FIBER OPTIC
AND ACCESSORIES

premium line

Introduction to Fiber Optic

Fiber Optics are made of thin threads of silicon in the form of silicon dioxide (SiO_2), which “guide” the light. These can be considered as “glass wave guides” which transport photons (light) instead of electrons (electrical current) as with conventional wave guides in microwaves or in coaxial cables used in electronics.
This support, similar in shape to a fine hair, is made of two coaxial cylinders of different transparent dielectric material.The figure 1 shows a frontal section of the structure of a typical step index fiber and emphasizes the different index of refraction, n1 and n2, between materials that compose core and cladding.
At the point of contact between the two materials there is a sharp increase in the refractive index, which has given its name to the “step index” fiber (figure 2).
The light wave is emitted inside the nucleus, which is confined within the core by the cladding. In order to isolate any existing micro-fractures, the fiber has a primary covering of one or two layers of synthetic coating (acrylate or silicon rubber). In order to understand the principle of “guided” emission, it is necessary to consider what happens when an elementary ray of light cuts into the dividing surface of the two material elements, both optically transparent, but characterized by different densities and therefore different refractive indexes.
When a ray of light reaches the joint between two materials which have different refractive indexes, “optic refraction” occurs. This is the sharp deviation of the ray which enters the core material with a different angle of incidence in relation to the direction of the same when it enters the cladding material, that is, the angle of incidence is different from the angle of refraction of the emerging ray. If the angle of incidence at the joint is the same as the so-called “critical angle”, which depends on the relationship between the refractive indexes of the two elements, total reflection occurs. The emerging ray of light spreads in a parallel direction to the joint between the two materials. In this case the light wave remains confined within the core.

The most common fiber classification is:

- **Multimode** – when the light ray emission has many varied angles of incidence (which are always less than the acceptance angle)
- **Singlemode** – when the only emission mode is that which is parallel to the fiber axis

A further classification is that relating to refractive indexes. We distinguish:

• Step-Index fibers, where the refractive indexes of the core and cladding are uniform. In this case the light rays follow a straight route within the core, reflecting against the dividing surface between the core and cladding on each impact
• Graded Index fibers, (the most commonly used nowadays) where the refractive index of the core is graded from the centre towards the edge. This type of core is obtained by placing layers of glass with decreasing refractive indexes so that the light rays are diverted, causing a curved line of progression towards the fiber axis

By combining both types of classification criteria we have the following:

- **Multimode graded index fibers** – are used both to send data at high speed and for telecommunications over medium distance (a few km)
- **Singlemode step index fibers** – are used for very high speed, long distance telecommunications and local and nationwide telephone networks

The second edition of ISO 11801 has recently redefined optical fibers in terms of three multimode grades called OM1, OM2 and OM3 and a singlemode fiber to be called OS1.
Generally speaking, OM1 is similar to the 62.5/125 fiber in circulation today. OM2 aligns with today’s 50/125 and OS1 is G652 singlemode fiber. OM3 however will be a new ‘VCSEL laser enhanced’ 50/125 fiber intended to support 10 gigabit Ethernet over 300 meters. OM3 has a very large bandwidth at the first operating window (850 nm), at least 2,000 MHz.km (ten times more than OM1 and OM2), and has a near perfect refractive index profile optimized for laser transmission through multimode fibers.
Which fiber type is required is determined by the questions: how far, how fast? A look on the table below will help.

Speed	Distance		
	300 m	500 m	2,000 m
100 Mb/s	OM1	OM1	OM1
1,000 Mb/s	OM1	OM2	OS1
10,000 Mb/s	OM3	OS1	OS1

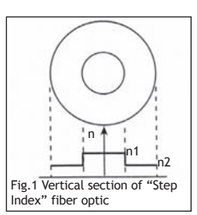
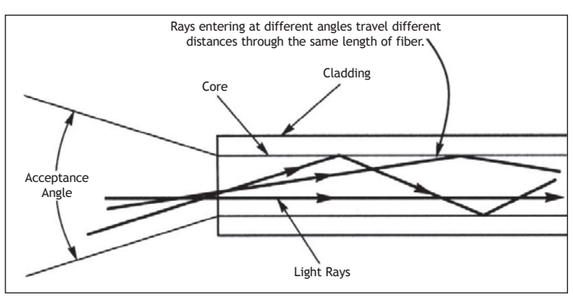


Fig.1 Vertical section of “Step Index” fiber optic



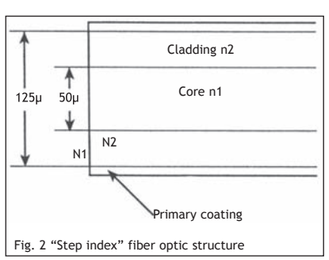


Fig. 2 “Step index” fiber optic structure

Optical Cables

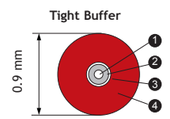
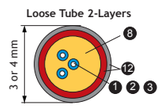
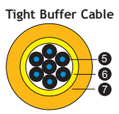
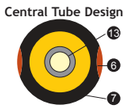
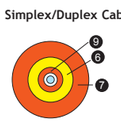
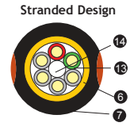
Optical cables can be divided in different categories according to their use or structure.
According to their use, they can be divided into two main categories: internal cables and external cables.
Internal cables usually contain tight buffered fibers, which are not waterproof and are easier to terminate.
In multiway cables the absence of a protecting tube and of a gel make them ideal for onsite direct termination.
Tight buffer duplex cables are used to manufacture patch cables.

Tight buffered cables usually contain up to 12 fibers buffered to 900 µm, beyond this number the diameter of cables increases considerably making difficult the passage in pipes.
The installation of a loose cable turns out to be easier in case of an increasing number of fibers. The loose cable is suitable to external and internal installations.

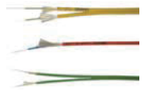
The fibers are covered with an ink that increases external diameter to 250 µm and are protected by a tube.
Each tube usually contains a water blocking gel to fill the interstices to protect the fibers against the entry and propagation of water in order to make them suitable for use in areas subjected to flooding.
For external installations loose cables are mostly used, with various kind of reinforcement.
Traditionally this design entails two or more 250 µm fibers installed loosely in tubes, with single or multiple tubes, usually wound around a central strength member.

These are then over sheathed with a cable jacket or jackets, to suit the particular cable’s purpose.
As this kind of application can be expensive, a gel filled single loose tube construction has been developed: instead of having multiple tubes, the number of 250 µm (up to 24) are deployed loosely in a single tube, which is over sheathed with aramid or glass yarn strength member and a cable jacket.

Cables section

Section	Tight buffer	Section	Loose tube
	1. Core 2. Cladding 125 µ 3. Primary coating 250 µ 4. Secondary coating 900 µ		1. Core 2. Cladding 125 µ 3. Primary coating 250 µ 8. Gel 12. Synthetic sheat
Section	**Tight buffer cable**	**Section**	**Central tube loose cable**
	5. Tight buffered fibers 6. Kevlar or glass yarn strength member 7. Outer sheath		6. Kevlar or glass yarn strenght number 7. Outer sheath 13. Loose tube
Section	**Simplex/duplex cable**	**Section**	**Multitube loose cable**
	6. Kevlar strenght member 7. Outer sheath 9. Semi tight fiber		6. Kevlar or glass yarn strength member 7. Outer sheath 13. Loose tube 14. Central strength member

Tight Cables



Internal Simplex and Duplex Cable

Simplex cable is a tight buffer construction available in both singlemode and multimode versions, reinforced with Kevlar and a protective LS0H jacket for a robust light weight cable structure.
Zip duplex cables consist of two individual coated fibers in a 900 µm tight buffer tube, reinforced with Kevlar and a 2.8 or 2.1 mm LS0H jacket, laid together and joined by an easy tear web in an “eight figure” configuration. Available in multimode and singlemode version and also round suitable for FDDI or ESCON application.
Internal “mini-zip” duplex cable is designed as a duplex cable with small dimensions (1.6 mm × 2) compared to a conventional zip duplex in order to fit to the new generation connectors SFF (Small Form Factor).

Internal Tight Buffered Cable

Also known as Distribution Cable, this consists of 900 µm tight buffered fibers, encased in aramid yarns, and over sheathed by LSOH or Flame Retardant material. It stands for easy indoor cabling and often replaces the Breakout cables in buildings. It is also the ideal cable for installations right to the desk due to the flexibility and the easy strip ability of the tight buffered fibers. It is available from 4 to 12 fibers.

Breakout Cable

The breakout cable can hold two or more simplex units, each with its own individual 900 µm buffered fiber aramid yarn strengthening and LS0H jacket to provide the fiber protection.
The fiber are contained in an external sheath.
Its typical application is for short and medium distances in protected outdoor environments and for indoor applications.

Tight Buffered Fibers

These fibers are secondary coated to 900 µm and are designed for the manufacture of pigtails etc., to be used without splice trays and other protected environments.

Loose Cables

All Dielectric Armoured

The loose optical cable dielectric armoured can hold from 2 to 144 fibers. It shows a good tensile strength to cable weight ratio. Its longitudinal water barrier, provided by the specially treated glass yarns and the wear-resistant PE-sheath, make this cable suitable for use in empty ducts and for laying in trunking.
The glass yarns covering the loose tubes provide rodent protection and excellent crush resistance, which is important when the cable is laid with other cables.
It is available in single (up to 24 fibers) or multi tube version.

External Armoured Cables

Armoured loose cable are available in many versions: steel tape cables, steel wire braid cables and steel wire armoured cables.
They can hold up to 144 fibers and they are designed for conditions where mechanical or chemical attack or rodent damage occur.
They guarantee excellent fiber protection from water and moisture.

Loose Cables with Central Steel Tube

Premium line has recently introduced Market a new cable on the Italian. This cable with dielectric armouring and central stainless steel tube allows you to have a very light and useful, but completely anti rodent cable.
Main features:

- Use in heavy environmental conditions
- Flexibility and crush resistance
- Total rodent protection
- Water proof
- Halogen free sheath

Loose Protecting Tube

The loose protecting tube is used to protect primary coated 250 µm fibers, when they are exposed to handling for any reason, for instance, during field termination of loose cables.
The tube itself has a 3.0 or 2.0 mm outer diameter and can be installed over coated or tight buffered fibers up to 1meter. A Kevlar strength member is also included within the product for extra protection.

Optical Connectors

Since the tiny core of an optical fiber is what transmits the actual light, it is imperative that the fiber be properly aligned with emitters in transmitters, photo-detectors in receivers and adjacent fibers in splices. This is the function of the optical connector. Because of the small sizes of fibers, the optical connector is usually a high precision device with tolerance on the order of fractions of a thousandth of an inch.

There are several types of optical connectors.

- Currently the connector specified in norms ANSI/TIA/EIA-568A, Commercial Building Telecommunications Cabling Standard, is the SC duplex plug connector.
- The one that is most widely used is the bayonet coupling ST connector.
- New and small in size are MTRJ and LC.

ST PC/UPC/APC CONNECTORS

- Easy to assemble, with high optical performance and low in cost.
- 2.5mm diameter keyed ferrule design.
- Ceramic and polymer ferrules.
- Metallic or plastic body.
- Singlemode and multimode.
- Also available as pre-loaded or Light Crimp.

LC PC/UPC/APC CONNECTORS

- It measures one-half-inch, doubling port density.
- 1.25mm diameter ferrule.
- IBM is producing LC-based transceivers for the Fiber Channel protocol.
- User-friendly audible latch to indicate proper mating.

SC PC/UPC/APC CONNECTORS

- The SC connector is becoming the most popular.
- Chosen as standard by EIA/TIA board.
- Resistant proof plastic body.
- Minimum back reflection.
- Common housing for duplex connectors.
- Rectangular plug housing eliminates the need to rotate the plug housing and the resulting torque applied to the ferrule.
- SC also allows high-density mounting, which is further increased by use of the SC Duplex.

MECHANICAL CONNECTOR

- Ideal design for two fiber direct connection
- Convenience installation
- Low loss ≤ 0.2dB
- Good repeatability, IL ≤ 0.2dB, RL ≤ 5dB after 10 times reuse

FC PC/UPC/APC CONNECTORS

- High precision connector with metallic body, but expensive.
- It is a screwed connector made up of several, all metallic, parts. Specially designed for tele nication applications. FC connectors are available in standard version or can be angled for low back reflection requirements.
- Zirconia ferrules, 8° angle on APC ferrule.

Adapters

There is a wide range of adapters available for all types of connectors, e.g.:

- ST-ST singlemode and multimode.
- SC-SC singlemode and multimode, simplex and duplex.
- LC-LC singlemode and multimode, simplex and duplex.
- FC-FC singlemode and mutimode

MTRJ Connectors

- Developed by a consortium including Hewlett-Packard, AMP, Siecor and Fujikura.
- Small, rugged design with the plug-in similar to RJ-45.
- Duplex connector.
- Plastic ferrule.

Fixed Attenuators

- They use a wavelength sensitive neutral density filter specify for 1310 nm operation.
- Available ST, SC, FC standards, female to female or female to male.
- Attenuation in 5 dB increments up to 20 dB.

Optical Assemblies and Tools

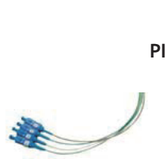
PATCHCORDS

- ST/ST, ST/SC and SC/SC patch cords are available in both multimode and singlemode, with 62.5/125 or 50/125 cable, LS0H or PVC jacket, in duplex or simplex version and in the standard lengths of 1 m, 2 m, 3 m, 5 m, 7 m, and 10 m.
- Other lengths, OM3 and custom specifications on request.

- LC/LC, LC/ST, LC//SC, MT-RJ/MT-RJ, MT-RJ/ST, MT-RJ/SC, FC/FC, FC/MT-RJ, FC/ST, and FC/SC patch cords are available in duplex version in multimode with 62.5/125 or 50/125 cable, LS0H or PVC jacket in standard lengths of 1 m, 2 m, 3 m, 5 m, 7m, and 10 m.
- Other lengths, simplex, OM3 and custom specifications on request.
- All patch cords are manufactured using OFNR riser grade cable and are 100 % factory tested to ensure performance according to TIA/EIA-568-B, ISO 11801:2002 and EN 50173-1 standards.

PIGTAIL

- Pigtail is a fiber optic cable with a connector at one end, terminated in laboratory. It allows field fiber termination using a fusion splicer.
- Premium Line offers pigtails with various kind of fibers and connectors in standard lengths of 1 m and 2 m.



Re-Usable Mechanical Splices

- Mechanical Splices allow to join the fiber without fusion splicer
- Requiring no special tools to install
- Equally compatible with 250 and 900 µm fibres
- Available in both single and multimode versions
- Extremely quick and easy to install and it is re-usable with high performance

Fusion Splice Protectors

- Standard length of 45 and 61 mm
- Reinforced by a stainless steel pin running down its length ensuring the maximum possible protection for delicate fusion splices
- Outside diameter is 2.4 mm
- Available in clear colour

SPLICE CASSETTE

- Accomodate up to 12 fusion splices
- Stackable tray
- Allows entry/exit of buffer tubing at any of the four corners

FTTD WALL BOX

- Apply to FTTx of PON project
- Standard A86 faceplate design
- Suit for SC,LC duplex and SC to FC adapter
- Self lockable cover design easy to re-terminal

FTTX FACEPLATE

- Secures to any surface, dry wall, baseboard, and even modular furniture
- Available 2 types, SC duplex (LC quad), ST dual ports
- With hidden mounting screws and clear outlet ID labels

Fiber Stripping Tool

- High precision stripping tool
- It has extremely accurate hardened jaws giving a smooth and clean stripping action
- It removes the coatings from 125 µm fiber without scratching the fiber itself
- The primary coating stripper quickly and precisely removes the 250 µm primary coating from loose tube fibers without damaging the fiber in any way

Pre-polished Termination Kit

- The pre-polished termination kit is a new system providing a fiber stub that is fully bonded and factory polished into the ferrule
- The other end is precisely cleaved and placed into the patented alignment mechanism
- The installation requires that the field fiber be cleaned, cleaved, and inserted inside the mechanical splice section
- Small installation tool completes the connector on jacketed cable in less than two minutes
- The pre-polished Connector Termination Kit will terminate ST, SC, FC, LC and MTRJ in both single and multimode
- The pre-polished Kit includes:
  - Installation tool
  - Aramid yarn crimp tool
  - Plier-type fiber stripper
  - Jacket stripper
  - Score and snap fiber cleaver
  - Electrician's scissors
  - Number marker
  - Tweezers
  - Alcohol wipes
  - Strip gauge
  - Super glue
  - Instruction manuals and video training

Splicing and Fiber Management

Fiber Optic Closures from 24 to 144 Fibers

- Complete range of fiber optic splice closures for various outside plant applications
- Ultimate protection for fiber optic splices from environmental conditions
- All closures are watertight and temperature resistant
- Maximum durability in aerial or underground installations
- All styles provide easy installation and fast re-entry without the need for tools, minimizing network disruption
- Each closure is provided with a "kit" of products needed to effectively protect your fiber optic splices
- Inline & Dome type for your optional

Splice Bridge Kits

- The 12/24 position splice bridge allows you to fix the fibers inside the optical box
- Supplied without lid
- Designed as a versatile solution to fibre splice management, these grey plastic splice bridges can be employed in most common applications

Fiber Optica Cleaver

- Blade life 12000times
- Compact and Handy Outfit Design
- Typical cleave Angle: 90 degree + (-) 0. 5 degree
- Adjustable Cleave Length: 5-20mm
- Coating Diameter: 250-900 micron

200× & 320× Microscope

- High quality magnification
- Precision microscope designed for the examination of optical connectors in the field, laboratory, or manufacturing environments
- Including a universal 2.5 mm ferrule connector adaptor

Visual Fault Locator

- The visual fault locator (VFL) is laser-based light source
- 635-670 nm typical wavelength
- The light reaches a 3 km distance
- Tipically Used:
  - To verify continuity of a fiber
  - To find out where a fiber goes
  - To verify polarity of a fiber pair
  - To see some breaks in fibers

FUSION SPLICER

- A fiber optic network installation usually requires splicing. The splices provide two techniques: mechanical and fusion.
- Mechanical splice is made through a device that couples the extremities of the fiber binding them together.
- In fusion splicing the fibers are "soldered" together by an appropriate splicer. Thanks to this technique the results are nearly untraceable.

A good mechanical splice with matching gel can have good results, but never equals fusion splicing.

- The fusion splicer offered by Premium Line automatically makes the whole process of fiber fusion be finished in 25 seconds.
- The 5" multi color LCD monitor makes each process of fiber fusion clear.
- User friendly multi language program.

19" FIBER Optic Panel

- Premium Line's 19" rack mountable fiber optic patch panel is designed for direct cable administration, termination, routing and splicing.
- The modular design of the patch panel allows the assembly with various face plates: standard face plates are 8port SC, 8port ST and blank panel. 4port, 6port, duplex and LC face plates are on request.
- The smooth sliding tray can be opened up to a 155° angle.
- Two tightly sealed cable entries on the back of the panel.
- Splice cassettes and cable routings available.

Wall Mount Fiber Optic Box

- Used for direct termination of fibers the Premium Line wall mount fiber optic box comes in 24port and 48port version for ST or SC adapters.
- Two separate sections for fusion splice trays and routing optical connecting modules.
- Cable entry and exit protected against dust and debris by flexible grommet seal.

www.premiumline-cabling.com