspension wire of a drop cable, making a sharp bend in the optical fiber can result in a break. Use care not to break the fiber.

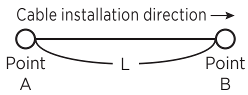
Example cable tension calculation method

The following are example formulae used in tension calculation.

(1)Straight section

$$T=10 \cdot f \cdot W \cdot L$$

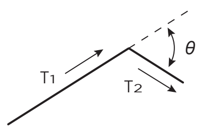
T : tension in straight section (N)
10 : acceleration due to gravity (m/S²)
f : coefficient of friction
W : cable weight (kg/m)
L : length of straight section (m)



(2)Bent section

$$T_2=T_1 \cdot K$$

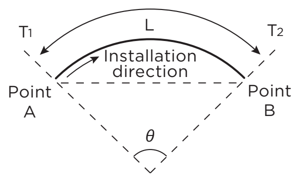
T_1 : tension immediately preceding bent section (N)
T_2 : tension immediately following bent section (N)
K : tension increase rate
f : coefficient of friction
θ : crossing angle



(3)Curved section

$$T_2=(T_1+T) \cdot K$$

T_1 : tension immediately preceding curved section (N)
T_2 : tension immediately following curved section (N)
T : 10fWL
K : tension increase rate
f : coefficient of friction
θ : crossing angle



Tension increase rate used in tension calculation (one case of underground conduit)

Combination	Cable plus Conduit made of flexible PE pipes and flexible pipe for cable protection	Tension increase rate (K)
Coefficient of friction	0.5	
Crossing angle (θ°)	6~10	1.10
	11~16	1.15
	17~20	1.20
	21~25	1.25
	26~30	1.30
	31~34	1.35
	35~38	1.40
	39~42	1.45

Basic Information

FAQs

Q1 Is there any limit to the degree of bend in an optical cable?

A1 In general, the minimum allowable bend radius of a cable is 10 times the outside diameter of the cable or the minimum bend radius of the fibers in the cable, whichever is larger. The minimum allowable bend radius of optical fibers is generally 30 mm. Accordingly, bending an optical cable to a bend radius of less than 30 mm should be avoided, however small the cable diameter. However, Sumitomo Electric has developed PureEther-Access and PureAccess-PB, an MM fiber and an SM fiber respectively, both of which feature a minimum allowable bend radius of 15 mm. Moreover, Sumitomo Electric has developed a 7.5 mm bend-radius SM fiber PureAccess-A2, representing a breakthrough in the optical cable bend radius.

Q2 Multimode optical fibers have a core diameter of 50µm or 625µm What differences are there between these specifications?

A2 The 62.5µm core diameter is used commonly in the United States, while the 50µm core diameter is generally used in Japan. The difference in core diameter entails the use of different transmission equipment. Optical fibers made to the larger 62.5µm core diameter spec are easier to connect with transmission equipment, which implies the use of low-cost equipment. In contrast, the 50µm core diameter spec necessitates the use of relatively costly equipment, yet with the advantage of optical fibers enabling a broader band. In recent years, the 50µm core diameter spec has been on the way to the mainstream due to the popular use of the Gigabit Ethernet, for instance the 10-Gigabit Ethernet, incorporating broad-band optical fibers.

Q3 Which optical cables offer resistance to moisture or water?

A3 Typical examples of such cables are the LAP-sheathed and WB types. The LAP-sheathed cable has the inside of the sheath lined with aluminum tape to provide resistance to moisture or water. If the sheath is damaged, water may enter and spread in the cable. The WB cable has fibers wrapped with a water-absorbing tape rendering it moisture/water-resistant. The water-absorbing material swells in the event of water ingress to prevent the spread of water in the cable.

■LAP-sheathed cables have “LAP” in their product names.

Example: Core-and-strands cable [8NHGI(PE-A1G)—L—LAP—FR]

■WB cables have “WB” in their product names.

Example: SZ slotted-core ribbon cable [100SM(PAPB)—SZ4R—WB—E]

Q4 In case SM fibers with the different mode field diameter were spliced, the splicing loss was extremely large. Is there a good solution to this problem?

A4 The OTDR method is in wide use for measuring the splice loss. When the splicing loss of SM fibers with the different mode field diameter is measured by OTDR, the measurement value is not the true splicing loss but the apparent splicing loss.
The OTDR measures the level of radiation scattered back by the optical line and collected by the receiver of the instrument. Since the backscatter coefficient depends on the mode field diameter of the fiber, the splicing loss differs by the direction of the incident light.
The error in a measurement made in one direction will be positive (Fig.1), and the error in the other direction will be negative (Fig.2). The use of an average of readings taken in opposite directions cancels the error due to differences in the backscatter coefficient of the two fibers (Fig.3).
Even the same SM fibers (the nominal mode diameter: 9.2 um) have different mode field diameters within a design tolerance of +/-0.4 um. If the accurate splice loss is desired, it is necessary to conduct the measurement in two directions.

Apparent splice loss by one way OTDR measurement

Fig.1 In case pulse is incident into the fiber with smaller MFD.

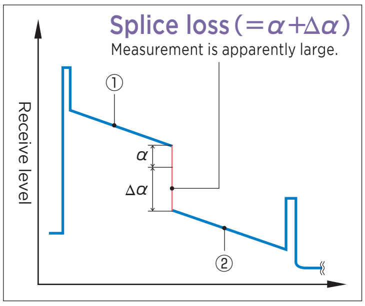
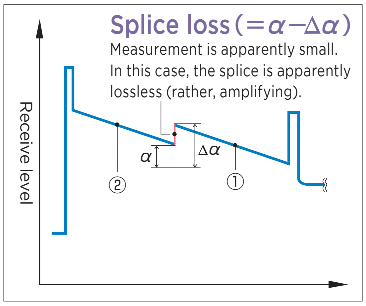
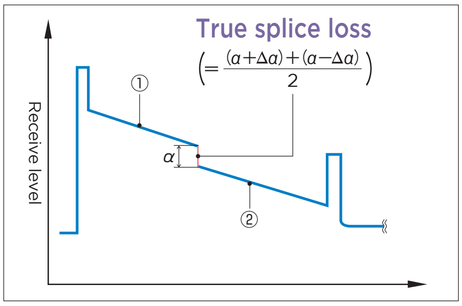


Fig.2 In case pulse is incident into the fiber with larger MFD.



True splice loss by two way OTDR measurement

Fig.3 The use of an average of readings taken in opposite directions cancels the error.



①: Fiber with smaller MFD. (Larger backscatter coefficient)
②: Fiber with larger MFD. (Smaller backscatter coefficient)
α: True splice loss
Δα: Error of splice loss

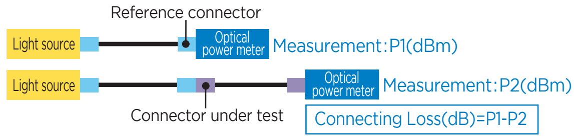
FAQs

Q5 Is there any good method to measure the connecting loss?

A5 ■Single mode

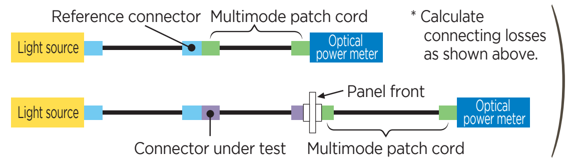
Set up is shown in Fig.1. It is compliant to IEC 61300-3-4.

Fig.1



(In case the connector is impossible to connect an optical power meter, use a multimode patch cord on the receiving end as shown in Fig.2.)

Fig.2



■Multimode

Figure 3 shows the set up for measuring the multimode connector. It is compliant to IEC 61300-3-4.
The objective of a mode filter is to remove unwanted transient higher order modes and eliminate measurement inaccuracies. The mode filter consists of five, close-wound turns on a smooth round mandrel whose diameter is selected to ensure transient modes have been attenuated and steady-state conditions have been achieved. The diameter of the mandrel may differ from fiber to fiber depending on fiber and coating type. The typical mandrel diameters are shown in Table 1.

Fig.3

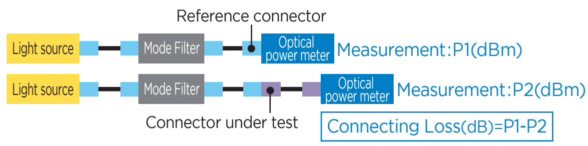


Table 1. Mandrel diameter sizes

Fiber size (um)	Mandrel diameter (mm)
50	18
62.5	20