STL

# estelan

## Installation Guide for Fibre Portfolio

## Content

# Types of optical fibre

About optical multimode fibre (OM) & optical singlemode fibre (OS): Fibre optic cables used in telecommunication are broadly categorized in two types – Multimode Fibre and Single mode Fibre cables. optical multimode fibre cable is prefixed with 'OM' and Single mode Fibre cable is prefixed with 'OS'.

Difference between multimode fibre & singlemode fibre: The main difference between OM and OS type cables is in core diameter with OM multimode Fibres has a much larger core size. Two types of OM cables with core diameters of 50 micron and 62.5 micron are specified.

## Comparison between different types of Multimode Fibre optic cables

As per Our Estelan Product Brochure, We use only OM3 & OM4 Multimode Fibres, As users requires higher speed networks laser-optimized OM3 & OM4 cables were deployed that provide bandwidth to support transmission above 10 Gigabit Ethernet. Laser optimized multi-mode (LOMMF) cable OM3 & OM4 are designed for use with 850 nm VCSELs that are capable of modulation over 10 Gbit/s whereas LEDs have a maximum modulation rate of 622 Mbit/s.
A guide to typical Bandwidth and Attenuation as well as transmission distances for each category of OM cables are shown in the table 1 It should be remembered that the actual reach for a given bandwidth depends upon the network design and chosen engineering hardware solution. The choice of cable is therefore part of a solution package and needs to be specified by the network designer.

## Table 1 - Bandwidth, Attenuation & Transmission distance comparison between different OM fibre optic cables

| Multimode Fibres EN 50173/ISO 11801 | | Bandwidth(Mhz.km) | | Attenuation(dB/km) | | Transmission link length at 1Gb/s (m) for OM1 & OM2 & 10Gb/s for OM3 & OM4 (meter) | |
|---|---|---|---|---|---|---|---|
| Categories | Core Dia (micron) | OFL at 850nm | OFL at 1300nm | At 850nm | At 1300nm | 850nm | 1300nm |
| OM1 | 62.5 | ≥160 - ≥ 250 | ≥500 - ≥ 800 | ≥2.7 - ≥ 2.9 | ≥0.6 - ≥ 0.7 | ≥500 - ≥ 300 | ≥550 - ≥ 1000 |
| OM2 | 50 | ≥500 | ≥500 | ≥2.3 | ≥0.7 | 500 | 500 |
| OM3 | 50 | ≥1500 | ≥500 | ≥2.3 | ≥0.7 | 300 | 300 |
| OM4 | 50 | ≥3500 | ≥500 | ≥2.3 | ≥0.7 | 550 | 300 |

The difference between OS1 and OS2 Fibre optic cables is mainly in cable construction rather than optical Fibre specifications. OS1 type cable is predominantly of a tight buffered construction (Optical Fibres cables like Tight Buffer LSZH Riser OFC) whereas OS2 is a loose tube Optical Fibres cables like Drop lite UT SIngle sheath Aerial, Armor lite UT Single jacket & Armor lite Multitube single sheath. Table 2 shows Attenuation between OS Fibre cables.

## Table 2 - Single-mode fibre parameters

| Single-mode Fibres EN 50173/ISO 11801 (ITU-G657A1) | | MFD | | Cutt off wavelength, cable (nm) | Fibre Attenuation (dB/km) | | | BendLoss (1 turn 10mm radius) | |
|---|---|---|---|---|---|---|---|---|---|
| Categories | Core/Clad DIa (micron) | 1310nm | 1550nm | | 1300nm | 1550nm | 1625nm | 1550nm | 1625nm |
| G.657.A1 | 8.2/125 | 8.8 ± 0.4 | 10.0 ± 0.5 | ≤ 1260 | ≥0.33 | ≥0.33 | ≥0.21 | ≥0.75 | ≥1.50 |
| G.657.A2 | 8.2/125 | 8.6 ± 0.4 | 9.6 ± 0.5 | ≤ 1260 | ≥0.35 | ≥0.35 | ≥0.23 | ≥0.1 | ≥0.2 |
| G.652.D | 8.2/125 | 9.1 ± 0.4 | 10.3 ± 0.5 | ≤ 1260 | ≥0.34 | ≥0.34 | ≥0.23 | NA | NA |

## Fibre Core/Tube color code –Typical 144F cable

| | blue | orange | green | brown | slate | white | red | black | yellow | violet | rose | aqua |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| blue | 1 | 13 | 25 | 37 | 49 | 61 | 73 | 84 | 97 | 109 | 121 | 133 |
| orange | 2 | 14 | 26 | 38 | 50 | 62 | 74 | 86 | 98 | 110 | 122 | 134 |
| green | 3 | 15 | 27 | 39 | 51 | 63 | 75 | 87 | 99 | 111 | 123 | 135 |
| brown | 4 | 16 | 28 | 40 | 52 | 64 | 76 | 88 | 100 | 112 | 124 | 136 |
| slate | 5 | 17 | 29 | 41 | 53 | 65 | 77 | 89 | 101 | 113 | 125 | 137 |
| white | 6 | 18 | 30 | 42 | 54 | 66 | 78 | 90 | 102 | 114 | 126 | 138 |
| red | 7 | 19 | 31 | 43 | 55 | 67 | 79 | 91 | 103 | 115 | 127 | 139 |
| black | 8 | 20 | 32 | 44 | 56 | 68 | 80 | 92 | 104 | 116 | 128 | 140 |
| yellow | 9 | 21 | 33 | 45 | 57 | 69 | 81 | 93 | 105 | 117 | 129 | 141 |
| violet | 10 | 22 | 34 | 46 | 58 | 70 | 82 | 94 | 106 | 118 | 130 | 142 |
| rose | 11 | 23 | 35 | 47 | 59 | 71 | 83 | 95 | 107 | 119 | 131 | 143 |
| aqua | 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 |

| Position | Jacket Color | Position | Jacket Color |
|---|---|---|---|
| 1 | Blue | 13 | Blue w / Black Strip |
| 2 | Orange | 14 | Orange w / Black Strip |
| 3 | Green | 15 | Green w / Black Strip |
| 4 | Brown | 16 | Brown w / Black Strip |
| 5 | Slate (Gray) | 17 | Slate w / Black Strip |
| 6 | White | 18 | White w / Black Strip |
| 7 | Red | 19 | Red w / Black Strip |
| 8 | Black | 20 | Black w / Yellow Strip |
| 9 | Yellow | 21 | Yellow w / Black Strip |
| 10 | Violet | 22 | Violet w / Black Strip |
| 11 | Pink | 23 | Pink w / Black Strip |
| 12 | Aqua | 24 | Aqua w / Black Strip |

Note: As per EIA/TIA- 598 Standard

# Safety Procedure
## Optical Fibre Cable

### General

This document describes some basic safety information applicable to Optical Fibre cable installation & storage. Personnel involved in Optical Fibre cable installation must be aware of all the applicable Occupational and Health safety regulations, the National Electrical Safety Code (NESC) and local regulations along with the company safety practices. Failure to follow the same can lead to fatal consequences to them as well as people in the vicinity.

### Cable Handling

All optical Fibres cables are sensitive to damage during handling & installation. Some of the important parameters that need to be special attention during cable installation are:

### Cable Bending Radius

Optical Fibre cables are designed with particular minimum bending radius. The cable should never be bent below minimum bending radius at any location. Doing so can result in higher bending losses and/or internal breaks in the Fibre. Generally the bending radius of a cable is greater than 20D, where D is the diameter of cable.

Exceeding the minimum bending radius of the cable can cause damage to the Fibres, which cannot be seen from outer surface of the cable. This can also lead to expensive restoration of cables at later dates.

### Cable Twisting

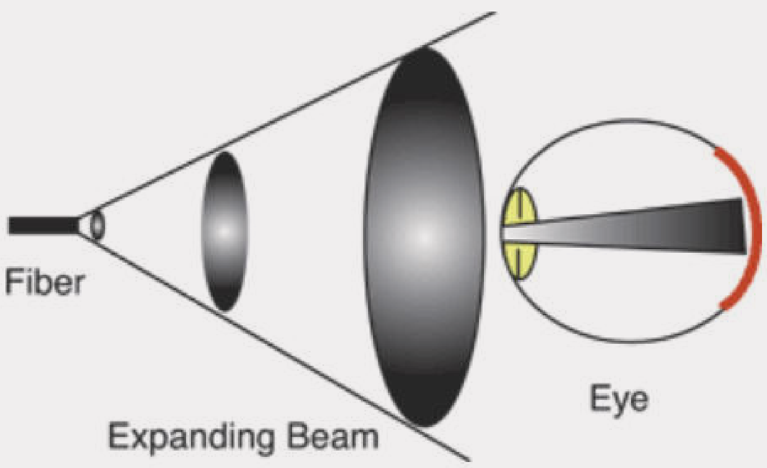
Optical Fibre cables are designed for particular twisting/torsion. Exceeding the cable twisting greatly increase the probability of Fibre damage. Hence it is recommended to use anti twisting device during cable pulling.

### Laser Precaution

Laser beam used in optical communication is invisible and can seriously damage the eyes. Viewing it directly does not cause any pain and the iris of Eye does not close automatically as it does while viewing the bright light. This can cause serious damage to the retina of eye.

Therefore-

- Never look into a Fibre having a laser coupled to it.
- If eye is accidentally exposed to LASER beam, immediately rush for medical assistance.




## Optical Fibre Handling Precaution

The broken ends of Fibre created during termination and splicing can be dangerous. The ends are extremely sharp and can easily penetrate the skin. They invariably break of and are very hard to find and remove. Sometimes pair of tweezers and magnifying glass is needed to take them out. any delay in taking the Fibre out of body could lead to infection, which is dangerous. Hence following below precautionary measures are recommended:

- Be careful while handling the Fibre
- Wear Safety Goggles (Figure a) and safety handgloves while working with Fibres (Figure b)
- Do not stick the broken ends of Fibre into your fingers
- Do not drop Fibre pieces on the floor where they will stick in carpets or shoes and be carried else where like home
- Dispose all scraps properly
- Do not eat or drink near the installation area

(Figure a)
Safety Goggles

(Figure b)
Safety Handgloves

## Material Safety

Fibre optic splicing and termination processes require various chemical cleaners and adhesives. The safety instructions defined for these substances should also be followed. If there is confusion in usage of these products, ask the manufacturer for a MSDS (Material Safety Data Sheet). Remember the following instructions while working with materials.

- Always work in well-ventilated areas
- Avoid skin contact to materials involved as much as possible
- Avoid using chemicals that cause allergic reactions

**Even simple isopropyl alcohol, used as a cleaner is flammable and should be handle appropriately.**

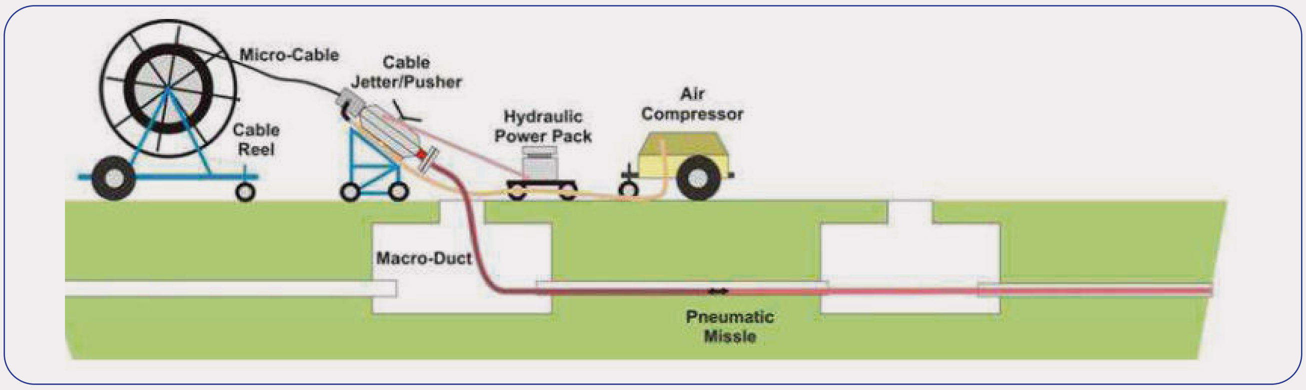
| Hexane | | | Iso-Propanol | |
|---|---|---|---|---|
| Type of Exposure | Effect of exposure | Emergency Treatment | Effect of exposure | Emergency Treatment |
| Inhalation | Irritation of respiratory tract, cough | Maintain respiration, Bed rest. | Irritation of upper respiratory tract | Remove victim to fresh air area, Administer artificial respiration if breathing is regular |
| Ingestion | Nausea, Vomiting, Headache | Do not induce vomiting, immediately seek, medical advice. | Drunkenness & vomiting | Have a victim drink water and milk, seek medical aid. |
| Contact with skin | Irritation | Wipe of afected area of skin & wash with soap & water | Harmless to skin | Wipe of afected area of skin & wash with soap & water |
| Contact with eyes | Irritation | Wash eyes with plenty of water for 15 min. | Irritation | Wash eyes with plenty of water for 15 min |

| Fire Safety | Working Safety |
|---|---|
| • The fusion splices use an electric spark to make splice, so ensure that there are no flammable gases in the space where fusion splicing is done.<br>• Splicing should never be done in places manholes where gases can accumulate.<br>• The cables are brought up to the surface into a splicing trailer where all Fibre work is done. So the splicing trailer is temperature-controlled and kept spotlessly clean to ensure good splicing.<br>• Smoking should not be allowed around Fibre optic work. The ashes from smoking can contribute to the dust problems in Fibres, apart from the danger of explosion posed by them due to presence of combustible substances. | • To minimize the risks of an accident in the work area follow specified rules for setting up barri- cades, manhole guards and warning signs.<br>• Before pulling cable directly from the Figure 8 shape, make sure that the area inside the loop of the cable is clear of personnel and equipment. Failure to do so may result in injury to personnel or damage to the cable due to entanglement.<br>• Ensure that the tools and equipments used for cable installation are in proper condition. Corrosion of equipments may damage cable or cause injury to personnel.<br>• Take care of electric hazards, if electrical lines are passing through the manholes or vaults where installation is being done |

## Safety During

## Duct Installation: Manhole /Underground Vaults Safety

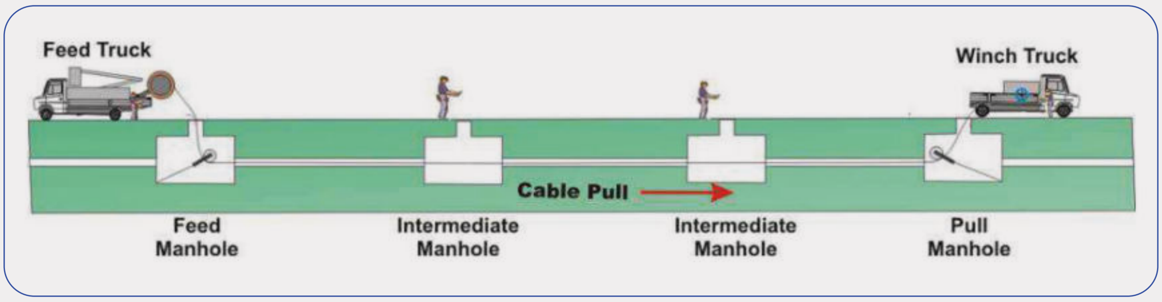
- Explosive gases or vapors might be present in manholes due to leaking of nearby gas or liquid pipelines. Before entering any manhole test the manhole atmosphere with an approved test kit for flammable and poisonous gases.
- Avoid usage of any device that produces spark or flame in manhole.
- Wear rubber gloves when working near exposed electrical circuits to avoid electric shock.
- Follow electrical safety rules when working near power lines.




Duct Installation

## Cable Pulling Safety

- Personnel normally should stay away from the area where a cable is being pulled around a piece of stationary hardware under tension. Appropriate safety measures should be taken while working near the installation site.
- Keep hands free from tools when climbing or getting down on pole or ladder.
- Suitable accessories must be used during installation to ensure smooth and safe working.
- Only essential skilled personnel should stay near the installation site during tensioning operation can minimize risk of injury or death. Nobody should allow climbing on intermediate poles, while tensioning. Passerby on ground should be kept away from poles during tensioning. Suitable warning / Safety display board should be put on installation site.
- Ground every metallic component to avoid electric hazards due to spark produced by power lines or any other means.




Cable Pulling Safety

## Aerial Installation Pole safety

- Before climbing a pole, inspect it for various safety issues like splintering, insect nests, sharp protrusions
- Use leather gloves when climbing or getting down on pole and when working with sharp instruments or materials

Aerial Installation Pole safety

## Safety summary

- Keep all food and beverages out of the work area. If Fibre slinters are ingested they can cause internal bleeding.
- Wear disposable aprons to minimize Fibre particles on your clothing. Fibre particles on your clothing can later get into food, drinks, and/or be ingested by other means.
- Always wear safety glasses with side shields, suitable safety Helmet, Safety belts and protective gloves. Handle the Fibre optic splinters similar to glass splinters.
- Never look directly through the end of Fibre cables till you ensure that there is no light source at the other end. Use a Fibre optic power meter to make sure that Fibre is dark. When using an optical tracer or continuity checker.
- Look at the Fibre from an angle at least 6 inches away from your eye to determine if the visible light is present.
- Only work in well-ventilated areas. Do not smoke while working with Fibre optic systems.
- Do not touch your eyes while working with Fibre optic systems until they have been thoroughly washed.
- Keep all combustible materials away from the curing ovens.
- Dispose the Fibre scraps (splinters) properly into hazardous material bin only. Thoroughly clean your work area after completion of installation.

# Handling, transportation and storage procedure for optical fibre cable Drums

There are a number of key safety issues that are important to keep in mind while handling the Optical Fibre Cables as follows:

## Keep the cable drum/reel protected with outer covering till the time it is used at site

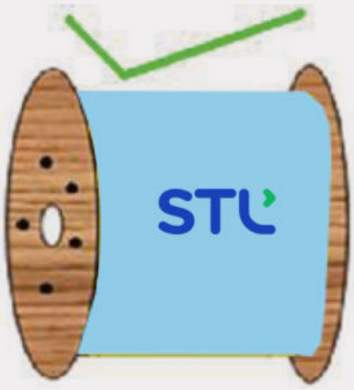


Figure 1 (a)

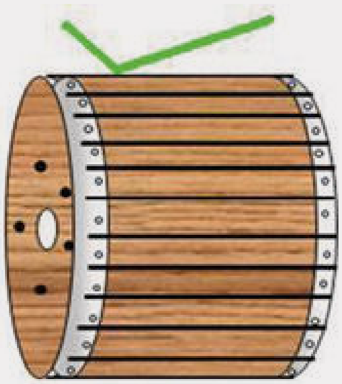


Figure 1 (b)

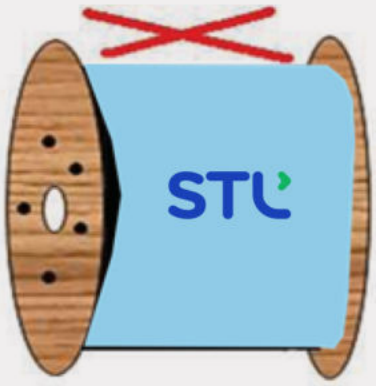


Figure 1 (c)

Figure 1

a) Drums packed with plastic sheets
b) Drums packed with wooden lags
c) Drum left uncovered

## Lift the drums without damage

When lifting the drum; use a shaft through the centre of the drum and a spreader beam. In case spreader is not used the rope may damage the flanges of drum which can cause cable damage.

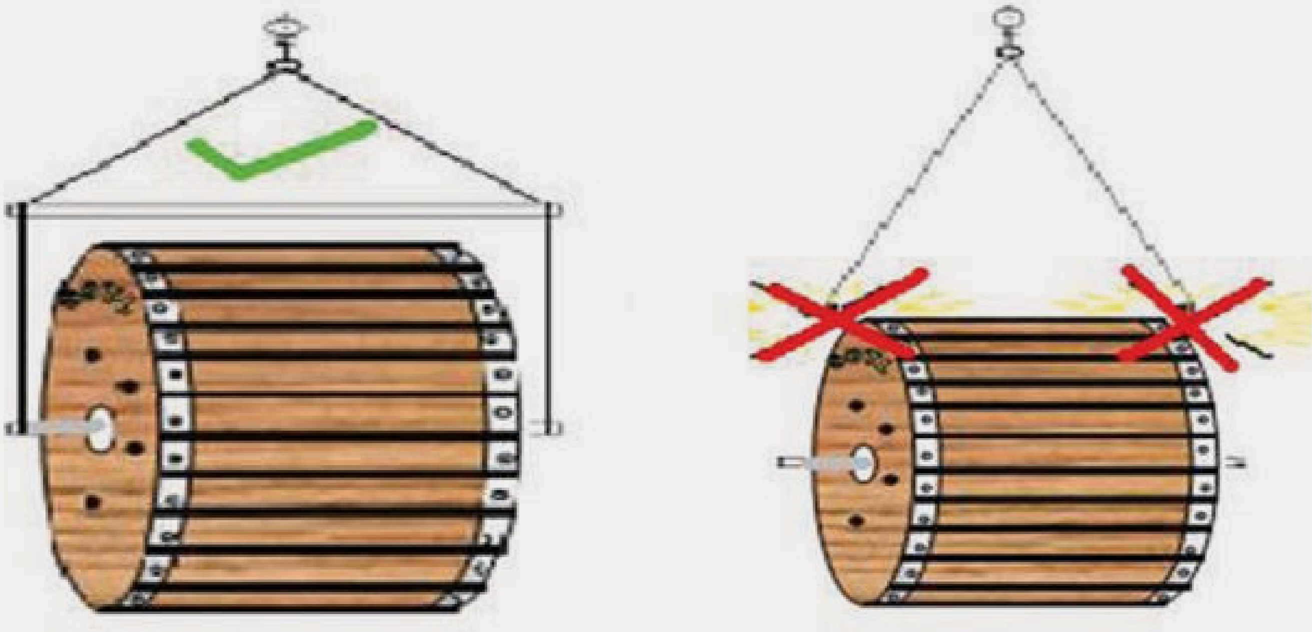


Figure 2

## Handling with Forklift

Ensure the drums to be moved in upright position and the fork must be longer than the width of the drum. When moving the drums, tilt the truck mast so that the drum remains in the fork and the points don't touch the ground. Raise the forks of the forklift at least 6-8 inches from ground surface.
Don't release the forks until the truck has stopped completely. Keep sufficient space between the drums so that forks don't damage the other drum.

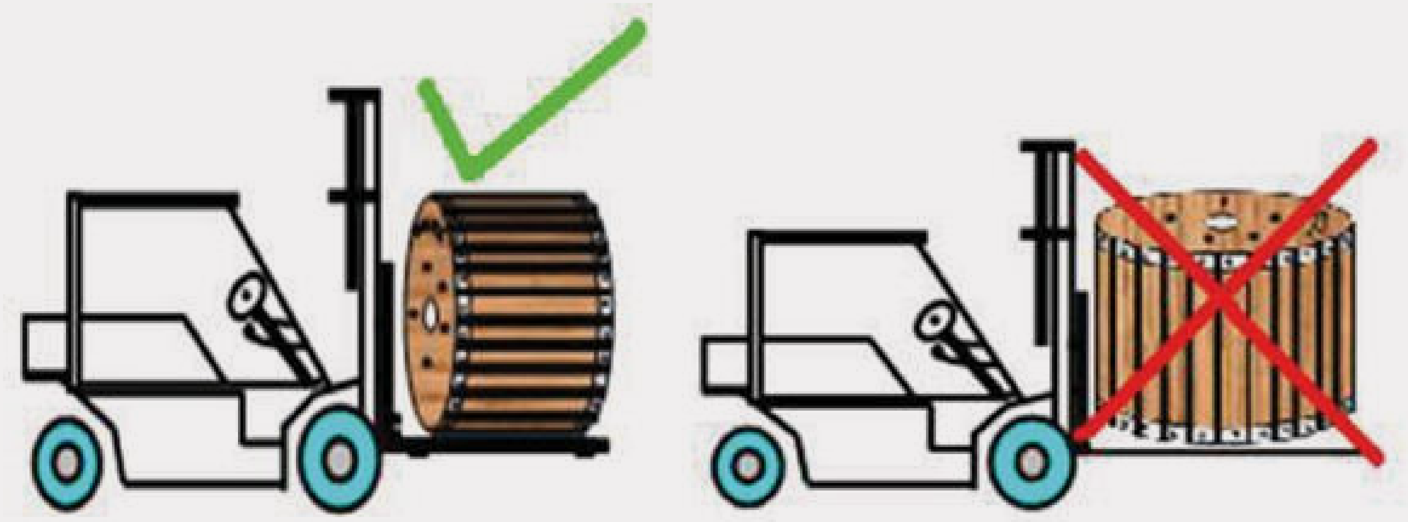


figure 3

## Keep the Drum in upright position

The drum is designed to be handled in upright position. It may not sustain if lifted laying flat. When stored in upright position, the cable layers do not get entangled during uncoiling.

Note: Always store and move the drums in upright position. In no case, should the drums be stored 'on the flat' that is with flange horizontal.

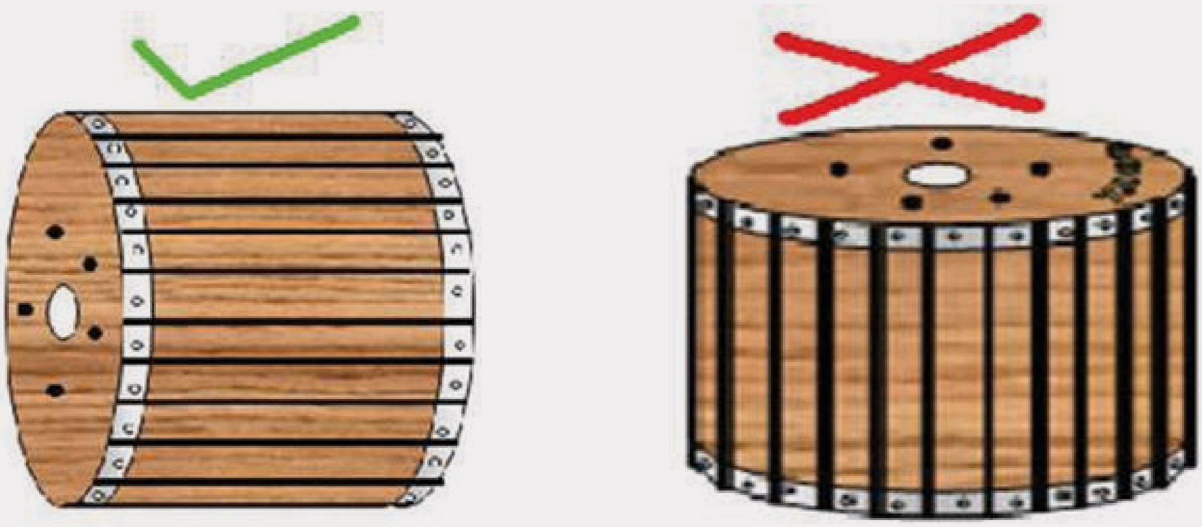


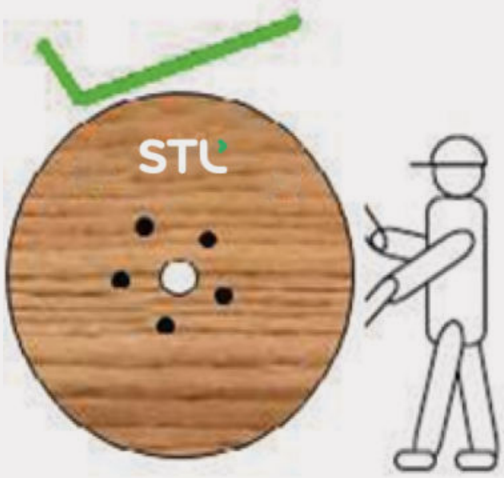
Figure 4

a) Drum on flange edge

b) Drum on the Flange Side

## Roll the drums only as per the direction marked on the drum flanges

When the drums need to be rolled due to some reason, always roll the drums in the direction of arrow marked on the drum flanges. This way the cable over the drum will not loosen. However, this does not mean that the drum can be rolled freely for any distance. Limit rolling distance 5-10 meters. Once placed in position, use proper stopper (wooden or rubber block) to prevent drums from rolling.



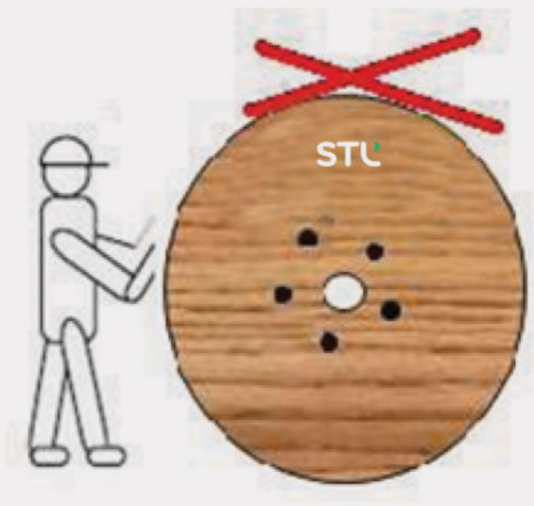



Figure 5

## Drum Transportation, Unloading and Storage

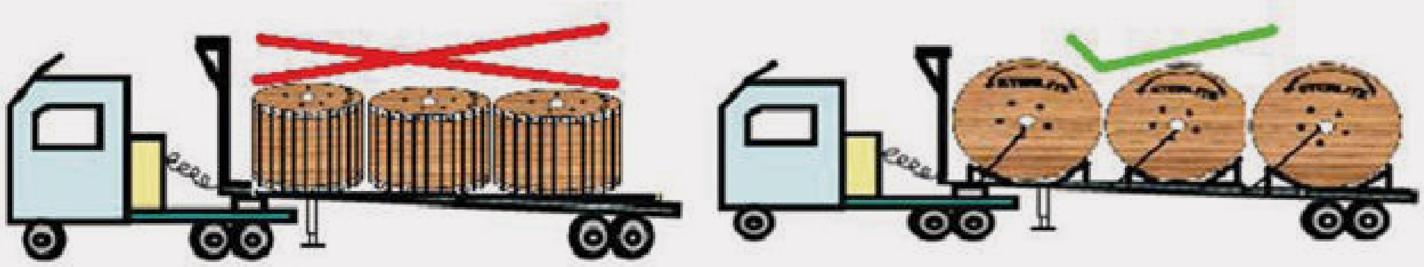


Figure 6

1. During transportation, the cable drums should not be kept in Flat position; it crushes the down the layer of the cable, resulting in Fibre breakage.

2. The cable drums should always be kept in upright position and be tied with a Chain or Belt with wooden blocks should be kept in between the flanges of each drum to avoid any jerks/ movements during transportation.

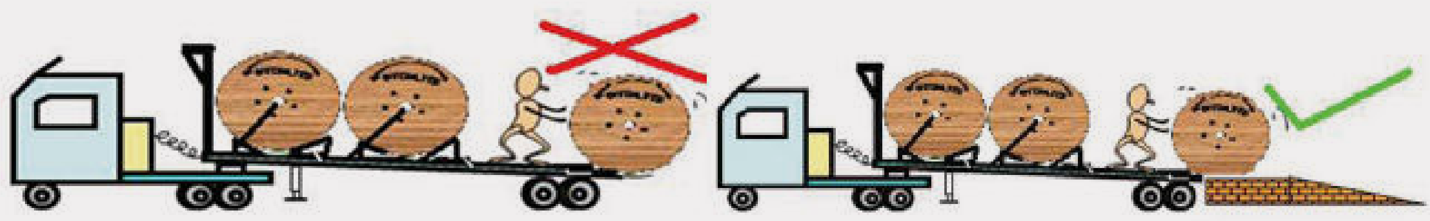


Figure 7

3. While unloading truck it is important that the cable drum should not to be dropped directly on the floor. The weight of Drum & cable may cause deflection of Drum flange resulting flattening, deformation or damage of cable.

4. The drum must be rolled from truck on to receiving platform, which should be in same height as the tailgate of the truck. An alternate is to use forklift to unload drums from truck.

**Note:** If inclined ramps are used, roll the drums over it; but don't allow them to roll out of control. Roll each drum away from the bottom of the ramp before handling the next drum.

5. The drums should always be stored in an upright position. Storage of drums in an alternative position can lead to winding defects.

6. If storage place is limited and it becomes necessary to stack, then stack the completely wrapped on their flanges. Stacking is allowed only for the drums whose flange diameter is 1250mm or less. Do not store drums on Flat flanges

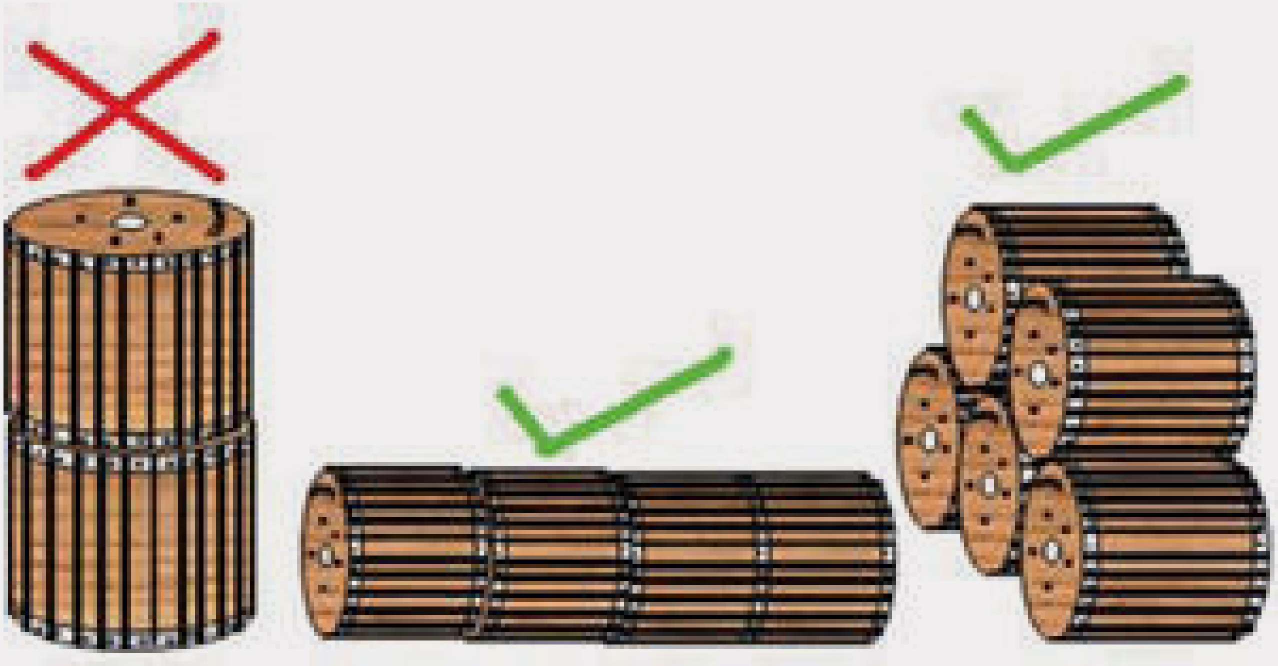


Figure 8

7. Optical Fibre cables are wound on wooden drums. Due to environment surrounding, drum gets degraded over a period of time. To avoid such degradation in the wood during its storage period, store in shelter or properly covered with tarpaulin to protect from external environment. If drums are stored outside, storing surface should be hard & no moist soil should be in contact with wood, this avoids generation of harmful insects responsible for wood degradation. During heavy rain, the drums should be closed by polythene to keep the Drum moisture content around 18% to 25%.

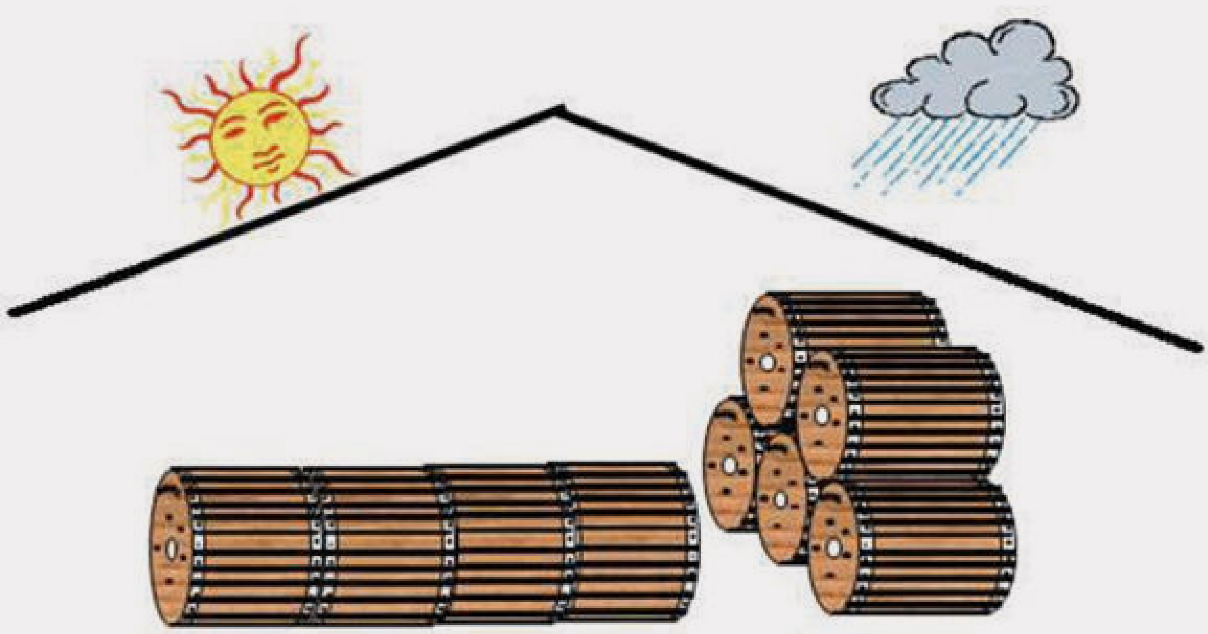


Figure 9

# Selection of the Correct Optical Cable Outer Jacket for the Application

## Introduction

This Cable Jacket Selection note is intended to provide the reader with an organized selection methodology when selecting the optimum optical cable for a specific application. Sheath issues discussed: single jacket versus dual jacket, armored versus unarmored, and metallic versus dielectric armoring.

## Jacket materials

The cable jacket provides the first line of defense against the surrounding environment. It resists water entry while remaining inert to gases and liquids that the cable may be exposed to during its service life. It provides a smooth, low friction surface for cable placement. The jacket must be made of a material that will allow the cable to remain flexible and serviceable at all of the temperatures it will experience during its lifetime.

It must resist abrasion during installation. It must provide, along with the cable's strength members, the mechanical strength required to survive its environment and installation forces. For indoor cables, the jacket also provides the fire retardance required by building codes.

## Table 1 - Summary of popular cable jacketing materials

| Sheath Material | Features |
|---|---|
| PE - Polyethylene | • Primary outside jacket material.<br>• Good resistance to UV (sun light) due to carbon black.<br>• Good flexibility over wide range of temperatures.<br>• Good abrasion and crack resistance. |
| MDPE - Medium Denisty Polyethylene | • Use in all dielectric self-supporting cable in high voltage aerial fields exceeding 12 kV, but not exceeding 50 kV applications. The anti-tracking jacket withstands a condition known as dry arcing. |
| HDPE - High Density Polyethylene | • Provides good mechanical protection.<br>• Flexible at normal installation temperatures.<br>• Flame retardant. (typical riser material)<br>• Used for many indoor applications.<br>• Can be protected against sunlight with various UV inhibitors. |
| LSZH - Low smoke, zero halogen | • Flame Retardant with low smoke and no halogenated materials<br>• For use in unventilated areas exposed to public, e.g., subways and tunnels.<br>• Good mechanical performance. |

## Armored Versus Non-armored Cable

Armoring increases the strength and robustness of a cable relative to its surroundings. The armoring is placed either just under the outside plastic jacket for single jacket cables or between two layers of jacket material for dual jacket cables. The armoring layer is typically corrugated metallic tape, but tightly wound steel wires, or dielectric Fibre layer are options for specialty applications. Double jacket, double steel tape armor is occasionally used for increased protection in direct buried, high rodent infested areas. Rip cords are placed under the armor layer(s) to enable jacket removal during cable preparation for termination.

Non-armored cables are also available that provide suitable service in underground conduit systems or aerial pole lines. Their light weight causes placing tensions to be somewhat reduced. Non-armored cables provide an easier cable to prepare for splicing. Non-armored cable will not have the extra crush resistance, impact strength, or rodent resistance of armored cable.

[1] Various polyethylene plastics should meet Table 5.4.2 of ANSI/ICEA S-87-640.

## Table 2 - Comparison of Outside Plant Applications Provided by Armored/Non-armored

| Armor | Aerial Plant | Buried Plant | Underground Plant | Micro-Cables |
|---|---|---|---|---|
| Steel Tape Armor | Double Jacket & Single Jacket | Double Jacket & Single Jacket | Single Jacket | No |
| Non- Armor | Fig 8, Single jacket, Double jacket, ADSS | No | In duct | In microduct |

## Bonding & Grounding for Steel tape Armor:

Bonding and grounding of all metallic elements is required for all outside plant equipment including optical cables. If lightening occurs or an accident takes down a power line, it is possible for unwanted current to be coupled into the metallic components of the outside plant cable. Dangerous current can potentially be coupled into any metallic cable components or into the messenger supporting strand in the case of aerial cables. If any conductor at the ground potential comes in contact with the metallic member carrying the coupled current, any unbalanced current will flow through the conductor to ground

- Improperly grounded metallic armoring in Fibre cables can cause voltage potential levels to be different from the ground potential for long stretches of cable, through intermediate manholes or hand holes and even into buildings, hence the requirement for metallic element bonding and grounding at regular intervals along the cable length.
- If all-dielectric Fibre optic cables are used, they are made without any conductive paths, and as a result, do not need to be bonded or connected to existing grounds at intermediate ground locations. It is imperative that all national, local, and industry codes covering bonding and grounding be followed.

# Splicing

Fibre Optic Cable Splicing is the method of joining two Fibre optic cables together. Termination is the other, more frequent way of linking Fibres. Fibre splicing is the preferred way when cable lines are too long for a single length of Fibre or when combining two different types of cable.

Fusion splicing and Mechanical splicing are two methods of Fibre optic splicing. Both techniques have much lower insertion loss than Fibre connections.

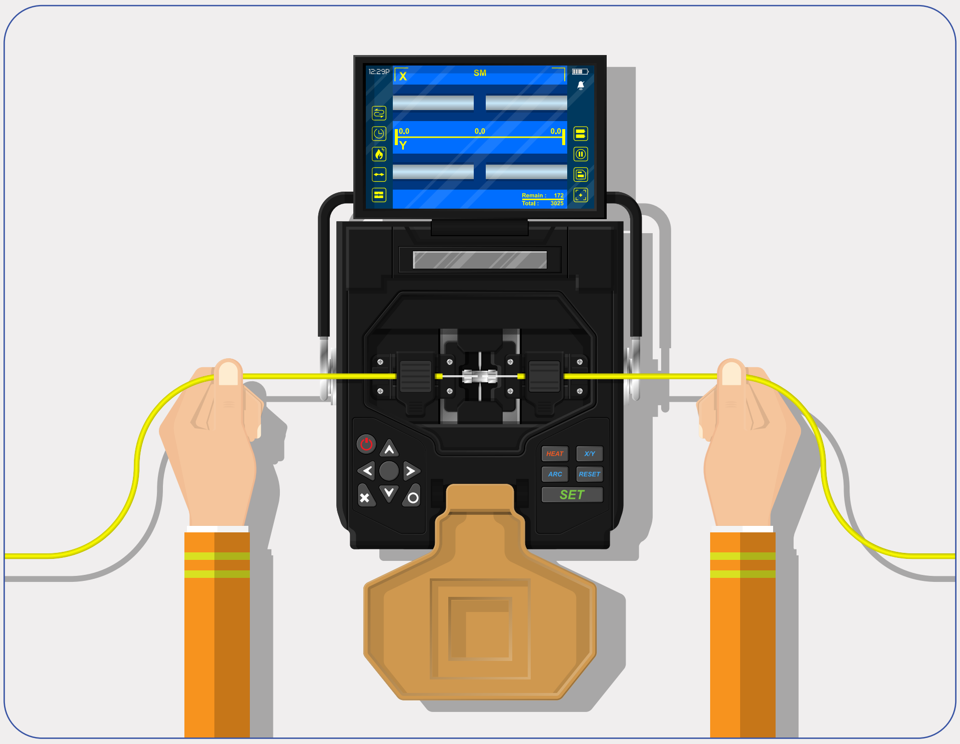
We will Discuss about Fusion Splicing, as Mechanical splicing is traditional method.
Fusion splicing is more expensive than mechanical splicing, but it lasts longer. The Fibre cores are fused together with reduced attenuation in the fusion process (insertion loss of less than 0.1 dB). Arc or another type of heat during fusion splicing. This leads to a clear, reflection-free, and continuous connection between the Fibres, which enables very little light loss (average loss of 0.1 dB). Fusion splicing is a complex process that requires great care. Your Fibres may not be connected properly and if not done correctly, your signal may degrade.

## Steps to perform Fusion splicing

Step 1:  Fibre striping
Step 2: Fibre Cleaning
Step 3: Fibre Cleaving
Step 4: Fibre Fusion
Step 5: Fibre Protection

## Advantages of Fusion Splicing

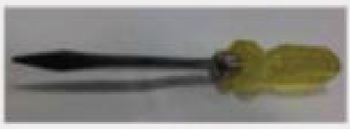
1. Fusion splicing is a compact process and has the lowest insertion loss and back reflection.
2. Fusion splicing is permanent and has the better mechanical strength.
3. Fusion splicing can withstand a wide range of temperatures.
4. Dust and other pollutants are kept away from the optical path by fusion splicing.




## Mid Span

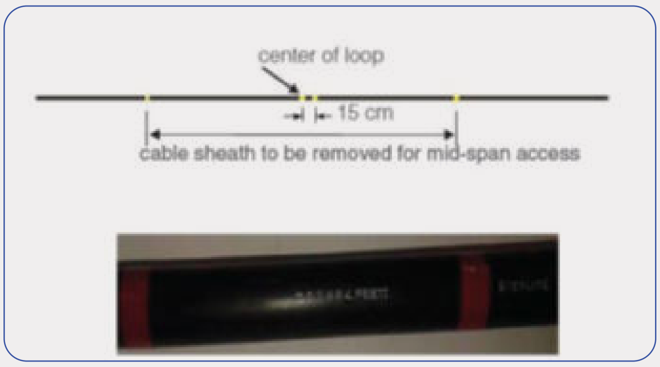
Midspanning is frequently used in FTTH for cable entry in each FDC for feedercables.
(Generally 48F/96F and Fibre counts for decentralized Architecture)and in each FAT for distribution and Riser Cable. Hence MidSpan splicing is done in JCs (Joint closures) ,FDC (Fibres Distribution cabinet)  and in FATs (Fibre access terminal)

## Tools required for Midspan as shown in below figure

| | | | |
|---|---|---|---|
| ACS TOOL: RING/ LONGITUDINAL MARK |  | MARKING TAPE |  |
| SCREW DRIVER |  | NOSE PLIERS |  |
| KNIFE |  | SCISSOR |  |
| CUTTER |  | TUBE SLITTER |  |

## Midspan Splicing

In Fibre optic network, it is sometime necessary to take out few Fibres from a cable having large Fibre count and splice to smaller cables at a location other than at the end e g manholes of a large cable, called mid span splicing. Make the marks on sheath by tape /marker of 15 cm at the left or right of the mid span portion, the marker 15 cm away will demarcate the sheath window that will be opened to enable the remainder of the cable jacket to be removed for the mid span access.

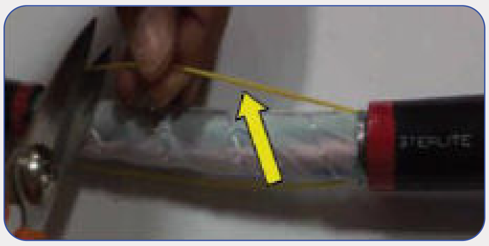



Make two ring cuts by ACS tool at both markers at 15 cm portion Be sure the ring cut through its outer jacket to its armoring (if present) or cable core (if unarmored)

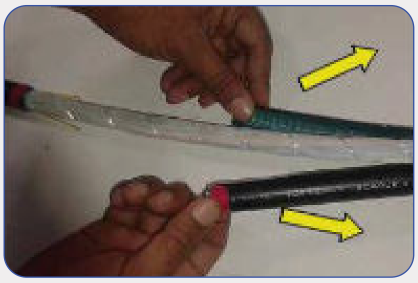

Mark two or more longitudinal cut over the cable at 15 cm ring mark portion for easy separation of cable outer jacket from corrugated metallic tape Make the cut mark clear by knife in case required as shown in above figure.

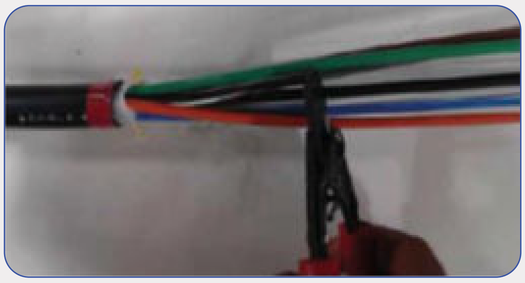
Lift up the cable outer jacket by screwdriver at ring cut longitudinal cut meeting point Be careful that the screwdriver knob shall not damage the cable core below metallic tape. Take out the outer jacket of cable with the help of nose pliers for 15 cm portion and subsequently remove corrugated metallic tape over the stranded core as shown in below figure.

Once the 15 cm section of cable jacket is removed, the remainder of the mid span cable jacket can be removed by using the rip cords that are exposed in the 15 cm window. Cut the rip cord thread over the water blocking tape/ polyester tape using scissor. Slitting of cable jacket by using rip cord as shown in below figure.

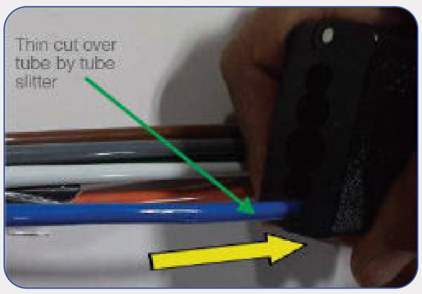


Slitted cable jacket Remove cable jacket at mid span portion. Removal of the binding tape which bundles tubes in cable core using blade knife. Cut and remove CSM (Central strength member) to get easy accessibility to all tubes.



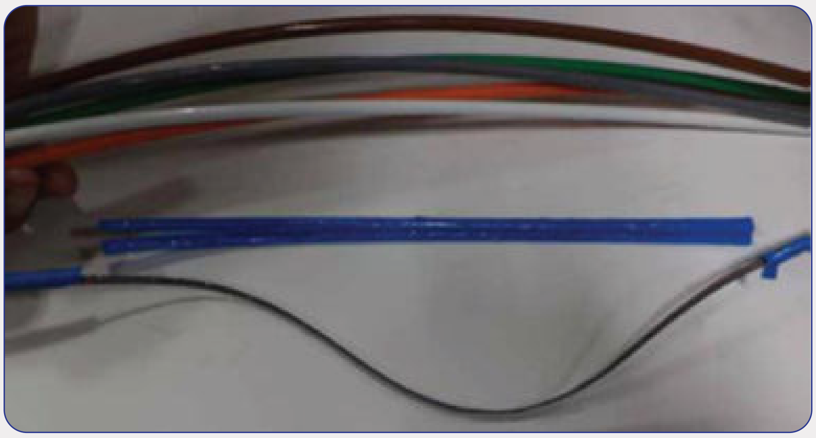


Select the tube on which mid span need to be performed and make it straight by removing stranded lay. Fix the slitter tool slot over tube as per tube diameter and pull in other direction to get proper tube slitting as shown in below figure.



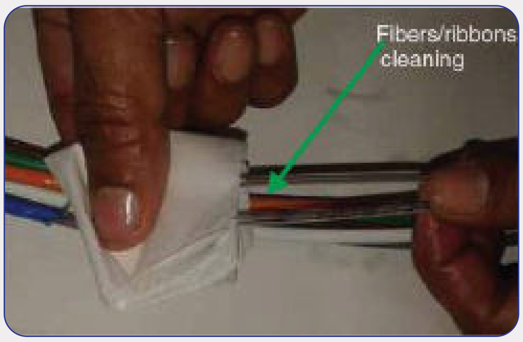
## Mid Span Splicing -Tube mid spanning

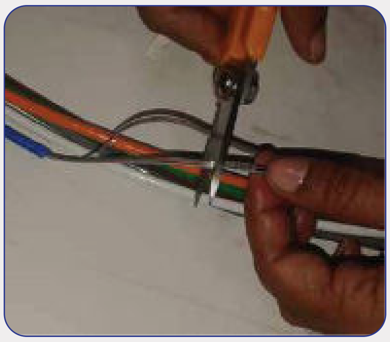
Cut the tube covering by scissor or by making ring cut on tubes. Cut the slitted tubes covering, clean the ribbons/fibres required for branching careful not to bend, kink, or damage any buffer tube as shown in below fig



Clean the gel or water blocking material from the buffer tubes and cable core using treated wipers It is necessary to enter one or more of the buffer tubes to access its Fibres/ribbons to splice them to a second independent cable. If all the Fibres in a buffer tube are to be dropped off at this point, make a ring cut at both locations in the buffer tube with the Ideal Coaxial Cable Slitter to demarcate the amount of Fibre to be exposed for the fusion splice These cuts will be in the appropriate buffer tube

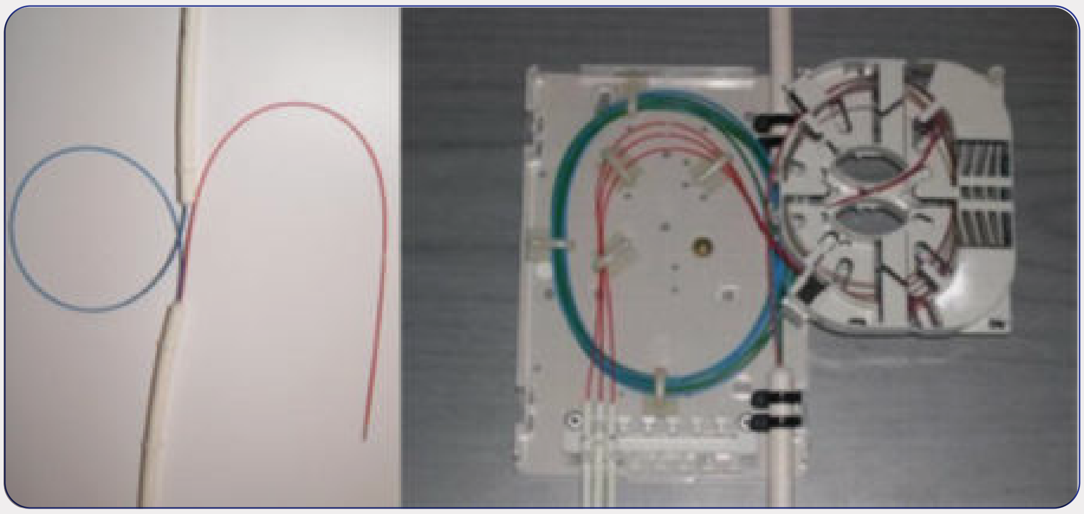
Cut the drop off/branch off required Fibres /ribbons and make splicing/joint with the other small cables as required as shown in below fig.



## Mid span splicing -Riser Cables

Midspan access riser cables.
Only Fibres are extracted from the cable and managed in the distribution branching point to be spliced with Fibres of the branching cable. Fibres to extract are cut in the upper branching point and pulled at the considered branching point : cable with a specific structure to extract Fibres over a few meters.



# Field Test Procedure for Optical Fibre Link Measurements

## Introduction

Optical cables are tested by their manufacturer at the factory during and after manufacture, again after delivery to the staging area for the construction project by the contractor or his agent, and finally after construction by the contactor, his agent, or the end-user.

Post-construction measurements provide assurance that cable placing, splicing, and link construction activities have been completed that will enable the intended transmission system to function properly and to provide support for any future maintenance activities on the link. The most common post-construction measurements include the following:

### Table 1 – Typical Post-Construction Fibre Link Measurements and Equipment Used

| Post-Construction Link Measurement | Test Equipment |
|---|---|
| Length of the fibre link | OTDR |
| End-to -end fibre attenuation for link | OTDR, OLTS, SLS[2]/OPM |
| Attenuation for each installed fibre | OTDR |
| Loss, location and reflectance of each aplice | OTDR |
| Optical return loss of link | OTDR |
| Any reflective or high loss event in link:record loss and location | OTDR |

Most post-construction optical Fibre loss measurements use the cut back method (TIA 455-78) or the back reflection method (TIA 455-8) to determine their measured quantity. The cutback method and the back

reflection method are mainly used for testing at the manufacturing facility and the back reflection method is normally used in the field for most tests. An optical time domain reflectometer (OTDR) is the back reflection, portable optical test set used in the field for pre and post-construction Fibre measurements. The backscatter concept is illustrated in Figure 1.

Forward moving light is reflected back off
immpurities in glass as Rayleigh Backscattered light.

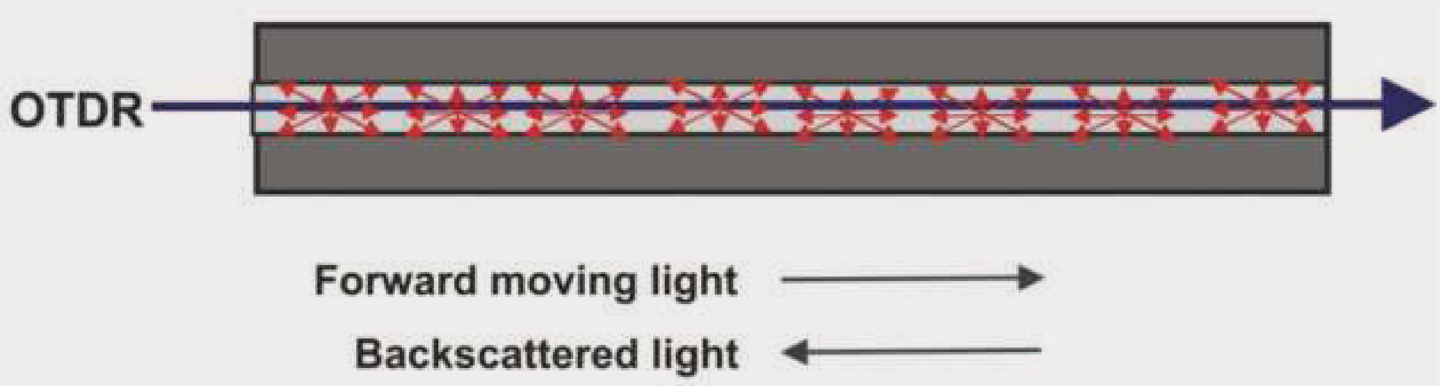



Figure 1 – Schematic of the Backscatter Phenomena Which OTDRs Use to Make Measurements

**Note:** Following the OTDR manufacturer's instructions, set the Fibre group index to 1.4670 for measurements at 1310 nm and 1.4675 for measurements at 1550 nm. The group index is used by the OTDR to convert time-of-flight of OTDR pulse to distance.

### Precaution: Please follow the safety instructions as per guidelines given in safety procedure for optical Fibre cables section.

## 3. Post-Construction Measurements Setup

Figure 2 and Figure 3 provide schematic drawings of the two primary setups that are commonly used to test new Fibre links: first, using an OTDR with a lead- in Fibre and second, using two optical loss test setsor a stabilized light source and optical power meter.

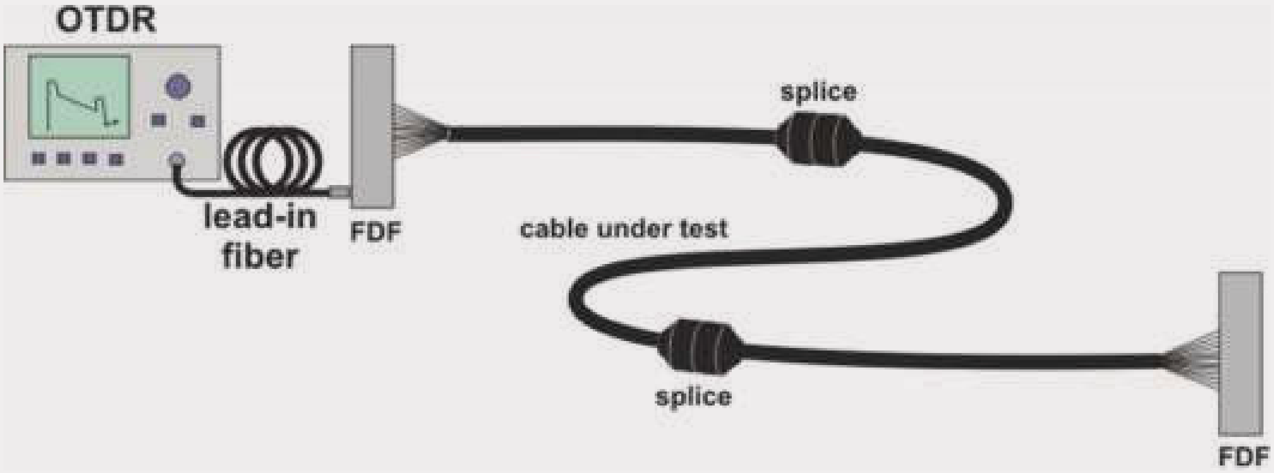



Figure 2 – Schematic Setup of OTDR Used to Measure Link Loss of Fibre Connected to Lead-in Fibre

## 3.1 Post-Construction Measurement Procedure

Post-constuction measurement is a necessary operation to verify the quality of the construction operation that just has been completed and to provide a data base that will provide useful information if and when future maintenance is required on the Fibre link.

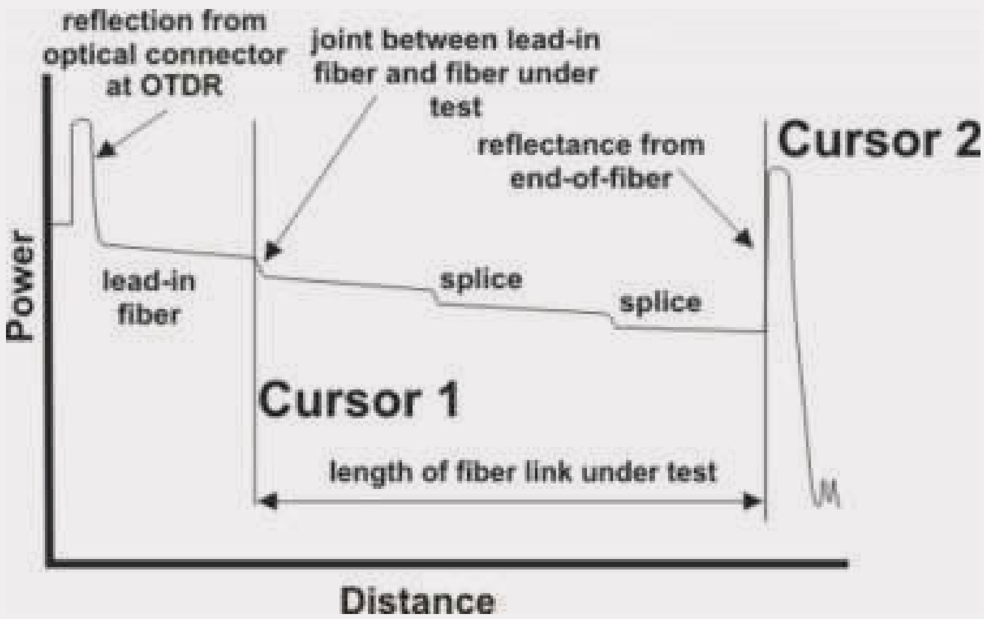



Figure 4 – Typical OTDR Trace Showing Lead-in Fibre Connected to the Post-Construction Fibre Link

The connection at the Fibre distribution frame (FDF) is shown as non-reflective in Figure 4. It may be somewhat reflective, depending upon the connector used at this location, see Figure 5.

NOTE: Clean all connectors properly and keep FDF ports and lead-in Fibre connector ends capped when not in use. Dirty connectors can cause permanent damage to the OTDR or the connecting Fibre end and will usually be the cause of OTDR measurement problems.

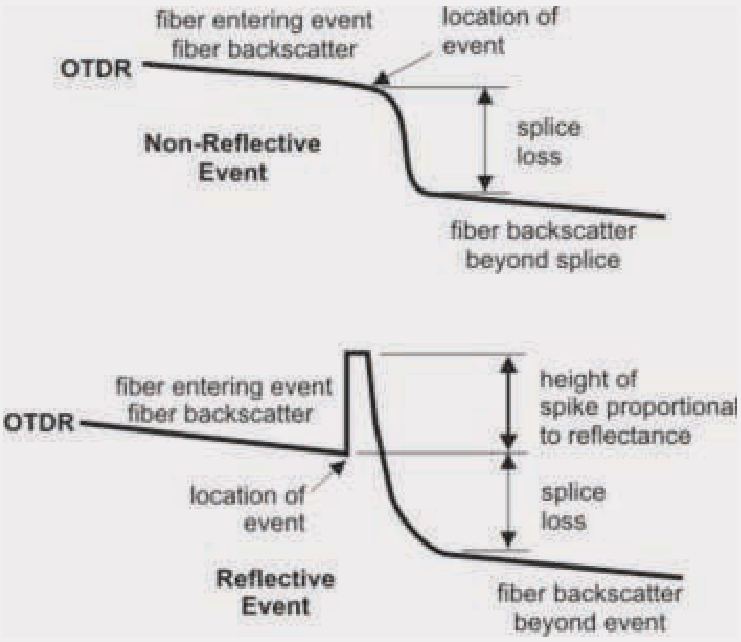



Figure 5 – Key Portions of an OTDR Trace for Non-Reflective and Reflective Fibre Events

## 3.2 Length Measurement

Connect the lead-in Fibre to the Fibre-under-test at its FDF port.

1. Set the OTDR to "auto" testing[3] and verify that the OTDR's group index is set to the appropriate value to match that of the Fibre-under-test (see Section ). The Fibre link trace shown in will appear on the OTDR.

Once a clean, proper Fibre connection is made, electronically record and observe the OTDR Fibre trace.

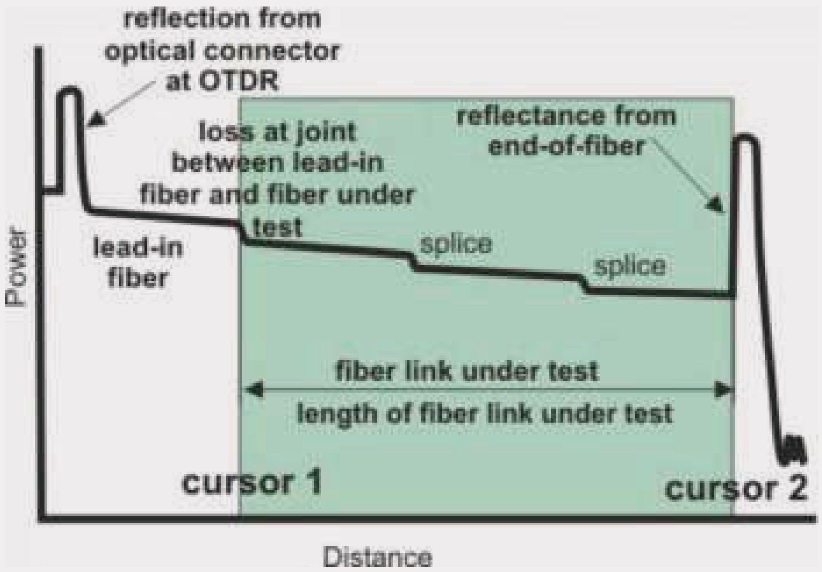



Figure 6 - Typical OTDR trace to determine the Fibre length of Fibre link under test.

Figure 6 and Figure 7 show the key cursor positions on the Fibre trace to measure the Fibre length. Set "cursor 1" to the connection at the FDF port between the lead-in Fibre and Fibre- under-test. It should be positioned at the entry point to the connection where the trace begins to drop from the lead-in, linear backscatter level through the attenuation of the temporary connection at the FDF or if the connection is reflective, it shall be positioned at the entry point to the FDF connection where the trace begins to rise from the reflective connection.

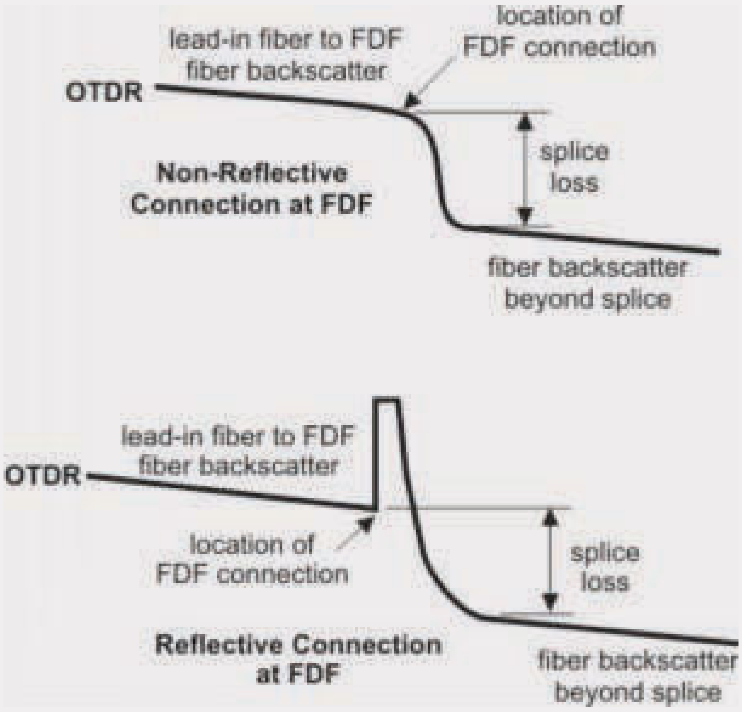



Figure 7 – Key Cursor Locations on OTDR Trace to Measure Fibre Length

The trace should have a slightly rounded or square peak at the far end of the Fibre (see ). Since the Fibre end is reflective, "cursor 2" shall be positioned at the last point on the linear lead-in to the reflective spike at the end of the Fibre trace. The difference between the two cursor positions is the length of Fibre in the cable under test.

**NOTE: The cable sheath length will be several percent shorter than the Fibre length because of the Fibre stranding used within the cable core.**

If available on the OTDR, activate the algorithm that automatically summarizes the entire Fibre link trace (Fibre lengths, splice loss, event reflectance, end-to-end link loss, and optical return loss) in tabular form. Save this table and the Fibre trace electronically, for future reference.

## 3.3 Fibre Attenuation - OTDR Measurement

While the OTDR is still attached to the Fibre just measured for length, it should be measured with the OTDR to determine its attenuation at the working wavelengths for which it was specified.

Set the OTDR to the first wavelength to be measured and obtain the Fibre trace shown in Figure 8. The vertical offset between the intersection points on the Fibre trace between cursor 1 and cursor 2, respectively, is equal to the Fibre link loss. This vertical offset is equal to the Fibre link loss including the loss of the FDF connection at the beginning of the Fibre. While the FDF connector is a loss that the transmission signal will experience, many definitions of link loss include only the Fibre between FDFs, not the loss of either FDF connector. This loss is shown by the height of the yellow box in Figure 8 .

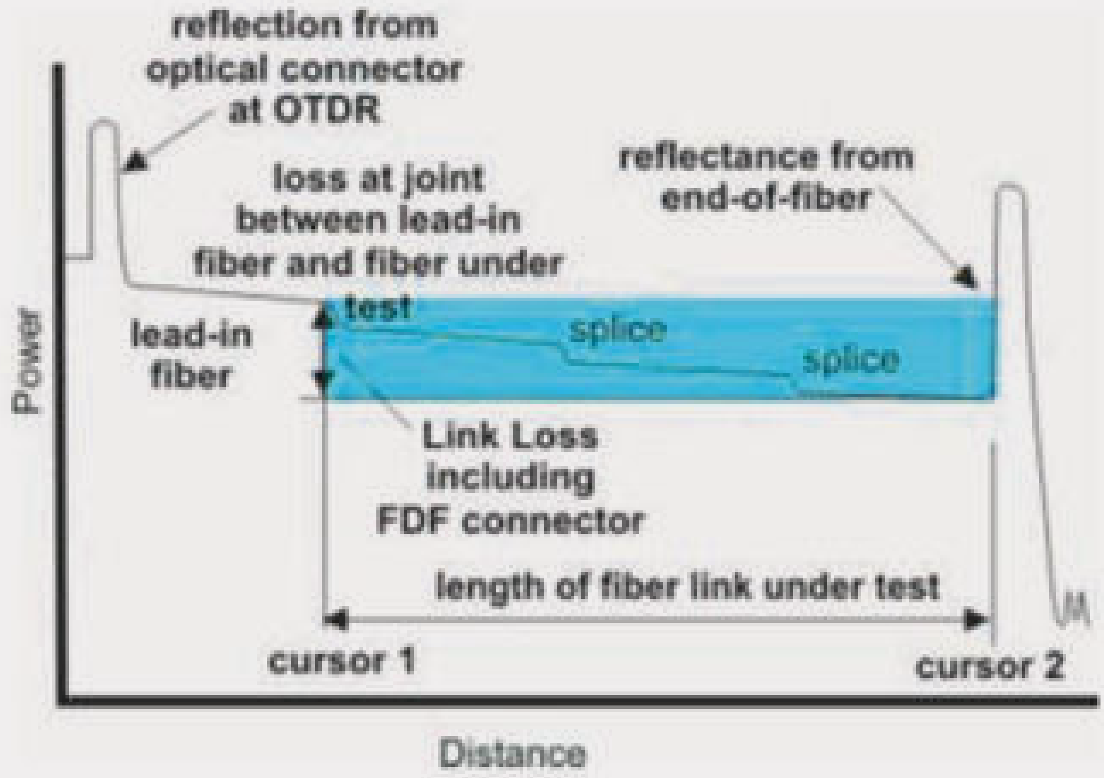



Figure 8 – Typical OTDR trace to determine the attenuation of Fibre link under test.

To determine the Fibre link loss without including the FDF connectors, the link loss determined above in Figure 8 must be decreased by the calculated loss of the near-end FDF connection (lead-in Fibre/FDF/fibre-under-test connection) calculated using the splice loss routine of the OTDR (see OTDR manual).

The near end FDF connector loss is calculated as is shown in Figure 9. Generally, a more accurate determination of splice or connector loss is achieved using the OTDR's least square methodas compared to its two point method.

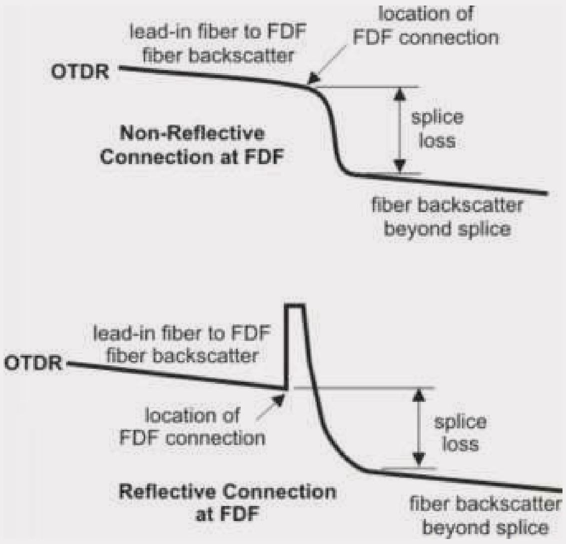



Figure 9 – Measure the splice loss at FDF between lead-in Fibre and Fibre link being measured.

The Fibre-link, end-to-end loss is determined by subtracting the near-end FDF connector loss from the Fibre link loss that includes the FDF connector loss (shown in Figure 8), using the principles of Figure 9.
The Fibre attenuation coefficient is often characterized by reporting the attenuation coefficient of the Fibre at a specific wavelength. The attenuation coefficient is defined as the optical power loss in the Fibre per unit length, dB/km, and is equal to the slope of the linear, backscatter portion of the OTDR Fibre trace when the optical power is at the specified wavelength.
If the Fibre link loss is specified at more than one wavelength, the OTDR measurement shall be made one at a time at each wavelength specified in the work plan. Typically, the attenuation thresholds at both 1310 and 1550 nm are specified for long-haul, single-mode Fibres; attenuation thresholds at 1310, 1550, and 1490 nm, respectively, are frequently specified for FTTH Fibres.

## 3.4 Remaining OTDR Fibre Measurements

The remaining measurements described in this section are made at the same time as the OTDR Fibre length measurements and attenuation measurement discussed in the preceding two sections.

Activate the OTDR algorithm that automatically summarizes in tabular form the Fibre link trace characteristics found by the OTDR after it produced the Fibre link trace shown (Fibre lengths, splice loss, reflectance, end-to-end link loss, and optical return loss). Save this table and the Fibre trace electronically, for future reference.

Fibre reflectance – Will be located with the OTDR measurements of each Fibre pathway, see splice loss. Normally, Fibre reflectance limits require that all events have a reflectance. Fibre reflectance occurs at Fibre connections and from the end face of a broken Fibre. Fusion splices will not be reflective.

Optical return loss of link – This may not be a measurement that will be required as part of the placing “proof-of-compliance measurements.” If it is required, it can be determined with an OTDR measurement for each Fibre pathway.

Fibre continuity – Fibre continuity will be determined when the OTDR measurements are made. These measurements will confirm continuity. If a light source and power meter are used, the receipt of light at the power meter (located at the far FDF) will assure the continuity of the Fibre pathway.

## 4. Conclusions

If the post-construction measurements confirm the Fibre link's ability to provide a physical transport medium that will match or exceed the proposed transmission system's performance requirements, the construction has been confirmed and the measurements are complete.

Otherwise the Fibre link must be trouble-shot to locate the problem and repairs must be made. All OTDR Fibre traces results determined during the post-construction measurement program should be saved for future reference if problems develop during the Fibre's service life. If the post-construction measurements indicate some inherent Fibre damage or noncompliance with respect to performance, the cable manufacturer should be notified immediately, so the problem can be investigated and rectified.

## Visual Fault Locator

Intoduction: Visual Fault Locator which can be also called visual fault identifier (VFI), Fibre fault locator, Fibre fault detector, etc, is a visible laser available in red laser light and designed to inject visible light energy into an optical Fibre. It is a cost-effective way to spot defects of Fibre glass such as sharp bends, breaks, faulty connectors and other faults which will "leak" red or green light visually. It can also locate the fault of OTDR dead zone and make Fibre identification from one end to the other end. No matter for installing new Fibres or troubleshooting the existing networks, visual fault identifier is a helpful handy kit.

You can diagnose Fibre link problems over Fibre patchcords & Pigtails(Part No: DPB & DPT series in Estelan Product brochure) using visual fault locators. When the Fibre fault locator is designed with adapter incompatible with your connector type, using additional adapters is necessary.

## Types of Visual fault locator (VFL)

The Visual Fault Locator is available in different shapes and sizes. Some may look like a pen, others may be built into an optical time domain reflectometer (OTDR), and some may look like a small test equipment box.

- Pen-Type Visual Fault Locator
- Hand-held Visual Fault Locator

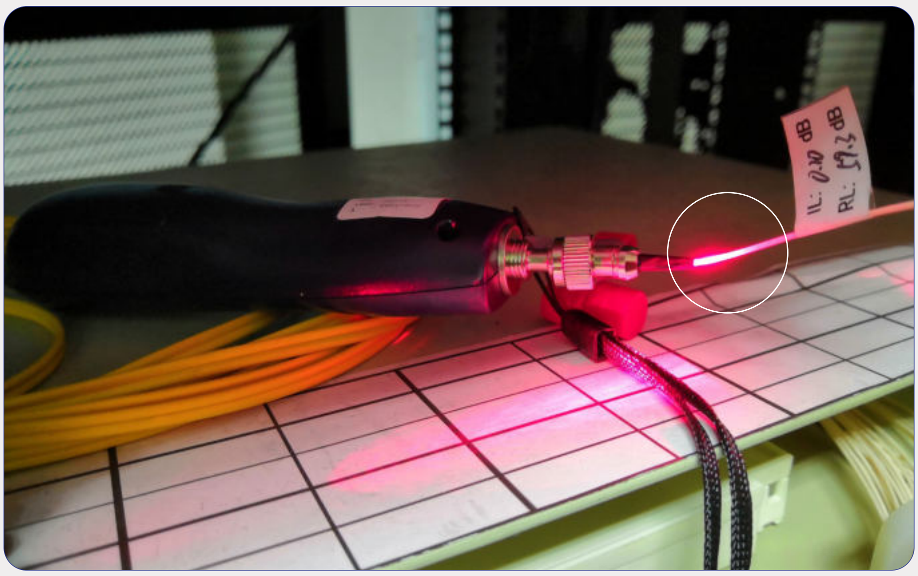
## How Does Visual Fault Locator Work?

The working principle of Fibre optic visual fault locator is as follows: The VFL fills the core of the optical Fibre with light from the laser. The light from the laser escapes the optical Fibre at a break or macrobend and will typically illuminate the buffer surrounding the optical Fibre. Though macrobends are not always visible through the jacket, they are typically visible through the buffer. While breaks may be visible through the jacket of the Fibre optic cable depending on jacket color, thickness, number of optical Fibres in the cable, and amount of strength member.

## How to Use Visual Fault Locator?

**Step 1:** Clean the Fibre optic cable connector endface and attach your visual fault locator to the connector.
Clean and inspect the Fibre optic cable connector with a microscope. If the endface finish is acceptable, the VFL can be connected to a Fibre connector.
**Step 2:** Connect the Fibre visual fault locator to the opti-crimp connector ferrule (with the included patch cord), turn on the VFL.
Notice the red glow in the connector ferrule. If the light comes up directly on the other end, it means there is no leakage.

Once there is a fault, light will leak out from the cladding and the light will not go through the other end of the cable as shown in below diagram.



# Cleaning Overview

Optimum optical performance often requires near pristine cleanliness and good physical contact between the mating optical Fibres. In order to achieve this level of performance by the Fibre infrastructure, all connector interfaces must be thoroughly cleaned and dried using the most effective cleaning aids and procedures available. Experience has shown that most optical system physical plant problems other than with the end equipment can be repaired by thoroughly cleaning all optical connectors.

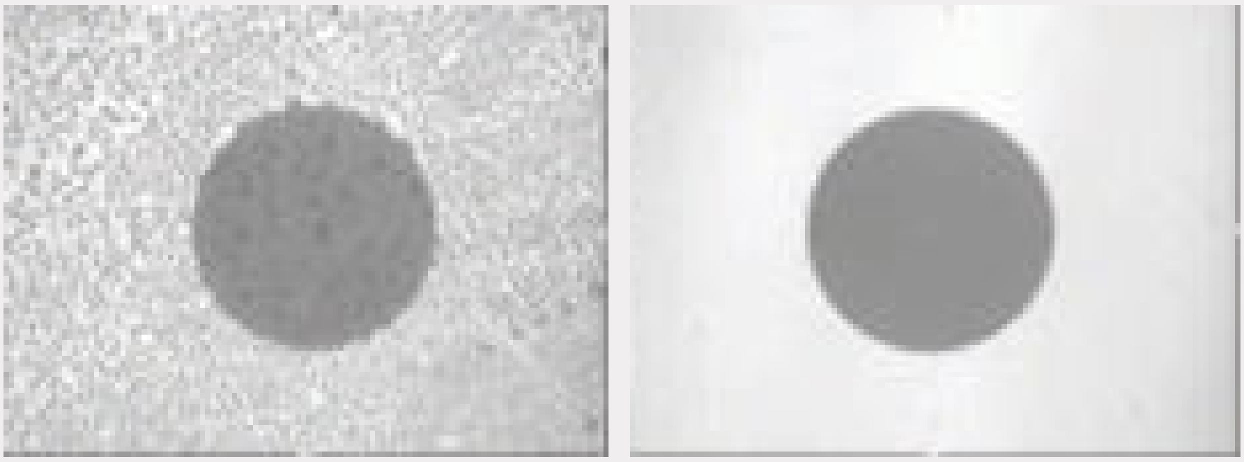


Figure 1 – View of Connector Ferrule End-Face After Exposure to 99.9% Pure Isopropyl Alcohol (IPA) and Then Air Dried, Right View is After Cleaning

For a product and procedure to be accepted, it must be safe and easy to use, effective, safe for the environment, and reasonably priced. It is also important that repeated use of such cleaning products not damage the connector, its user, or the environment One of the major suppliers of Fibre cleaning products tells its clients, "... more (is) usually thought of as being better, but this is not always correct in the Fibre cleaning business". In the science of cleaning Fibre, less is better in regard to efficiency of the cleaning technique but also for environmental, health and safety matters.

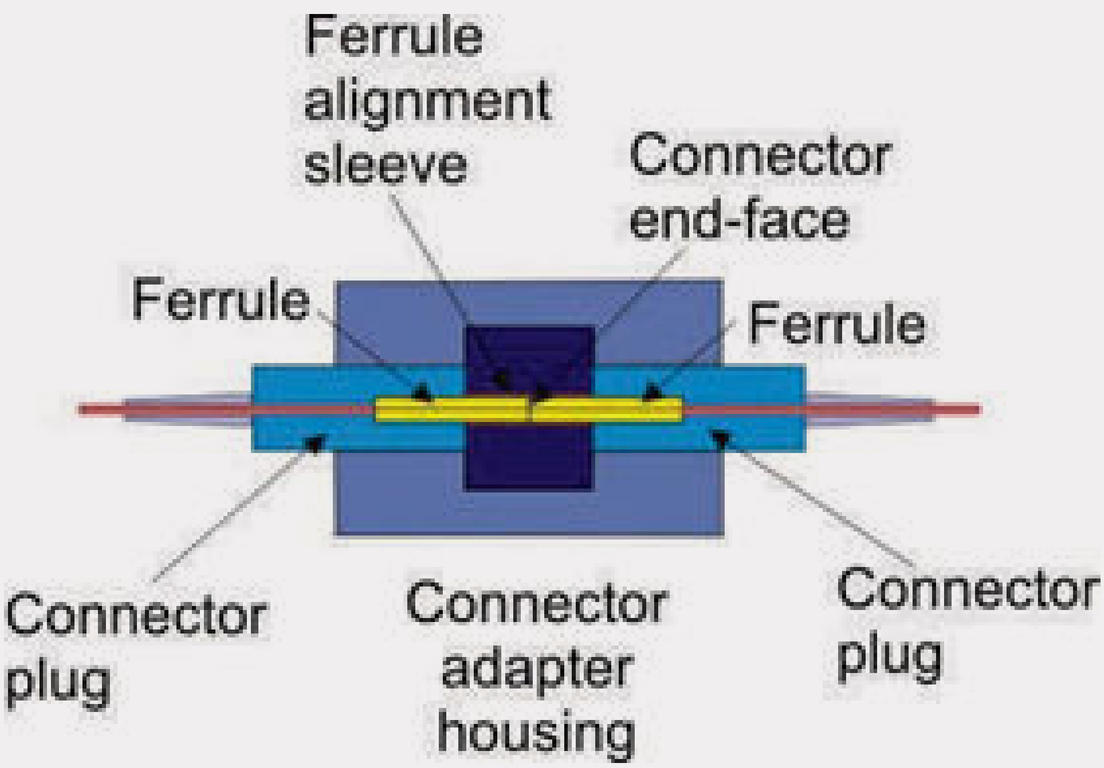



Figure 2 - Typical Optical Fibre Connection

## Terminology

The following are some of the typical cleaning tools and materials available to the communications technician:

Wet/Pre-Saturated Wiper is a cloth which may or may not be individually wrapped and is pre--saturated with a cleaning solvent that may or may not contain isopropyl alcohol(IPA). If the wiper contains IPA, the wiper should be minimally 94% IPA with no other

Figure 3 – Two Examples of Pre-Saturated Wipers Kept Sealed Before Use to Avoid Hygroscopic Absorption of Water

A Dry Wiper is a lint free, non-100% cellulosic wiper designed to be used either dry or with a cleaning solvent. Dry wipers or dry tools have limited ability to absorb dusty contaminants. They can generate a static field that can attract dusty soils such as those present in central offices (COs) as well as the OSP.

Over saturation of an optical connector with a wet wiper or direct spray can flood the ferrule's end face and deposit cleaning solvent and soils on the sides of the ferrule.

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Over saturation of an optical connector with a wet wiper or direct spray can flood the ferrule's end face and deposit cleaning solvent and soils on the sides of the ferrule.

Figure 4 – An Example of the Large Variety of Available Dry Wipers

Dry Cleaning Tools include various cassettes or ratchet style tools that contain dry wiper material used to clean the Fibre end face, connectors and adapters plus swab mounted wipers to reach deep into optical devices.

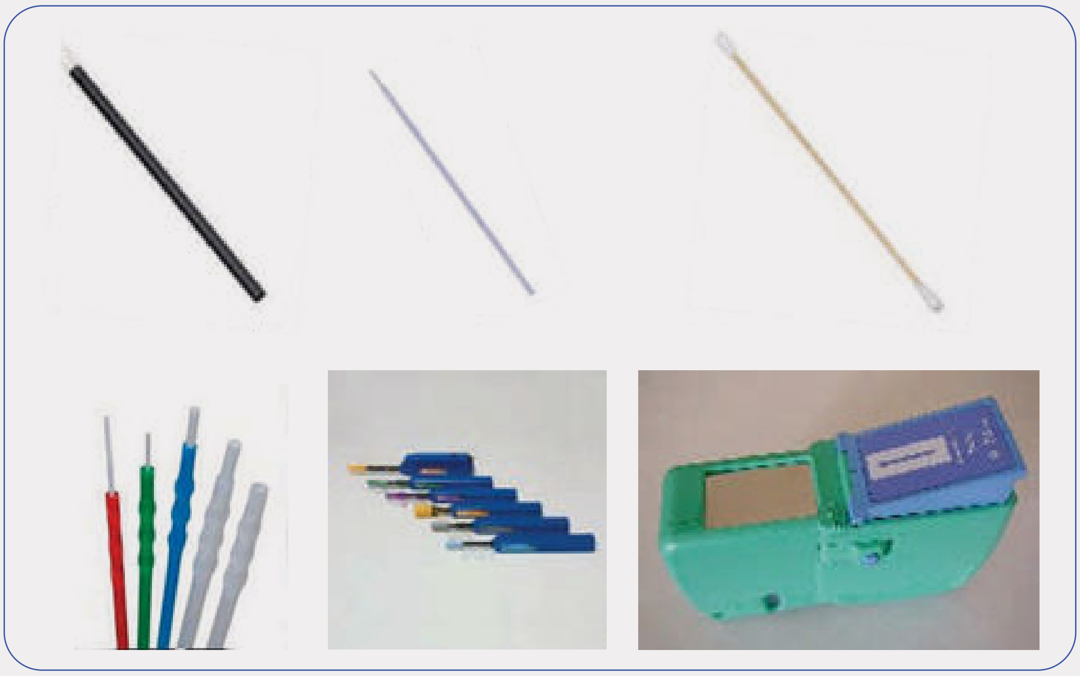


Figure 5 – Examples of Dry Wipe Tools: Top Row Dry Swabs; Bottom Row Assortment of Swabs, Assortment of Adapter Housing Cleaning Tools, Cleaning Cassette

Compressed Gas Dusters use aerosol propellants to remove moisture and large particle co· ntaminants. Some duster propellants are non-flammable such as 134a and safe to use in any environment. Other propellants such as 152a and DME have varying degrees of flammability and should be used with caution. Avoid using volatile flammable solvents near any possible ignition source or enclosed space. Some propellants may be incompatible with some plastics.


Figure 6 – An Example of the Large Variety of Available Gas Dusters

Compressed gas dusters are effective at removing large visible dust. Smaller particles have an electrostatic or surface bond to the ferrule end face and their attraction becomes stronger despite theirsmall size.Often compressed gas dusters are less effective at removing these smaller particles.

High velocity compressed gas dusters are effective removing moisture in a storm-damage or water damaged situation or for large particle contaminants. Most gas dusters should be used in the vertical position

## Solvents

While a connector's end face may appear to be clean, excess solvent can hide on the side of the ferrule and over time, excess solvent or moisture and soils are drawn into IPA and eventually cloud theconnector end face. If IPA is used as a solvent, it will attract moisture due to its hygroscopic nature, especially if it is stored in a container that exposes it to ambient air or if it has been stored for a long period of time. What started as high-purity IPA can be converted to a much less pure mixture of absorbed water because of the hygroscopic nature of IPA. IPA is an effective solvent that can be used to clean Fibres, but should be used properly, considering its hygroscopic propensity. See Figure 1 for the extent of hygroscopic contamination of 99.9% IPA if it is allowed to air dry on a ferrule end-face before drying and wiping clean.

Solvents such as IPA, precision hydrocarbons, hydrofluoroethers, and hydrofluorocarbons aid in soil removal by:

1. breaking the bond between the soil and its substrate,
2. dissolving the soil
3. Creating an affinity in a soil for a wiper.


Figure 7 – An Example of the Large Variety of Available Solvents and Dispensers

## A wide variety of cleaning solvents are available in an assortment of chemical blends to impart specific properties such as :

4. effectiveness in removing specific soils
5. cost
6. availability
7. flammability
8. environmental impact
9. drying rate
10. Material compatibility.

For a solvent to be selected, it must be easy to use, effective, safe for technicians to use, safe for the environment, and reasonably priced. It is also important that repeated use of the solvent not damage to the connector, its user, or the environment.

The Material Safety Data Sheet (MSDS) is available for each of the solvents used for Fibre cleaners.The MSDS contains pertinent information on each solvent relating to how it should be safely used, how to treat or deal with accidental ingestion or over exposure to the solvent, and any other safety issue that relates to the use of the material.

## Wipers

The size of the wiping surface should be considered as should the surface on which the wiper is placed. Experience has shown that the larger the wiping surface the more effective the cleaning is likely to be.


Figure 8 - Common Wipers Used to Clean Optical Fibres

The size of the wiping surface should be considered as should the surface on which the wiper is placed. Experience has shown that the larger the wiping surface the more effective the cleaning is likely to be.

## Cleaning Methodology

Always examine a connection before and after cleaning with a video Fibre scope. If possible disassemble the entire connector assembly and clean each plug and its adapter housing separately. If this is not possible, there are several innovative tools to clean the inside bore of a connector adapter and the Fibre-end of the back-plane connector while it is plugged in to its adapter. These tools basically are automated versions of the manual procedure described in Section 1.2. As is the case with wet and dry wipes and precision-swab tools, care must be exercised when using these techniques. A technical challenge for precision swab is the small cleaning surface on which they are used. An effective cleaning technique moves soils away from the Fibre end-face.

Do not clean a connector Fibre plug end-face using a wiper supported over a finger or palm of the hand. It is possible to contaminate a wet or dry wiper if cleaning is attempted using a finger or palm to back up the wiper. It is recommended to always examine a connector's end - face condition with a video Fibre scope (see Figure 10) both before and after cleaning.

Figure 9 – Fibre Connector End-Face Inspection Tool

A hard surface such as a work bench used as a backing surface for a wiper during cleaning can entrap sand or soil between the Fibre end-face and wiper that could damage the Fibre end.

Cleaning should be accomplished using a non-paper wiper backed up by a compliant surface. Such a surface can be emulated by stacking 4-5 non-paper wipers as the cleaning surface. Minimally moisten a dry wiping tool or dry wiper. Using the wetted tool or wetted wiper, lightly scrub the Fibre ferrule end-face. Dry the Fibre end-face by wiping on the stack of dry wipers or a dry tip on the tool.

Solvent selection is critical to the ultimate effectiveness of the cleaning procedure to remove soils. Their chemical formulations range significantly causing a wide variation in their performance, characteristics, costs, and EH&S impact. Common cleaning solvents, as of this time, include:

1. high purity IPA >99%,
2. hydrofluoroethers (HFE), Fibre optic precision hydrocarbons,
3. hydrofluocarbons (HFC), Fibre optic grade precision hydrocarbons,
4. precision Hydrocarbon Fibre optic cleaners, and
5. aqueous Fibre optic cleane rs specifically formulated for the application.

A solvent should be effective on both ionic (polar) and non-ionic (non-polar) soils. In addition to water, ionic (polar) molecules include alcohols and sugars. Non-ionic (non-polar) molecules are more like oil or silicone.

## Examples of ionic and non-ionic soils:

6. Ionic soils: finger print, dried water, and moisture from an excess solvent such as IPA.
7. Non-ionic soils: buffer gel, dust, and lubricants; static contamination from “dust caps”; moisture from excess solvent that has dust or oily residue

The end-user of any of these solvents is urged to investigate each of the chemical families.

## Cleaning Fibre Connector Plug or Near-End Front Plane Connectors

There are basically three procedures to clean to clean an optical connector :

Figure 10 – Dry Wipe Process Illustration (Using Dry Wipe, Tool, or Cassette)

## Wet wiping:

Using a wet wiper (or wetted tool) to saturate the Fibre end-face with a cleaning solvent and then drying the saturated surface with either a compressed gas duster, a dry wiper, or dry tool end.

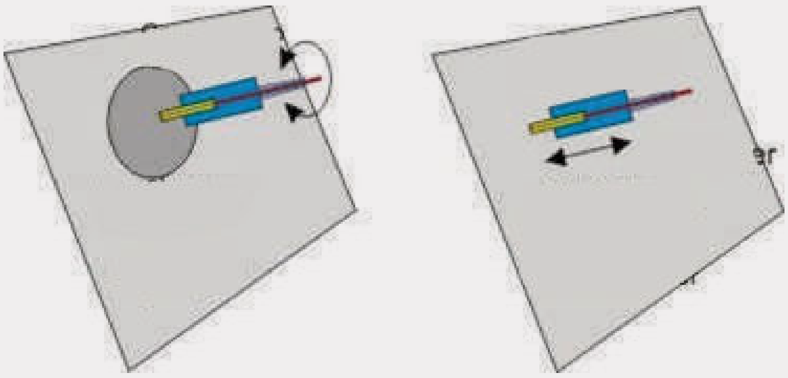


Figure 11 – Wet Wipe Process Illustration

## 5.Combination process:

Using a small spot of solvent applied to the wiping material to scrub the connector end-face in the wetted wiper spot. Dry and wipe the scrubbed connector end-face with the dry portion of the wiper.

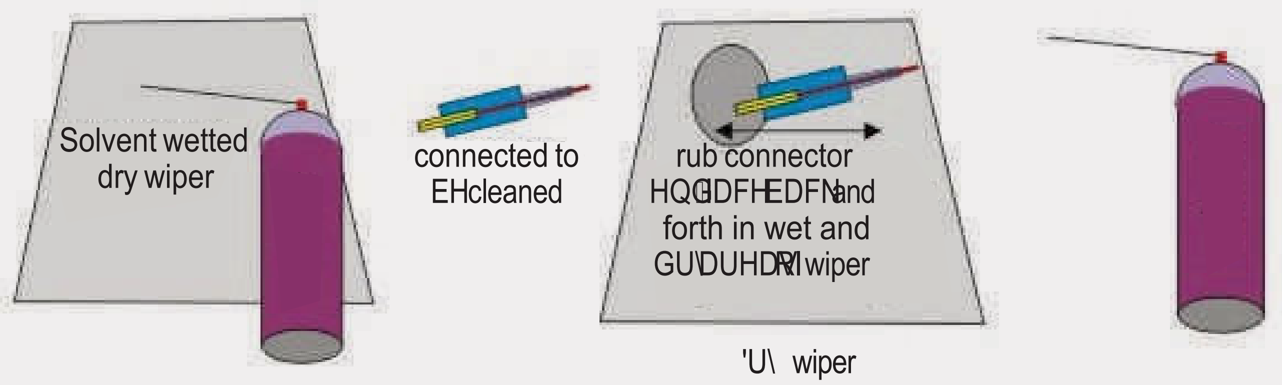



Figure 12 – Combination Dry/Wet Clean Procedure Illustration

It is important to note that "dry cleaning" procedures often move soils around and can create an electro-static field that attracts more dust contaminants to the ferrule."Wet cleaning" can cause excess solvent to migrate to the sides of the ferrule and as a result is more difficult to remove.

The table below provides an over view summary of the three cleaning procedures

It is important to note that "dry cleaning" procedures often move soils around and can create an electro-static field that attracts more dust contaminants to the ferrule."Wet cleaning" can cause excess solvent to migrate to the sides of the ferrule and as a result is more difficult to remove.
The table below provides an over view summary of the three cleaning procedures

## Table 1 - Comparison of Three Common Methods to Clean Optical Connector Plug

| | Method | Advantages | Disdvantages |
|---|---|---|---|
| Dry | • Cleaning cassette or non-paper lint-free wiper.<br>• Cleaning swab for backplane conections | • Most effective on ionic soils such as fingerprint.<br>• Easy to use | • Transfers dusty soils.<br>• Not always effective on non-ionic soils (gels, lubricants or combination soils).<br>• Can create an electrostatic field that attracts dust contaminants.<br>• Cleaning small surfaces can be difficult for APC/ MT connectors. |
| Wet | • Any solvent can be used, IPA recommended.<br>• Pre-saturated wipers. | • Releases ionic, non-ionic, and combinations of contaminants.<br>• Reduce electro-static fields.<br>• Easy to use. | • Excessive solvent can be trapped in the side of the ferrule making drying surprisingly difficult.<br>• Excessive solvent not seen in normal video inspection may 'reside' on side of ferrule and move to end face a future time.(flooding)<br>• Higher expense of some solvents. |
| Compound | • Uses expendables more efficiently. | • Ionic, non-ionic, and combinations of soil contaminants.<br>• Reduce electro-static fields.<br>• Easy to use.<br>• Dries end-face as integrated part of cleaning.<br>• Least cost per application | • Requires two interactive products.<br>• Selection of solvent may require careful consideration of Environmental<br>• Health and Safety issues. |

## The following steps are recommended for cleaning an optical connector plug:

- Remove the front plane optical connector.
- If possible, disassemble both connector plugs from their housing.
- Examine both Fibre-ends of the two mating optical connectors with a Fibre scope.
- Blow out the ferrule alignment tube in the adapter housing with a gas duster.
- Wet the tip of a ferrule swab with an all-purpose solvent. Note: it is better to under-use solvent than to over-use the solvent.
- Dry the solvent from the inside wall of the ferrule alignment tube with a dry ferrule swab sized to scrub the inside diameter of the ferrule alignment tube.
- Clean each connector plug end-face using the following recommended procedure.
- Blow off each ferrule end-face with a gas duster.
- Wet a wiper swab sized to fit in the space between the ferrule and the plug housing. This is intended to wipe the side walls of the ferrule barrel.
- Wipe the ferrule barrel with the wetted swab using a circular motion. Note: it is better to under-use solvent than to over-use the solvent.
- Re-wipe the ferrule barrel with a dry version of the wiper swab used above.
- Wet a small spot on a dry wiper with an all-purpose solvent. Note: it is better to under- use solvent than to over-use the solvent.
- Lightly rub the end-face of the ferrule on the wet spot on the wiper.
- Dry the solvent from the end-face of the ferrule with a dry wiper (or a dry portion of the solvent wetted wiper).
- Repeat steps 4 through 14 on the mating connector plug (if the connector can be disassembled, otherwise follow the steps outline in Section 1.2).
- Check the cleanliness of both connector plugs with an after examination of theier nd- faces using a Fibre scope.
- If the two connector end-faces are clean, assemble the connection and move on to the next connection.

## Cleaning Back Plane Connector Plug, if Connector Can't be Disassembled

Thus, disassembly and cleaning both sides, when practical, is recommended. Always examine a connection before and after cleaning with a video Fibre scope. When this is not practical follow the steps described in this Section. This procedure assures that a wide variety of contaminants are removed, the static field is reduced, and an area beyond the contact patch is better cleaned.

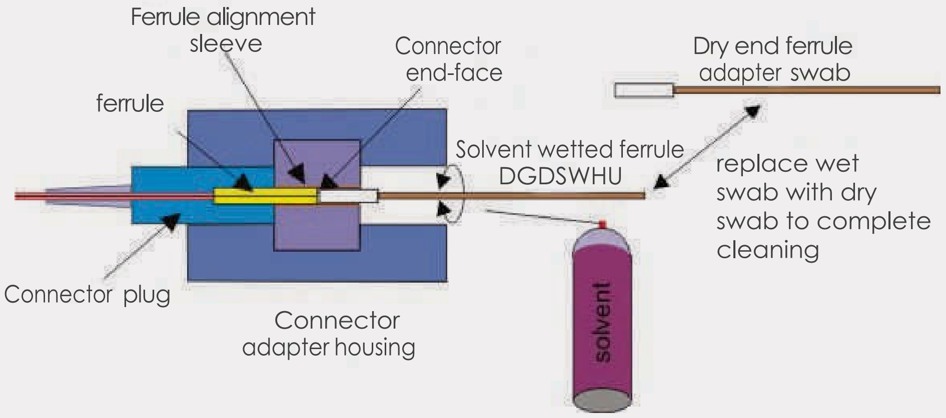
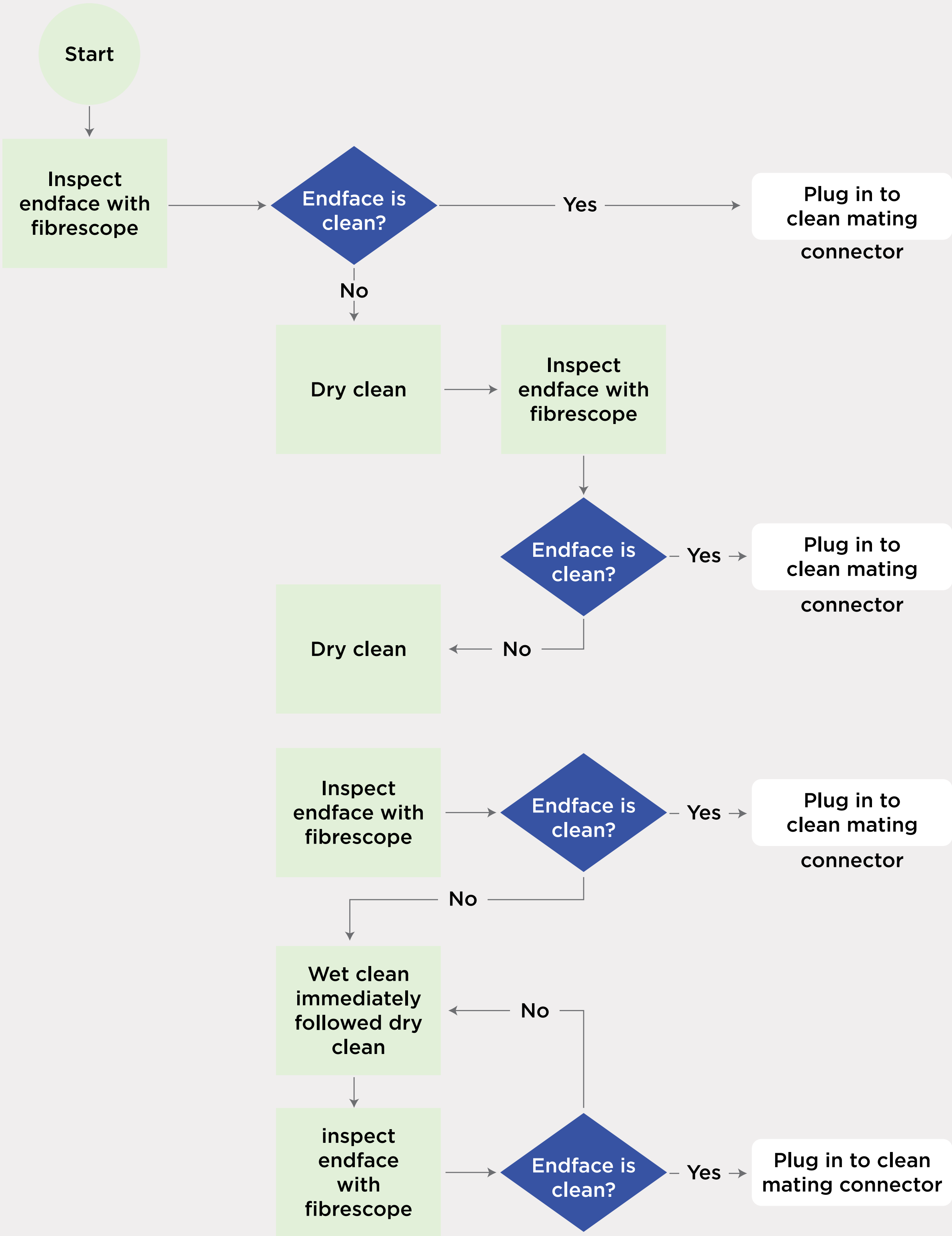



Figure 13 – A Description of the Cleaning Procedure for a Back Plane Optical Connector

## A wide variety of cleaning solvents are available in an assortment of chemical blends to impart specific properties such as :

- Remove the front plane optical connector.
- Examine both Fibre-ends of the two mating optical connectors with a Fibre scope.
- Clean the front plane optical connector plug following the steps in Section 1.1.
- Blow out the ferrule alignment tube in the adapter housing with a gas duster.
- Wet the tip of a ferule swab with an all-purpose solvent. Note: it is better to under-use solvent than to over-use the solvent.
- Dry the solvent from the inside wall of the ferrule alignment tube with a dry ferrule swab sized to scrub the inside diameter of the ferrule alignment tube.
- Wipe the back plane ferrule end-face with a smaller sized swab.
- Check the cleanliness of both connector plugs with an after examination of their end- faces using a Fibre scope.
- If the two connector end-faces are clean, assemble the connection and move on to the next connection.

## Cleaning Process Flow




ALWAYS:

**INSPECT | CLEAN | INSPECT | CONNECT**

| Sr.No | | Glossary |
|---|---|---|
| | Terms | Abbreviations |
| 1 | ANSI | American National Standards Institute |
| 2 | FAT | Fibre Access Terminal |
| 3 | FDC | Fibre Distribution Closure |
| 4 | FDF | Fibre distribution frame |
| 5 | IEC | International Electrotechnical Commission |
| 6 | ISO | International Organization for Standardization |
| 7 | IPA | Isopropyl Alcohol |
| 8 | JC | Joint Closure |
| 9 | LOMMF | Laser optimized Multimode Fibre |
| 10 | LSZH | Low-Smoke Zero-Halogen |
| 11 | OFL | Overfilled Lauch |
| 12 | OLTS | Optical Loss Test Set |
| 13 | OM | Optical multimode fibre |
| 14 | OPM | Optical Power meter |
| 15 | OS | Optical singlemode fibre |
| 16 | OTDR | Optical Time Domain Reflectometer |
| 17 | PE | Polyethylene |
| 18 | PVC | Poly Vinyl Chloride |
| 19 | TIA | Telecommunications Industry Alliance |
| 20 | VFL | Visual Fault Locator |

beyond tomorrow

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