

Fibre Optic Cable Splicing and Terminating

What is fibre optic cable splicing

- Simply put, **fiber optic splicing** involves joining two **fiber optic cables** together
- The other, more common, method of joining fibers is called termination or connectorization
- Fiber splicing typically results in lower light loss and back reflection than termination

When is splicing done?

- When the cable runs are too long for a single length of fiber or when joining two different types of cable together, such as a 48-fiber cable to four 12-fiber cables
- To restore fiber optic cables when a buried cable is accidentally severed.

Methods of Splicing

- There are two methods of fiber optic splicing
 - Mechanical
 - Fusion

Mechanical Splicing

- A **mechanical splice** is a junction of two or more optical **fibers** that are aligned and held in place by a self-contained assembly
- The fibers are not permanently joined, just held together in a precisely aligned position thus enabling light to pass from one fiber into the other.
- Typical loss: 0.3 dB

Fusion Splicing

- Fibre optic fusion splicing is a joining method whereby a machine is used to precisely align two fiber ends then the glass ends are "fused" or "welded" together using some type of heat or electric arc.
- Produces a continuous connection between the fibers enabling very low loss light transmission.
- Typical loss: 0.1 dB

Mechanical vs Fusion Splicing

- Cost benefit
 - Mechanical has low initial investment (\$1,000 - \$2,000) but costs more per splice (\$12-\$40 each)
 - Cost per splice for fusion splicing is lower (\$0.50 - \$1.50 each) but the initial investment is much higher (\$15,000 - \$50,000 depending on the accuracy and features of the fusion splicing machine being purchased)

Mechanical vs Fusion Splicing

- Performance
 - Based on the industry you are working with the performance of this two splicing methods may vary
 - Because resulting points from fusion splicing are almost seamless, fusion splicing tends to produce less back reflection as well as lower light loss

Mechanical vs Fusion Splicing

- Performance
 - Fusion splicing is usually used with single mode fiber while mechanical splicing usually used with both multi mode fiber as well as single mode fiber.
 - Telecommunication companies as well as CATV companies are willing and ready to invest their time and money on fusion splicing for their single mode networks

Mechanical vs Fusion Splicing

- Performance
 - The same organizations also tend to put into use mechanical splicing for their short, local cable runs.
 - Given that for optimal performance video signals usually require minimal reflection, fusion splicing has managed to remain the first choice for many companies

Fibre Optic Splicing Safety



Fibre Optic Hazards

- Vision
- Skin Puncture
- Ingestion

Fibre Optic Hazards - Vision

- Avoid looking directly into fibre end with naked eye
 - Severe burning of the retina resulting in permanent scarring on the retina, does not heal, sight impaired for life
 - Severe burning of retinal nerve end, does not heal, sight lost for life

Fibre Optic Hazards - Vision

- Wear safety glasses with side shields
 - Every termination and splice produces shards (scraps) of optical fiber which is potentially very harmful to your eyes
 - The sharp ends of the fiber may cause it to imbed itself in the eye or surrounding tissue, making it even more difficult to remove.
 - Unlike metallic particles, they cannot be removed with magnets

Fibre Optic Hazards - Skin Puncture

- Shards of fiber are tiny, thin and often very sharp where they break off the fiber
- Can easily puncture your skin, burying themselves deep enough to be difficult to pull out
- Being transparent they practically disappear once imbedded in your skin. In most parts of your body

Fibre Optic Hazards - Skin Puncture

- Become a nuisance in body, perhaps infecting or causing an irritating bump, until they eventually work themselves out
- Be extremely careful whenever handling fibers, especially when stripping fiber or scribing and breaking

Fibre Optic Hazards - Ingestion

- Keep all food and beverages out of the work area. If fiber particles are ingested they can cause internal hemorrhaging

Fibre Optic Hazards – Other Hazards

- Chemicals:
 - Fiber optic splicing and termination use various chemical cleaners and adhesives as part of the processes
 - Even simple isopropyl alcohol, used as a cleaner, is flammable and should be handled carefully
 - Manufacturers will supply "material safety data sheets" (MSDS)

Fibre Optic Hazards – Other Hazards

- Splicing hazards:
 - Fusion splicers use an electric arc to make splices, so care must be taken to insure no flammable gasses are present in the space where fusion splicing is done

Fibre Optic Hazards – Other Hazards

- No Smoking
 - Smoking should also not be allowed around fiber optic work
 - The ashes from smoking contribute to the dirt problems with fibers, in addition to the possible presence of combustible substances

Fibre Optic Installation Safety Rules

- Work on a black work surface as it helps to find fiber scraps
- Wear disposable aprons to minimize fiber particles on your clothing. Fiber particles on your clothing can later get into food, drinks, and/or be ingested by other means

Fibre Optic Installation Safety Rules

- Always wear safety glasses with side shields and protective gloves. Treat fiber optic splinters the same as you would treat glass splinters
- Never look directly into the end of fiber cables until you are positive that there is no light source at the other end.

Fibre Optic Installation Safety Rules

- Use a fiber optic power meter to make certain the fiber is dark. When using an optical tracer or continuity checker, look at the fiber 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

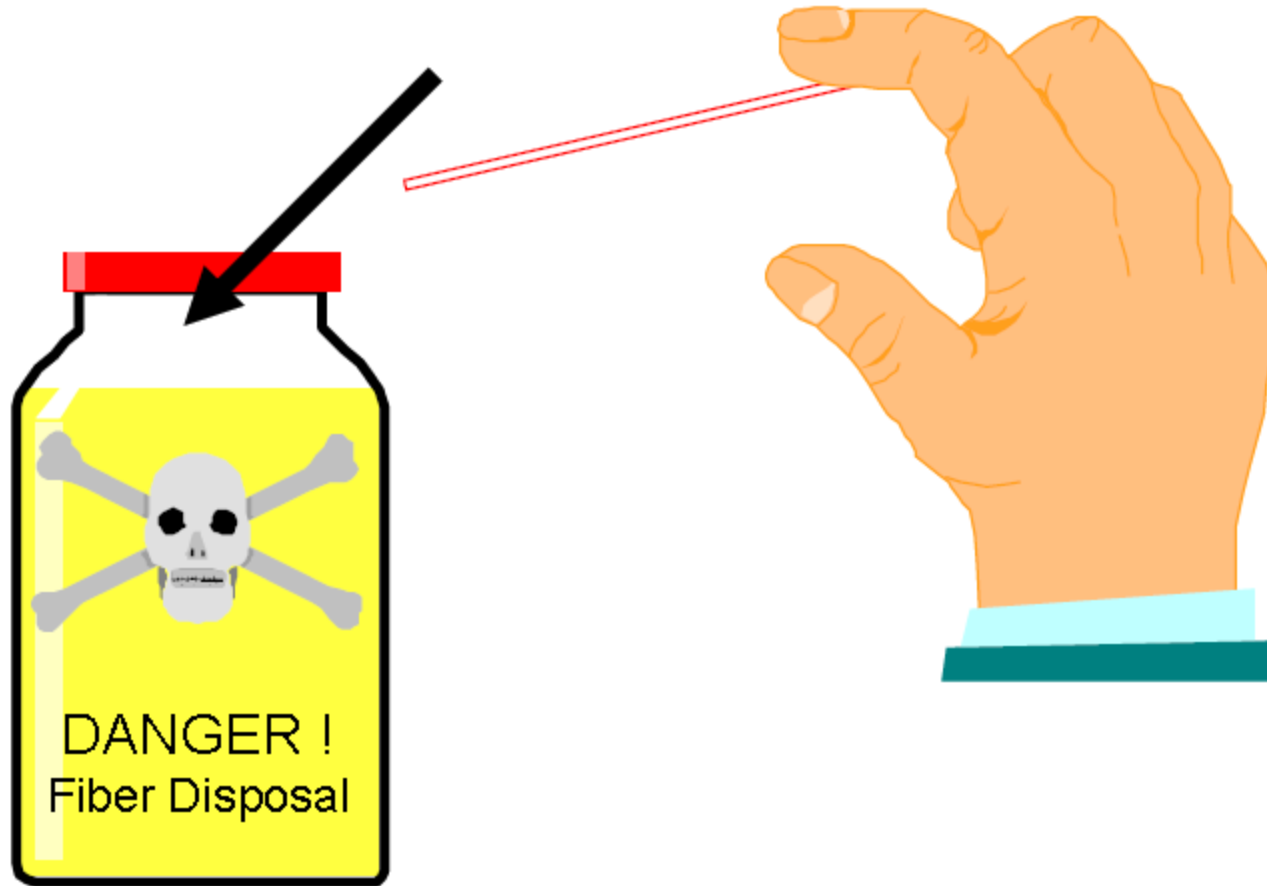
Fibre Optic Installation Safety Rules

- Contact lens wearers must not handle their lenses until they have thoroughly washed their hands
- Do not touch your eyes while working with fiber optic systems until your hands have been thoroughly washed

Fibre Optic Installation Safety Rules

- Keep all combustible materials safely away from the curing ovens
- Put all cut fiber pieces in a properly marked container for disposal
- Thoroughly clean your work area when you are done
- Do not smoke while working with fiber optic systems

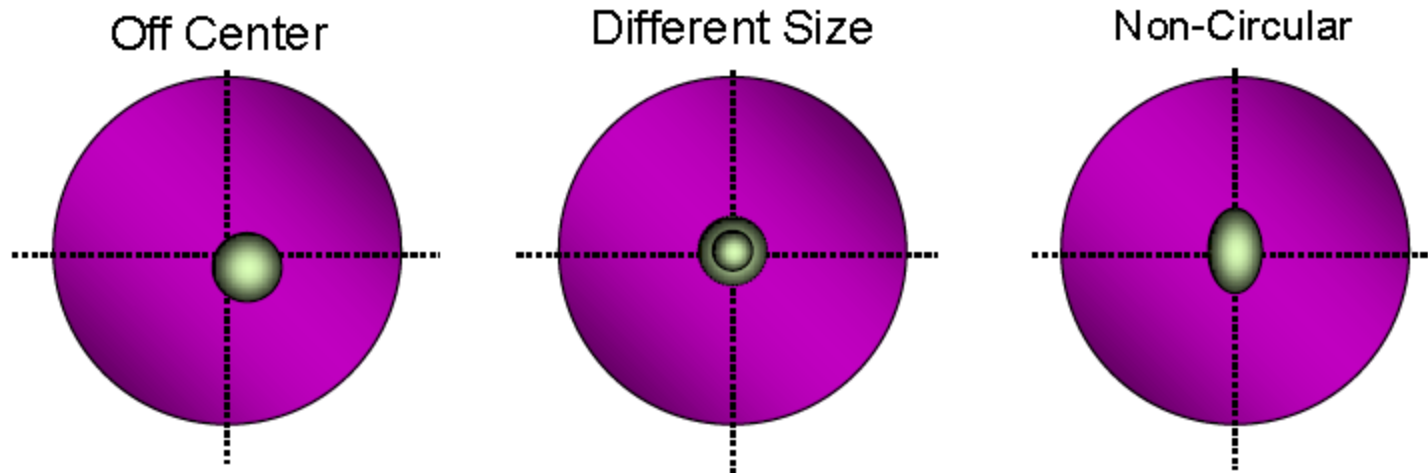
Fibre Optic Disposal



Clean Up Procedure



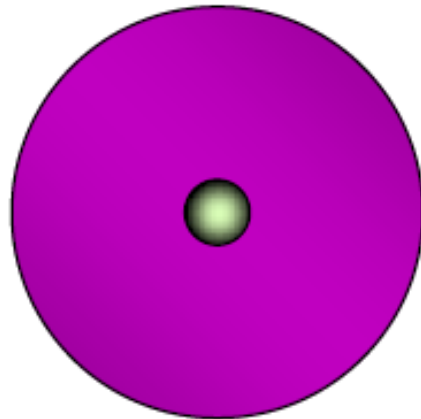
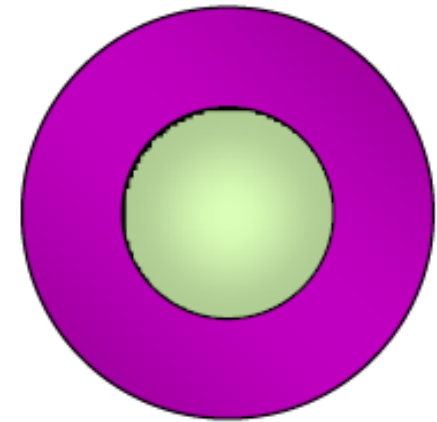
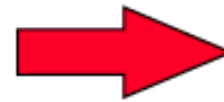
Fibre Geometry Problem



All fibers are allowed a certain tolerance in the core/cladding geometry. This can cause light loss at joints between fibers.













Fibre Geometry Problem

Multimode fiber has a large core relative to the cladding diameter



Singlemode fiber has a smaller core relative to the cladding diameter.

Fibre Optic Colour Code

TIA-598-A Fiber Optic Cable Standard Color Code			
1 blue		7 Red	
2 Orange		8 Black	
3 Green		9 Yellow	
4 Brown		10 Violet	
5 Slate		11 Rose	
6 White		12 *Aqua	

* 13 fibers and higher, the color code is repeated every 12 and the buffered fibers or subcables are striped once for every additional 12 according to the TIA-598-A specifications.

Fusion Splicing Golden Rule

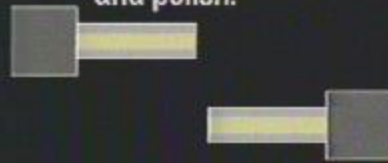
- *Safety First*
- Wash hands before you start
- Prepare a clean work environment
- Strip, Clean, Cleave
- Never clean after cleaving
- If you remove it clean it
- Always use dust caps
- Leave spare cable/fiber when possible

Fusion Splicing Steps

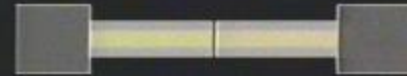
1. Remove the coating



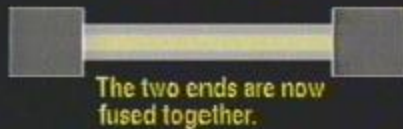
2. Cut to proper length and polish.



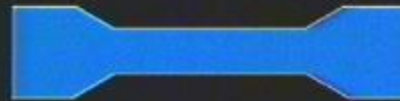
3. Place in the fusion machine. Align and gap.



4. The fiber cores are melted together.



5. A protective tube is placed over the splice.



Splicing

