M E F C
Middle East Fiber Cable Manufacturing Co

كابلات الألياف البصرية
شركة الشرق الاوسط لصناعة كابلات الالياف البصرية

OPTICAL FIBER SPLICING TIPS

Optical Fiber splicing is one of the cable termination techniques. The other method of termination is direct connectorising or connector mounting onto the cable. No area of fiber optics has been given greater attention than termination as it effects the complete link performance and power budget calculations.

Mechanical splicing and fusion splicing are two common methods of splicing the fibers.

MECHANICAL SPLICING

Mechanical splices are simply alignment devices, designed to hold the two fiber ends in a precisely aligned position thus enabling light to pass from one fiber into the other. (Typical loss: 0.3 dB)
Mechanical splicing is an optical junction where the fibers are precisely aligned and held in place by a self-contained assembly, not a permanent bond. This method aligns the two fiber ends to a common centerline, aligning their cores so the light can pass from one fiber to another.

Four steps to performing a mechanical splice:

1: Preparing the fiber - Strip the protective coatings, jackets, tubes, strength members, etc. leaving only the bare fiber showing. The main concern here is cleanliness.

2: Cleave the fiber - The process is identical to the cleaving for fusion splicing but the cleave precision is not as critical.

3: Mechanically join the fibers - There is no heat used in this method. Simply position the fiber ends together inside the mechanical splice unit. The index matching gel inside the mechanical splice apparatus will help couple the light from one fiber end to the other. Older apparatus will have an epoxy rather than the index matching gel holding the cores together.

4: Protect the fiber - the completed mechanical splice provides its own protection for the splice.

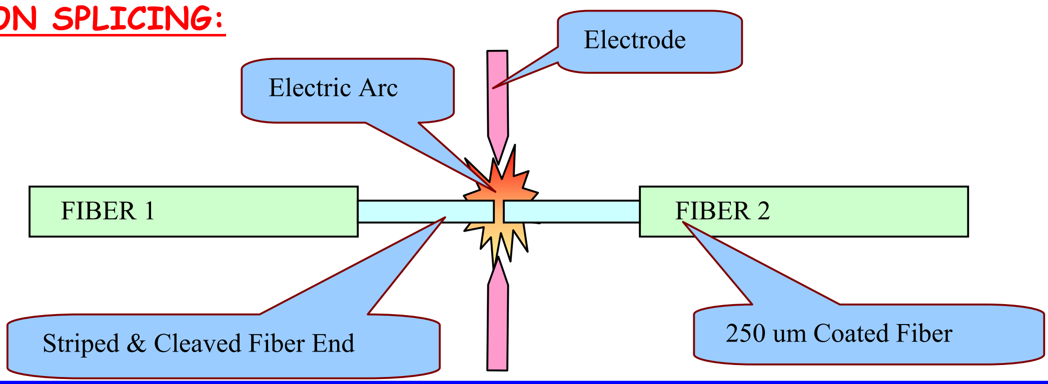
FUSION SPLICING

Fusion splicing typically works out as the preferred method of performing connections at the splitter and at the house for performance, reliability, and economic reasons. Fusion splicing differs from mechanical splices and connectors in that it directly fuses optical fibers together in a high quality process using a fusion arc. This produces a continuous connection between the fibers enabling very low loss light transmission. (Typical loss: 0.1 dB)
The result is a physical low loss bond between the fibers, free of air gaps and inclusions. In practical applications fusion splicers are used for this purpose. Fusion splicing is the most accurate and durable method of interconnecting optical fibers permanently. Mechanical splice and Fiber optic connectors are used for temporary joints.
After preparing the fiber ends, the fiber ends are inserted in the "V" grove of the splicer, aligned to each other and fused together. The crucial factor here is to align the fiber cores to each other as accurately as possible. Almost all the automatic fusion splicers having the facility of aligning the fibers automatically. During splicing the alignment and fusion process is shown on the monitor including the display of additional information like fiber offset values, fusion time, core eccentricity and the splice loss result.

The Splicing Process Typically Involves The Following Steps:

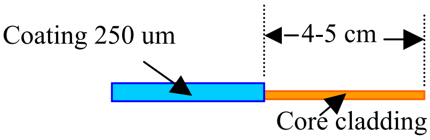
1. Stripping the fiber ends with a stripping tool.
2. Preparing the end faces with a fiber optic cleaver.
3. Cleaning the fiber ends.
4. Inserting the fiber ends in the fusion splicer and alignment of fibers.
5. Fusing the fibers using an electric arc ignited between two electrodes.
6. Analyzing the finished splice.
7. Protecting and storing the splice.

FUSION SPLICING:

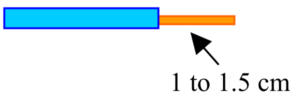


SPLICING PROCEDURE :

1. Clean the Fiber ends with isopropyl alcohol.
2. Strip the coating(Approx 4 to 5 cm) by a fiber stripper.



3. Clean the stripped fiber again.
4. Cleave the fiber (Approx 1 to 1.5 cm) using fiber cleaver.



5. Before keeping it to the splicer insert the splice protection sleeve.
6. Kept both fibers in the "v" groove of the fusion splicer.
7. press the start button of the fusion splicer. Machine will automatically align and splice the fiber.
8. After splicing the fiber remove the fiber from the machine carefully and slide the splice protection sleeve up to the splice point. The spliced portion should be kept exactly at the center of the protection sleeve.
9. Place it in to the heat oven attached with the splicing machine.
10. After reaching the setted temperature machine will give an alarm.
11. Remove the fiber from the heat oven.
12. Kept the fiber in the splice tray properly looped (Bending radius not less than 60mm)
13. When preparing the fibers for splicing (stripping the fibers) it is necessary to ensure that no damage occurs to the fiber cladding. Any damage to the unprotected glass of the fiber can produce micro cracks causing the fiber to break during handling, splicing or storage.

CAUSES OF HIGH SPLICE LOSS

Connector and splice loss is caused by a number of factors. Loss is minimized when the two fiber cores are identical and perfectly aligned, the connectors or splices are properly finished and no dirt is present. Only the light that is coupled into the receiving fiber's core will propagate, so all the rest of the light becomes the connector or splice loss.

End gaps cause two problems, insertion loss and return loss. The emerging cone of light from the connector will spill over the core of the receiving fiber and be lost. In addition, the air gap between the fibers causes a reflection when the light encounters the change n refractive index from the glass fiber to the air in the gap. This reflection (called fresnel reflection) amounts to about 5% in typical flat polished connectors, and means that no connector with an air gap can have less than 0.3 dB loss. This reflection is also referred to as back reflection or optical return loss, which can be a problem in laser based systems. Connectors use a number of polishing techniques to insure physical contact of the fiber ends to minimize back reflection. On mechanical splices, it is possible to reduce back reflection by using non-perpendicular cleaves, which cause back reflections to be absorbed in the cladding of the fiber.

The end finish of the fiber must be properly polished to minimize loss. A rough surface will scatter light and dirt can scatter and absorb light. Since the optical fiber is so small, typical airborne dirt can be a major source of loss. Whenever connectors are not terminated, they should be covered to protect the end of the ferrule from dirt. One should never touch the end of the ferrule, since the oils on one's skin causes the fiber to attract dirt. Before connection and testing, it is advisable to clean connectors with lint-free wipes moistened with isopropyl alcohol.

Two sources of loss are directional; numerical aperture (NA) and core diameter. Differences in these two will create connections that have different losses depending on the direction of light propagation. Light from a fiber with a larger NA will be more sensitive to angularity and end gap, so transmission from a fiber of larger NA to one of smaller NA will be higher loss than the reverse. Likewise, light from a larger fiber will have high loss coupled to a fiber of smaller diameter, while one can couple a small diameter fiber to a large diameter fiber with minimal loss, since it is much less sensitive to end gap or lateral offset.

These fiber mismatches occur for two reasons. The occasional need to interconnect two dissimilar fibers and production variances in fibers of the same nominal dimensions. With two multimode fibers in usage today and two others which have been used occasionally in the past and several types of singlemode fiber in use, it is possible to sometimes have to connect dissimilar fibers or use systems designed for one fiber on another. Some system manufacturers provide guidelines on using various fibers, some don't. If you connect a smaller fiber to a larger one, the coupling losses will be minimal, often only the fresnel loss (about 0.3 dB). But connecting larger fibers to smaller ones results in substantial losses, not only due to the smaller cores size, but also the smaller NA of most small core fibers.

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