



Attendee Announcements

- ✓ **Seminar Raffle** – Be sure to drop your raffle ticket in the drum at today's Keynote located in the Mile High Ballroom. You have a chance to win a \$250 American Express Gift Card. One winner will be drawn at the Opening Keynote and the Tech Talks Keynote. **You must be present to win.**
- ✓ **Seminar Evaluations** – All attendees will be receiving an email with regards to the seminar and we encourage you to respond to the surveys. The survey results will be compiled by ISE EXPO team members, summarized, and will be shared with the seminar speakers. *The seminar feedback is an important aspect of continually improving ISE EXPO.*
- ✓ **Seminar Certificates** – Attendees will be able to log into the Attendee Resource Center (ARC) using their first name, last name, and their Badge ID (this number will appear on the badge and also on any registration confirmations) to view/print their seminar certificates. If a certificate is needed on-site, the attendee may visit the ISE EXPO registration counter between the hours of 1 PM – 3 PM August 15 & August 16 and ask for a certificate to be printed. Attendees will be able to access the ARC website up to 2 – 3 months after the event to print CEC certificates.
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GREENLEE®
A Textron Company

INNOVATION DRIVING EFFICIENCY

Fusion Splicing

Do It Right The First Time!

Keith Foord
Product Manager
Greenlee Communications



Introduction

- Why Fusion Splice
- Splicing Basics
- Splicing Misunderstandings
- Best Practices
- Core & Active Clad vs Cladding Alignment
- Dissimilar Splicing Challenges
- Splice on Connectors
- Evaluating the Splice



Why Fusion Splice

- Provides lowest possible Insertion Loss
- Provides nearly zero reflection
- Connectors cause reflections and loss
- Today's networks require low reflectivity
- Reflections corrupt signal integrity





Fusion Splicing Basics

- Splicing provides consistent results
- Excellent insertion loss, typically 0.02dB SMF and 0.01dB MMF
- Should splice where a connector is not necessary to reduce IL & RL
- More reliable than mechanical connectors & has lower IL & RL
- Splice on connectors are suitable for high bandwidth applications





Misunderstandings

- Drop test – hammer test
- IP Rating – IP52 (Dust & Water)
- The fine print
- ARC Calibration
- Cleaning

* Insertion loss is for cut and re-splice of identical fibers.

* Dust resistance and rain resistance test do not guarantee that the product will not be damaged under these conditions.



Misunderstandings

- * Dust resistance and rain resistance test do not guarantee that the product will not be damaged under these conditions.
- * Insertion loss is for cut and re-splice of identical fibers.

Need to protect your investment

Splicing is easy until there is a problem

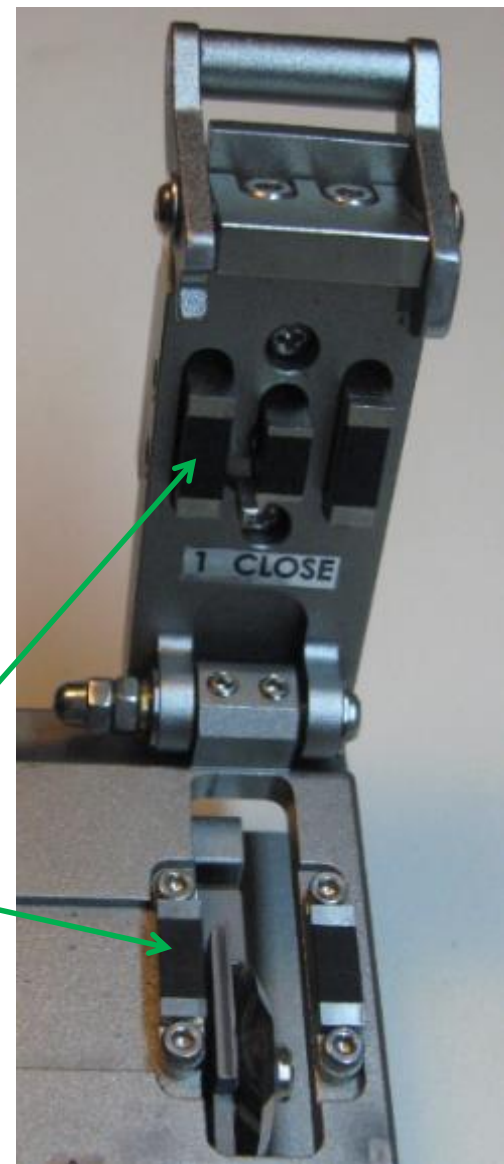


Splicing Best Practices

Good cleaves are imperative

- Stripping the fiber is most time consuming
- Make sure that the cleaver is clean
 - Glass shards on presser pads
 - Sides of cleaving wheel
 - Use 99% IPA
- Make sure that the fiber is clean
 - Make sure to remove acrylic coating
 - Use 99% IPA on lint free cloth
- Bad cleaves will compromise the quality of the splice

Fiber presser pads





Splicing Best Practices

ARC test is required for every splicing session

- Load two cleaved fibers
- Perform ARC calibration
- Fibers shape is analyzed & power is adjusted

Compensates for:

- Barometric pressure changes
- Temperature changes

Auto Mode:

- Uses previous splice settings
- Still need ARC Calibration





Splicing Best Practices

Keep the Splicer Clean

- Mirrors
- Objective lenses
- V-Grooves
- Fiber clamps
- Do not use compressed air!
 - Propellant contamination
 - Lodges contamination even deeper
- Use 99% pure IPA & lint free swabs

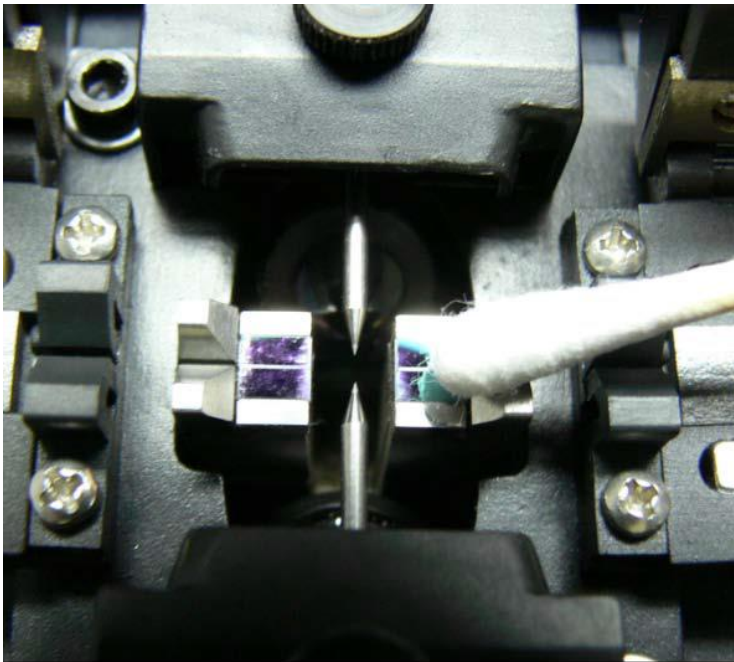




Splicing Best Practices

V- Grooves

- Use 99% pure IPA & lint free swabs
- Use fiber optic cable to remove stubborn debris – hardened gel

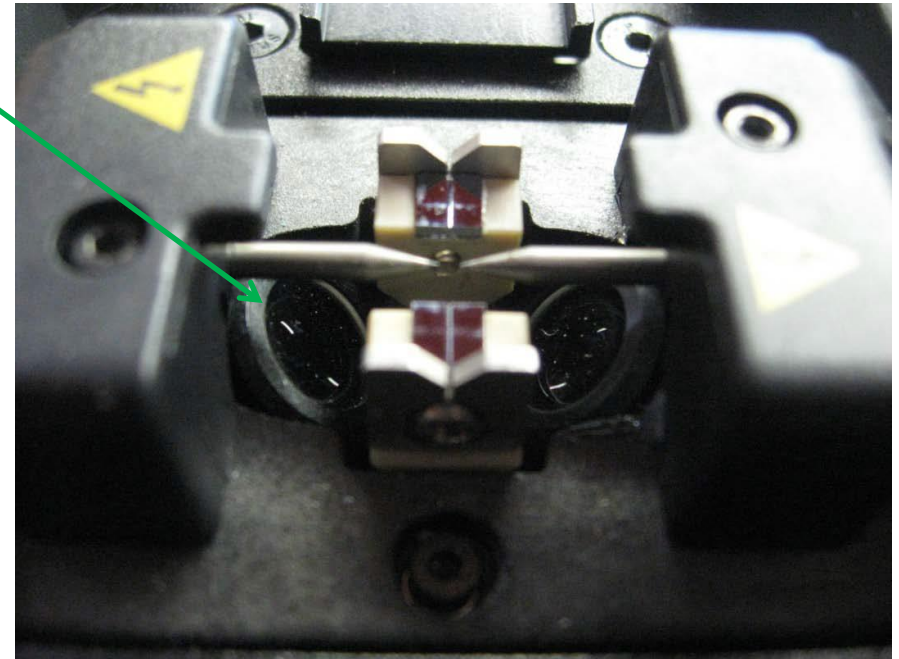




Splicing Best Practices

Objective Lenses (2)

- **Do not** use 99% pure IPA
- Use lint free swab
- Start in center of lens and clean in a circular motion pushing contamination to the edge
- Easier to do when electrodes are removed
 - Do not touch electrodes
 - Stabilize electrodes if removed
 - ARC calibration if removed

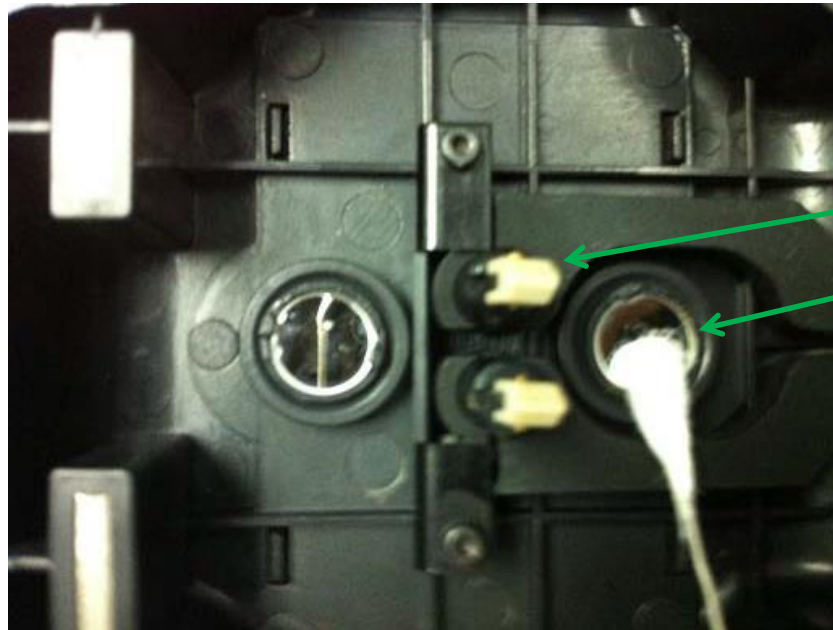




Splicing Best Practices

Windshield Mirrors and Clamps

- Use 99% pure IPA and lint free swab



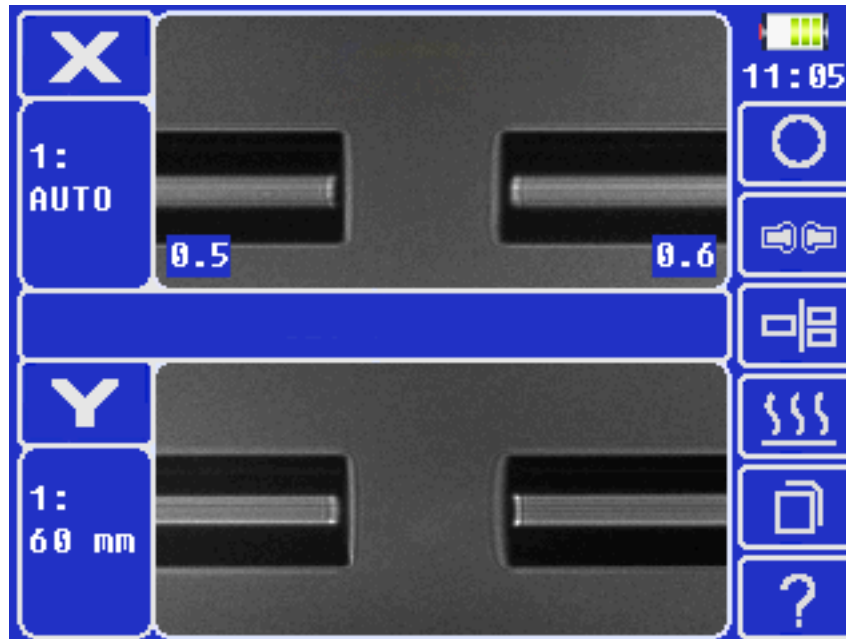
Clamps (2)
Mirrors (2)



Splicing Best Practices

Maintenance Menu

- ARC Calibration
- Motor Calibration
 - Bring the motor travel back to factory setting
- Screen Calibration
 - Bring the camera position back to factory setting





Splicing Technologies

- Core Alignment
- Active Clad Alignment
- V – Groove Alignment (cladding)



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Splicer
Performance



+

V Groove

Active Clad

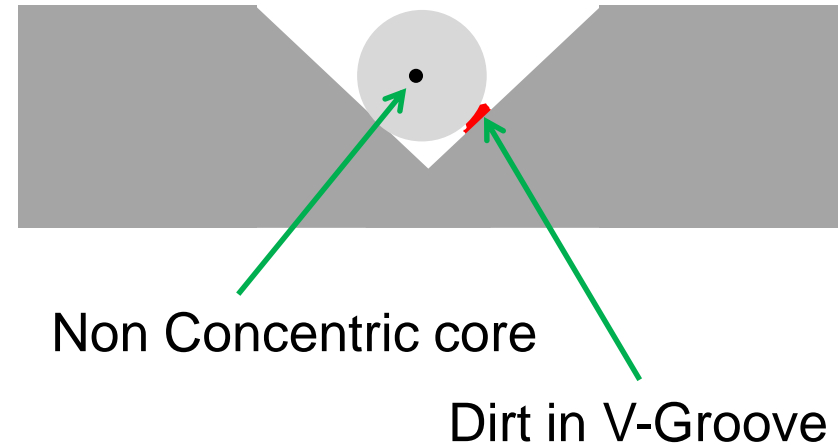
Core



Core vs Cladding Alignment

Core alignment

- Provides the lowest splice loss under adverse conditions
- Is more tolerant of contamination
- Virtually eliminates fiber concentricity issues
- Controls in the X, Y & Z domains
- Provides camera focus capability



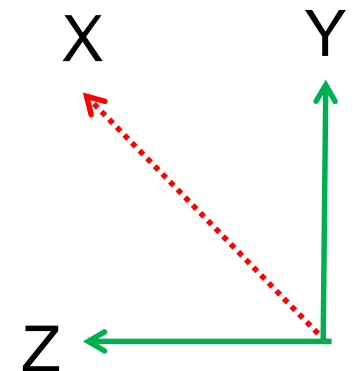
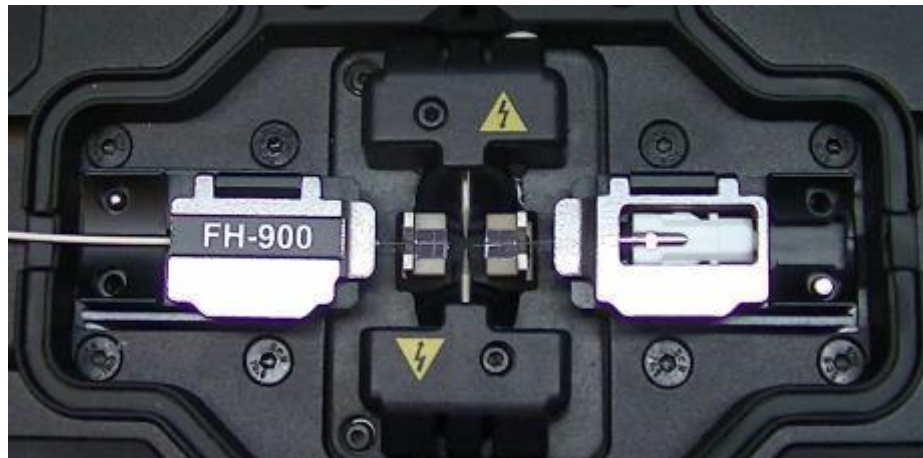
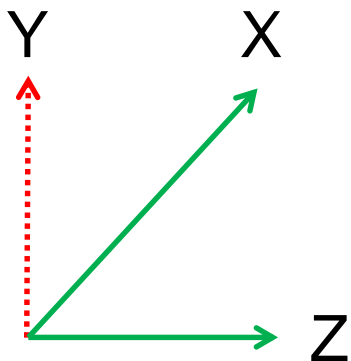
Cladding alignment

- Z control only
- Susceptible to V-Groove contaminations and damage
- Higher splice losses
- Most economical



Active Clad Alignment

- Similar splice loss as Core when splicing similar or new fibers
- Geared towards FTTH – last mile
- Controls the X, Y and Z domains
- Does not have motors that focus on the center of fiber
- The core of new fiber is centric to the clad





Splicing Technologies - Recommendations

FTTH – Active Clad

Old fiber to new fiber – Core

Dissimilar Fiber - Core

Newer Fiber – Active Clad

Network Backbone – Core



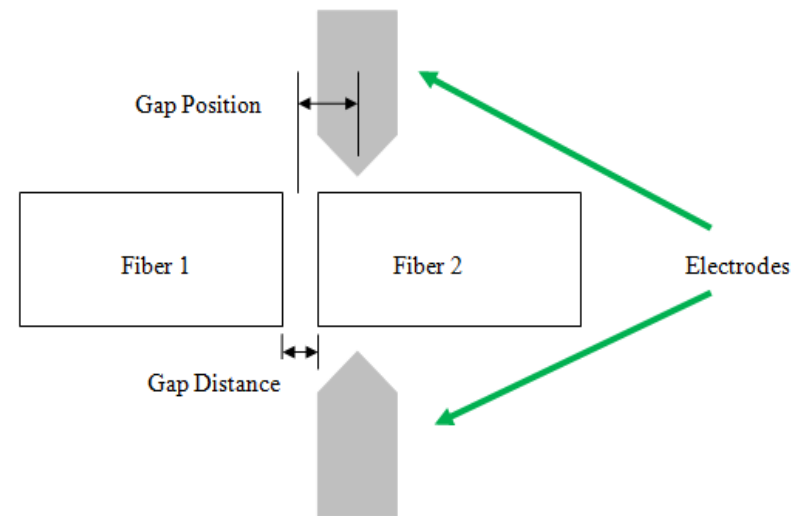
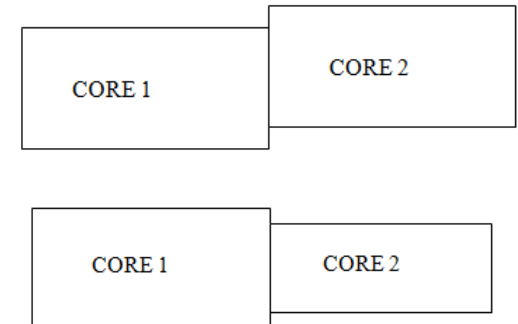
Dissimilar Splicing Challenges

Fiber geometries can cause problems

- Concentricity
- Fiber diameters

Fiber Composition

- Some fiber is easier to “melt” than others
- Need to adjust the settings of the splicer
 - Arc power & duration
 - Gap settings
 - Consult your instruction manual!



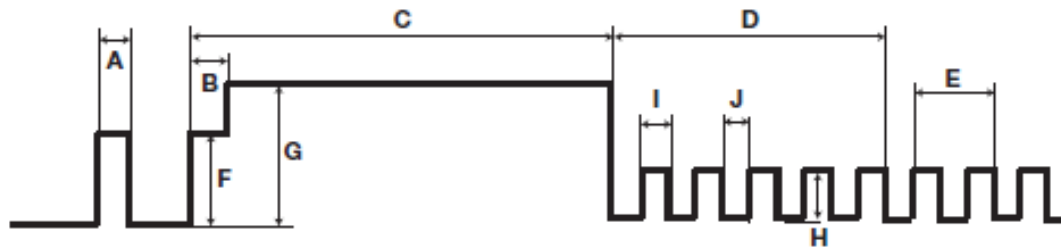


Dissimilar Splicing Challenges

Non – Auto mode controls

Consult your instruction manual!

Summary of electrode activation:



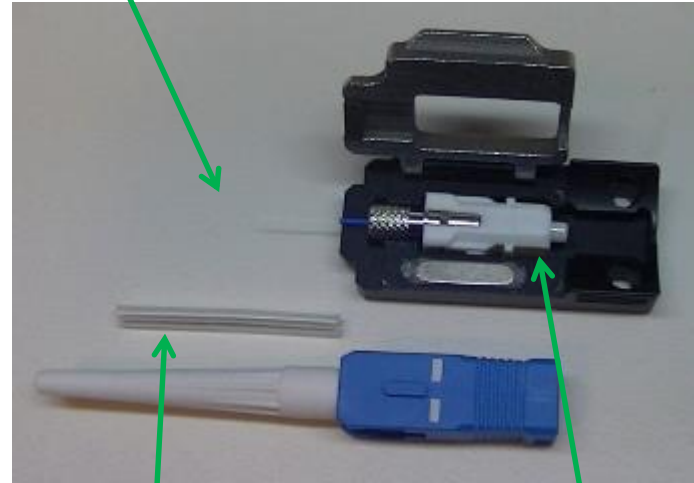
- A: Cleaning Arc
- B: Prefuse Time
- C: Arc1 Time
- D: Arc2 Time
- E: Rearc Time
- F: Prefuse Power
- G: Arc1 Power
- H: Arc2 Power
- I: Arc2 ON Time
- J: Arc2 OFF Time



Splice on Connectors – Reduce the RL

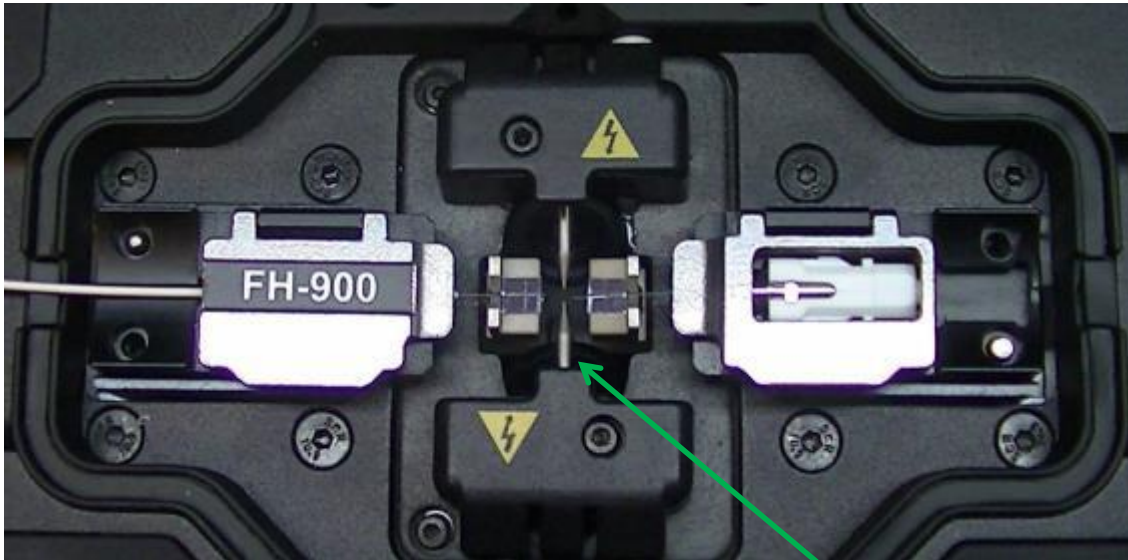
- SC, LC, FC, ST terminations (>60dB RL for APC)
- Inserted into the fusion splicer using fiber adapters
- Protection sleeve is located in the strain relief
- No splice tray is required
- No crimping, epoxies, matching gels
- Easier cable management
- GR326 compliant

Pre-cleaved fiber ready for splicing



Pre-polished fiber termini

Splice protector located in strain relief



Electrodes



Evaluating the Fusion Splice - OTDR

- The loss displayed on the screen is only an estimate!
- Need an OTDR to validate

Optical Time Domain Reflectometer (OTDR)

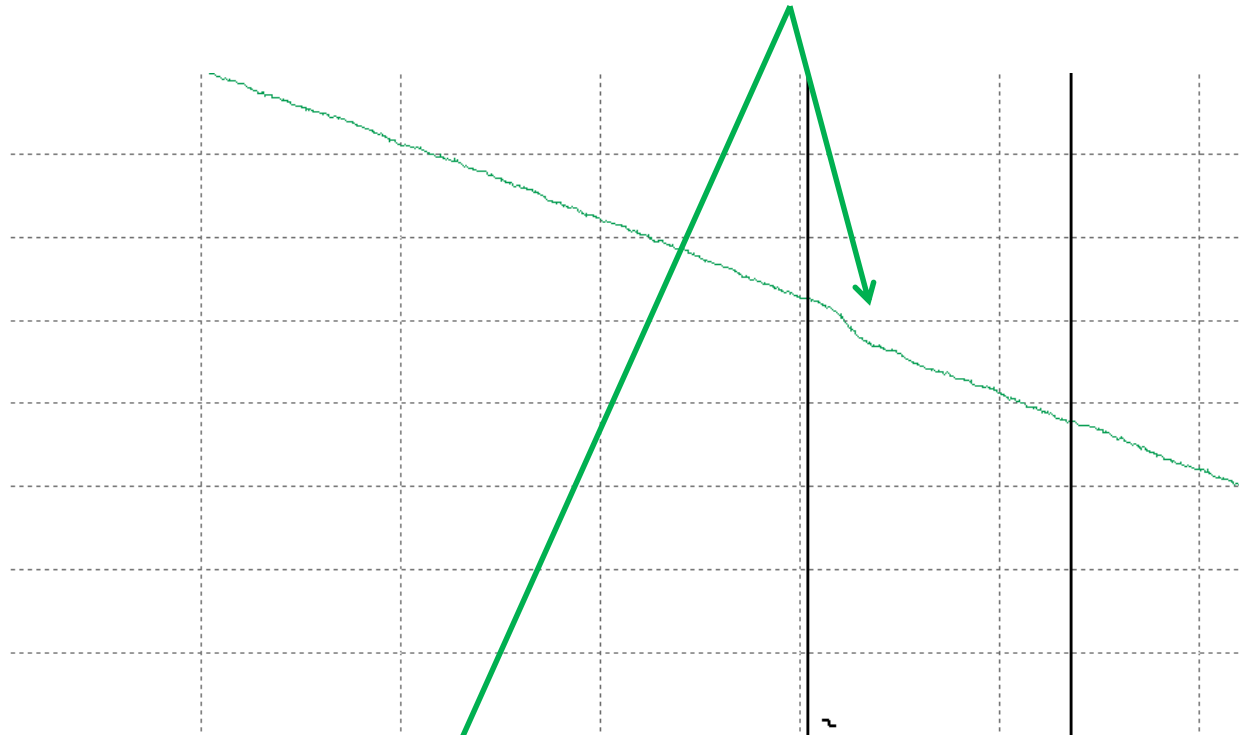
- Single ended measurement
- Typically used to locate faults
- Also used to validate installations
- Locates & quantifies individual IL & RL events
- Full reporting can be used to record fiber links for qualification, later troubleshooting and analysis





Typical Fusion Splice Loss

Fusion Splice Measured to be = 0.048dB



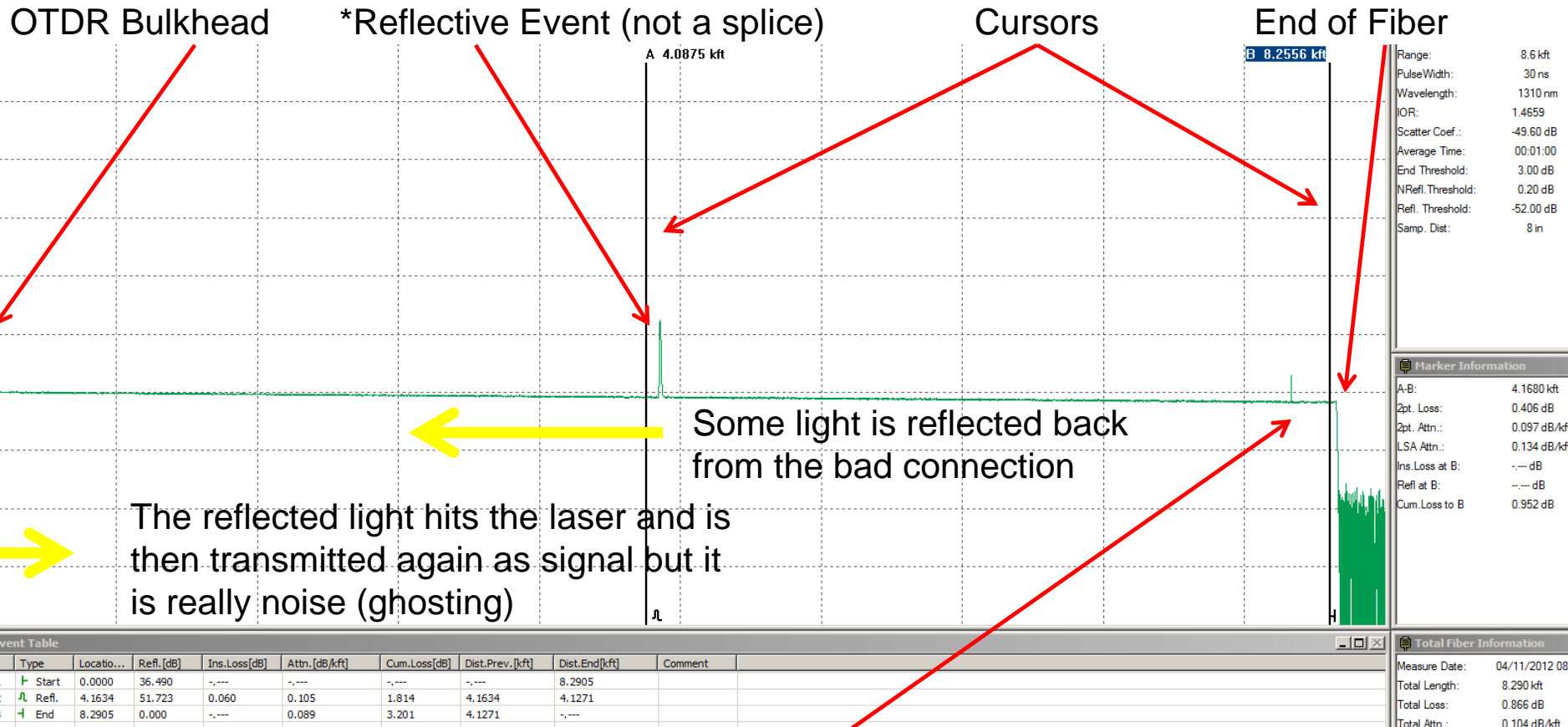
No.	Type	Locatio...	Refl. [dB]	Ins.Loss[dB]	Attn. [dB/km]	Cum.Loss[dB]	Dist.Prev. [km]	Dist.End[km]	Comment
1	Start	0.0000	-46.314	-	-	-	-	50.5821	
2	Non...	25.3064	-	0.048	0.181	4.586	25.3064	25.2757	
3	End	50.5821	-26.736	-	0.179	9.291	25.2757	-	

The return loss was not measurable!



If You Do Have Reflections

Typical OTDR Trace using Trace Viewer Software:



A ghost (not “real”) of the original reflection will be at 2X the original reflection
Reflections will limit the bandwidth of fiber links due to ghosting effects!



Summary

- Handle the fusion splicer with care
- ARC calibration is a must
- Clean, Clean and Clean
- Core alignment compensates for fiber geometries
- Active clad provides near core performance
- An OTDR should be used to validate the insertion loss and return loss of the splice
- Splice on connectors should be used – not mechanical connectors
- Non auto controls determine who really is a splicing technician



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