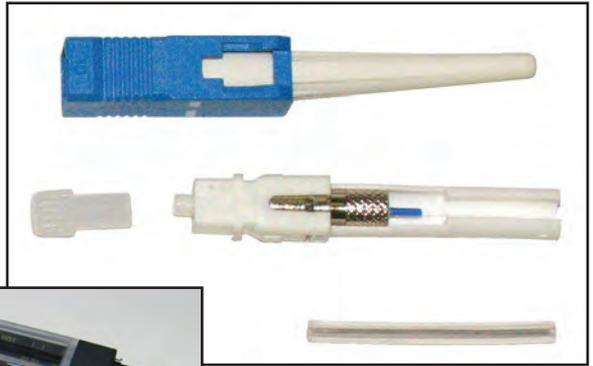


# Splice-on Connector



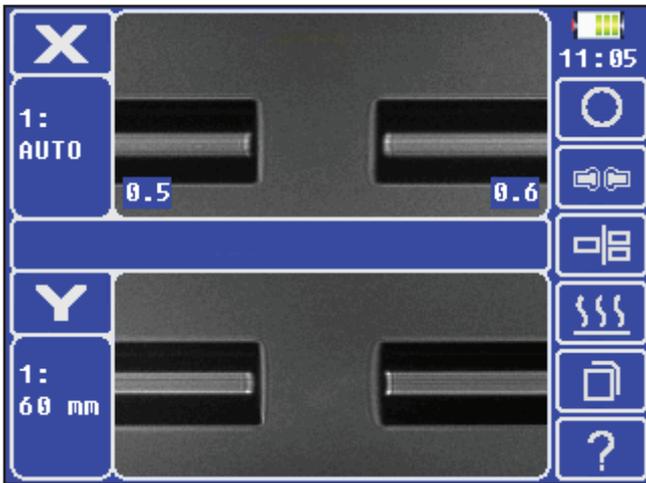
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# 1.0 UNDERSTANDING SPLICING TECHNOLOGY

## 1.1 How does a splicer work?

1. A fusion splicer takes precision cleaved fibers and welds the pieces of glass together between two metal electrodes.
2. After fibers are loaded into the splicer, it moves them forward to a certain position at which point the splicer discharges an arc to burn off any remaining debris on the fibers.
3. Following the cleaning arc, the fibers are inspected for cleave angle, end-face quality, and alignment issues against pre-set criteria. These results can be displayed.
4. With inspection complete, the splicer arc discharges from electrodes and an estimated loss is displayed on screen.
5. If splice loss exceeds acceptable budget or fibers are detected to have bubble, flat, or thin splice point, it is recommended to re-splice the fibers.



## 1.2 V-Groove (Clad Alignment) vs. Core Alignment

### V-Groove Splicer

- Fibers sit in a fixed fiber holder, or removable holder, that is intended to hold a 900  $\mu\text{m}$  or 250  $\mu\text{m}$  buffer fiber.
- Fibers are lined up “physically” based on the outer diameter of the fiber’s cladding.
- Uses camera(s) for splice operation but only allows for single axis movement of fiber.
- Typical loss is 0.02 dB to 0.05 dB for Singlemode fibers and 0.03 dB to 0.06 dB for Multimode fibers.

### Core Alignment Splicer

- Also uses either fixed fiber holders or removable fiber holders.
- Fibers viewed by multiple cameras with splicer locating core of fiber and aligning fiber cores using movable stages.
- Compensates for non-concentric fibers.
- Misalignments are corrected by the movable stages.
- Typical loss is 0.02 dB.

# 1.3 Preformative Fusion Splicing (Acceptable vs. Defective Splices)

## Acceptable Splices

Evaluating a splice can be a tricky process, depending on what you use to determine a good or bad splice.

*Note: A fusion splicer will provide an estimated splice loss value. This value is only an estimate and should not be used to determine splice quality. The splicer is creating an estimate based on several key factors; however, until light passes through the splice, there is no accurate way of determining actual splice loss.*

## Defective Splices

Defective splices can be caused by several factors:

- Bad cleave angles
- Dirty fiber
- Worn or damaged electrodes
- Contamination
- Over application of cleaning products
- Unstable power distribution (no arc calibration)
- Unsuitable splice mode

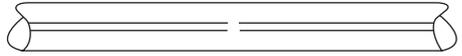
**Note: The only way to determine splice loss is to test the link with an OTDR.**

*Note: The link should be tested in both directions. The attenuation values of the fusion splice should be averaged in order to get an accurate measurement. Fusion splices may show no attenuation in one direction and higher loss in the other.*

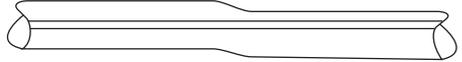
White lines or faint lines in splices should not be considered automatic failures. Without testing through the splice there is no accurate way to evaluate the splice. Splices with black lines or bubbles should be re-spliced.

### Acceptable Splices

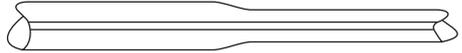
Blurred Thin Line



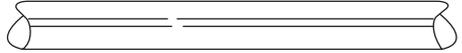
Offset



Diameter Difference

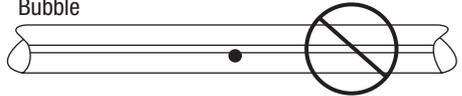


Dirt on Fiber

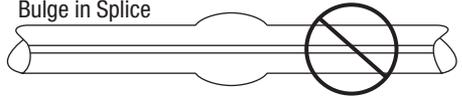


### Defective Splices

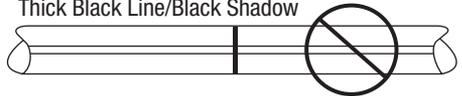
Bubble



Bulge in Splice



Thick Black Line/Black Shadow



## 2.0 FUSION SPLICER BASICS

### 2.1 Steps a Splicer Performs

1. Pre-fuse: Splicer discharges arc to clean off any debris.
2. Angle Measurements: Splicer identifies cleave angles and rejects poor angles that could result in poor splice. Angle thresholds can be changed in editing menu of splicer.
3. Fiber Alignment: Splicer moves fibers together and cameras verify correct angles.
4. Splice: Splicer discharges arc, fusing the two fibers together.
5. Tension Test: Designed to confirm the fibers are indeed spliced. It is recommended that the tension test (proof) be disabled for the splice-on connectors.
6. Splice Loss Estimation: The splicer will estimate the splice loss based on cleave quality, angle offset, and resulting shape of the splice.
7. Splice Sleeves: Heat shrink sleeves installed prior to splice now are moved into position, centered over splice area and placed in oven.
8. Ovens: Shrink protection sleeves onto fiber. The oven can be adjusted for length of sleeve, temperature, and length of cycle.

### 2.2 Hands-on Performing an Arc Calibration

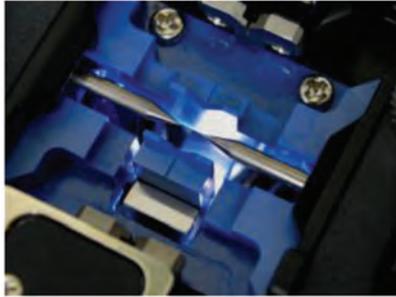
1. Prepare, clean fibers for cleaving.
2. Cleave fibers to correct length (refer to splicer instruction manual).
3. Choose Arc Calibration in splicer menu options.
4. With top hood/lid closed perform arc calibration.
5. Determine if splicer reports arc check/calibration complete/finished.
6. If not satisfactory, repeat process.

### 2.3 Hands-on Performing Fusion Splice

1. From splicer menu choose the type of optical fiber to be spliced (Singlemode, Multimode, etc.) or choose Auto Mode.
2. Prepare, clean fibers for cleaving (strip about 1-1/2" of buffer off fiber).
3. Cleave fibers to correct length (refer to splicer instruction manual).
4. Place buffer/coating at end of holder with bare optical fiber extending; then place in cleaver and cleave.
5. Load fibers into splicer; cleaved fiber should extend centered between the end of chuck/holder stage and the electrodes.
6. Press button to execute splice. The splicer may be set to pause after angle inspection; user may have to press button again to discharge arc. This pause feature can be disabled.
7. Review splice estimation and/or visual inspection of fiber splice to detect problems such as bubbles, streaks, separation, fat or thin area in splice.
8. Open hood/lid, remove fiber from chucks, slide protection sleeve centered over spliced area, and place in oven for heat shrinking onto fiber.

## 3.0 SPLICING MAINTENANCE

### 3.1 When and How to Replace Electrodes



1. Always be sure to review the splicer instruction manual for specific instructions and techniques.
2. Access the Maintenance menu to replace the electrodes.
3. It is recommended to replace electrodes after 3000 arc discharges.
4. Locate the electrodes, which are held in place with thumbscrew clamp. Loosen screw and remove from socket.
5. Clean the new electrodes with alcohol and clean lint-free tissue.
6. Place new electrode back into place and finger-tighten the thumbscrew.
7. Perform the electrode calibration as defined by the on-screen prompts.

### 3.2 How to Clean Cameras and Mirrors

1. Refer to the 910FS cleaning instructions in the instruction manual.
2. If camera lens becomes dirty, incorrect view of the fiber position may occur, resulting in higher splice loss or overall poor operation.
3. Always turn off splicer prior to cleaning.
4. User may need to remove electrodes to gain access to the camera lenses. Do not hit electrodes during cleaning process; it may damage tip, resulting in replacement.
5. Gently clean the camera lenses with a lint-free swab, starting at the center of the lens and moving in a circular motion to the outer edge.
6. Mirrors and clamping chips should be cleaned with alcohol and lint-free swabs.
7. After cleaning is complete, turn on splicer and make sure no visible streaks or dirt are on the monitor.

### **3.3 Why and When to Perform an Arc Check**

1. Atmospheric conditions such as temperature, humidity, and pressure are constantly changing, which can change the arc temperature.
2. Changes in arc power due to wearing electrodes cannot be corrected automatically.
3. An arc check is often recommended at the start of every day or if changes in splicing environment occur within the day.
4. Clean and prepare fibers normally and place in splicer.
5. Choose Arc Calibration and the splicer will move fibers forward to specified setting and then discharge arc. After arc, the burn back of the left and right fibers is measured, and splicer will indicate operation is complete/finished or will ask for further testing or arc calibration.

### **3.4 Cleaning the Electrodes**

Cleaning the electrodes may sometimes be necessary.

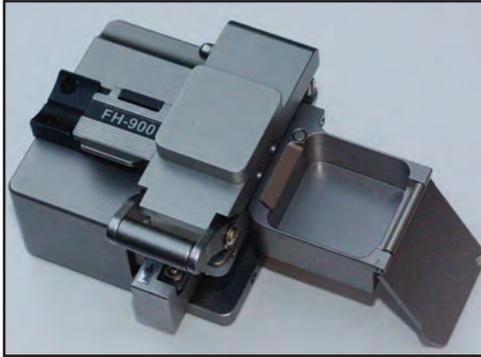
1. Insert the electrode into the electrode cleaner with a cleaning pad.
2. Rotate the electrode a few times.
3. Clean the electrode with isopropyl alcohol.
4. Place the electrode back into the holder.

### **3.5 Refurbishing**

1. Greenlee Communications offers splicer refurbishing services where the splicer is cleaned, electrodes are replaced, and the mechanical settings are reset to factory limits.
2. Often recommended once a year, or depending on overall use.

## 4.0 CLEAVERS, PARTS, AND ACCESSORIES

### 4.1 Cleaver Cleaning and Blade Rotation



1. Cleaning maintenance is important on cleavers. If cleaver becomes contaminated, the quality of cleaves could degrade and result in higher losses.
2. Clean the clamp pads with a cotton swab soaked in isopropyl alcohol.
3. If cleaver does not cleave properly, rotate the blade as specified in cleaver instruction manual.
4. Often blade life is 1000 cleavers per blade position, so coordinating rotating the blade with replacement of electrodes is a good idea.
5. When rotating the blade, it is important not to touch the cutting edge of blade.
6. Use cotton swab for rotating blade to avoid damage.

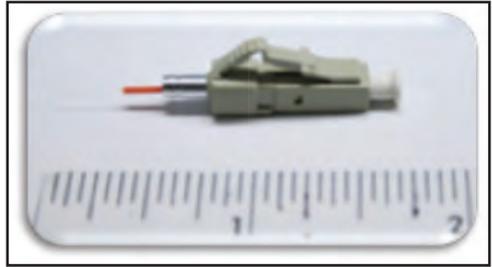
### 4.2 Removable Chucks (Fiber Holders)

- Stripped fiber placed into chuck prior to cleaving.
- Chuck placed into cleaver for consistent cleave lengths.
- Different size chucks for 250  $\mu\text{m}$  or 900  $\mu\text{m}$  coated fibers.
- Compatible with splice-on connector solution.

## 5.0 GREENLEE COMMUNICATIONS SPLICE-ON CONNECTOR (SOC)

### 5.1 Components of Greenlee Communications SOC for Buffered Fibers

- Fiber pigtail less than 2" in length, pre-cleaved for direct insertion into special SOC holder and then into a fusion splicer.
- Specialty heat shrink protection sleeve 27 mm length slides over the spliced area and is centered to adhere to either side of the fiber optic 900  $\mu\text{m}$  or 250  $\mu\text{m}$  buffer.
- Custom strain relief boot conceals and protects the protection sleeve, eliminating the need for splice trays, chips, and extra cabinets.
- Cleave protector prevents damage to fiber pigtail during shipment.
- Universal dust cap with extended handle can aid in transfer from holder to oven.



**Industry's Smallest Pigtail**



**900  $\mu\text{m}$  Boot**

*Note: Fiber Alignment – Fiber cable has a “memory” from being stored on a spool. Some fibers experience more memory than others. The Greenlee Communications SOC’s may also contain a “memory” in the form of a curled fiber; this is normal. This memory or curled fiber can sometimes create misalignment or excessive cleave angles. The connector should always be placed in the holder with the curl of the fiber facing down; this will generally flatten out the curl. If the misalignment or high cleave angles occur using SC or ST connectors, the connector should be rotated 90 degrees inside the holder. By rotating the connector, the technician is repositioning the fiber in the V-groove of the splicer. This repositioning can often correct the misalignment and high cleave angles. The SC connector can be rotated three times in order to find the proper alignment.*

### 5.2 Available Styles and Fiber Types

Greenlee Communications offers over 19 connector styles of splice-on connectors to accommodate any solution.

Available connector types:

- ST, SC, FC, LC
- Singlemode and Multimode
- UPC and APC ferrule polishes

## 5.3 Advantages of SOC

- Ease of training – no polishing, just need to prep and good cleave on field fiber.
- Performance – SOC is performance tested prior to cleaving; factory polish provides superior insertion loss and back reflection.
- Material cost – Less expensive than mechanical connectors; competitive to standard pigtailed without use of splice trays.
- Eliminate points of failure – Fusion splicing provides best connection and performance for termination of connectors in the field. Mechanical connectors are prone to failure.

## 5.4 Tension Test Setup

When installing the Greenlee Communications splice-on connector, it is recommended that the fusion splicer's Proof Test, or pull test, be shut off during the splicing action. Here is how to shut the Tension Test off on a few of the popular splicer models.

### Fitel S123, S153, and S178 Models

1. From the menu screen, select "Settings."
2. From the settings screen, select "Parameters."
3. Scroll down three screens until you find Tension Test; highlight "Tension Test."
4. Press enter and press the up arrow to change from "Active" to "Cancel" and press "Set."
5. Press escape and confirm the action by pressing enter on "Over Write."

### AFL 18S, 60S/R, 19S, 70S/R, 12S

Turning off the Tension ("Proof Test") on an AFL splicer.

*Note: You must set up the splicer with a specific fiber type (SM or MM). You cannot use any "Auto" fiber setting.*

1. Select Splice Mode from the main menu screen.
2. Scroll to "SM-SM" or "MM-MM", depending on the fiber type you are splicing.
3. Select the splice mode by pressing the Green Arrow.
4. Scroll to the "Edit Mode" and select by pressing the Green Arrow.
5. Scroll to the "Proof Test" and select by pressing the Green Arrow. Turn to "OFF", and press the red ESC key to complete.

### FIS Super Cougar

1. Select "Menu" from the main screen and press enter.
2. Select "Splice" from the menu screen and press enter.
3. Select "New" to create a new splice mode.
4. Select the fiber type, either SM or MM, to create the new splice mode for edit.
5. Scroll to and select the new splice mode created and press "Edit."
6. Scroll to "Proof Test" and press "Edit."

7. Turn “Proof Test” off and press “Ok.”
8. Press “Close.”

Create additional splice modes as needed for fiber types you are splicing by repeating the instructions.

### **Sumitomo Type39, Type66**

1. Turn on the power. After initializing, from “Ready” screen, while holding down “Square” key, press “X” key.
2. Input 0000 for password and press the “Right Arrow” key four times.
3. Splicer will initialize and when “Ready Screen” is displayed again, press the “Left Arrow” key (Menu) to enter the administrator menu screen.
4. Scroll to window 6 of 6 and highlight “Postsplice” action.
5. Press “Right Arrow” to select the function and press the “Up Arrow” and select “None-Open”.
6. Press “Right Arrow” to select.

## **5.5 Specialty SOC Holders**



**Custom Metal Holder**

- The universal holder allows for flexibility of use within the industry’s most popular fiber optic fusion splicers such as the Alcoa Fujikura (AFL), Sumitomo Electric, and Furukawa (Fitel/OFS).
- Custom metal holders have alignment pin holes machine-drilled to custom fit fusion splicers with removable holders. Expanding compatibility to other splicer manufacturers.

## **5.6 Protection Splice Sleeve Ovens**

The 910FS oven accommodates all connector styles. The actual connector is placed outside the oven on the right-hand side of the oven assembly with the splice protector on the snug to the actual connector assembly.

## 5.7 Installation Instructions for Greenlee Communications SOC's

*Note: This splice-on connector is compatible with 900  $\mu\text{m}$  optical fiber.*

**Greenlee Communications splice-on connector contains the following items:**

- A. (1) Handle, each kit contains a limited number
- B. (1) Outer housing (SC style only)
- C. (1) Splice-on connector (SOC) pigtail with cleave protector and fiber alignment sleeve
- D. (1) 27 mm mini splice sleeve
- E. (1) Universal strain relief boot
- F. (1) Fiber positioning tool (not pictured)

*Note: If fiber alignment sleeve has become separated from the SOC body, do not attempt to re-install; discard it.*



A

B

C

D

E

### Cable Preparation

Slide the 900  $\mu\text{m}$  strain relief boot and then the 27 mm mini splice protective sleeve over the 900  $\mu\text{m}$  field fiber. Use the 910CL to cleave the field fiber. Insert the fiber adapter with the cleaved fiber into the left-hand side of the 910FS fusion splicer. Make sure to butt the 900  $\mu\text{m}$  buffer up to the edge of the fiber adapter. This will ensure that the mini splice sleeve will adhere to both sides of the 900  $\mu\text{m}$  buffer.

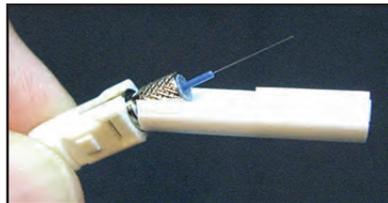
### Installation

1. Disable the "Proof Test" on the fusion splicer.
2. Remove the factory dust cap from the connector.

*Note: The extended dust cap may be placed on at this time, if so desired, to aid in the transfer of the connector. DO NOT LEAVE THE EXTENDED DUST CAP ON THE CONNECTOR, INSIDE THE FUSION SPLICE MACHINE.*

3. While holding the connector firmly, pull down on the cleave protector to remove it from the connector (Figure 1).

*Note: Do not touch the cleaved fiber stub with the protector or your fingers as this may damage the factory cleave.*



**Figure 1**

4. Insert the connector into the universal splice-on connector holder so that the back end of the connector is flush with the end of the holder (Figures 2-5). Once aligned properly, the connector should fit freely into the holder with no force required.



Figure 2 (SC)



Figure 3 (FC)



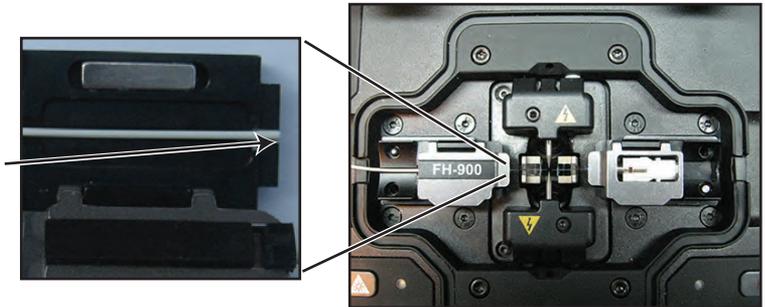
Figure 4 (LC)



Figure 5 (ST)

5. Insert the holder into the right-hand side of the splicer (Figure 6), making sure that the fiber stub lays properly into the V-groove block of the splicer. You may use the fiber positioning tool to help align the fiber in the V-groove. The fiber for FC and ST splice-on connectors must have the fiber laying in the end of the fiber groove in the V-groove. The fiber positioning tool can be used to align the fiber with the V-groove. Turning the fiber and/or the connector may also be necessary to accomplish this. The FC/ST fiber adapter may also need to be twisted slightly to ensure that the fiber is aligned with the V-groove.

*Note: Make sure that the edge of the 900 micron tight buffer is even with the edge of the 900 micron fiber adapter.*



*Note: Remove the extended dust cap before initiating the fusion splice.*

Figure 6

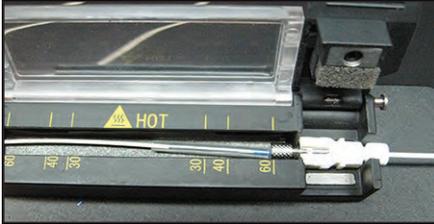
6. Perform the fusion splice as described in the fusion splicer manufacturer's instructions.
7. Once the fusion splicing cycle is completed, remove the connector from the splicer and slide the splice protection sleeve up to cover the splice. Make sure that the splice protector is positioned against the connector body.

*Note: The extended cap may be put in place now to aid in the transfer to the splice sleeve oven.*

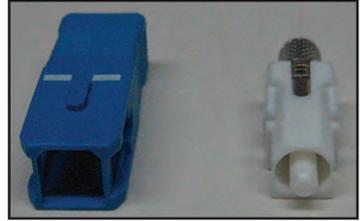
8. Transfer the splice to the splice sleeve heat oven on the right-hand side (Figure 7). Verify the position of the splice sleeve is butted up against the metal portion of the splice-on connector. Use the 60 mm heater mode #1 with center and edges activated. Press the **HEAT** button to run the shrink cycle.

9. Verify that the splice protection sleeve is completely shrunk onto the fiber to avoid the end catching on the strain relief boot. If the splice sleeve is not completely shrunk, then place it back in the sleeve oven and initiate a second heat cycle.

*Note: Make sure that the splice sleeve has fully cooled before sliding the strain relief boot into place. For SC connectors, install the outer housing onto the connector, being sure to align the angled corners of the inner housing with those of the outer housing (Figure 8).*



**Figure 7**

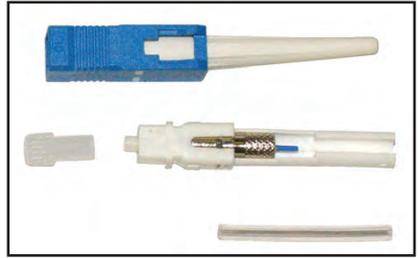


**Figure 8**

## 5.8 Greenlee Communications SOC Compatibility

### Features

- Return loss: APC >60 dB, UPC >55 dB, and MM 35 dB (typical)
- 19 styles available: SM, MM, 10Gig
- Compatible with AFL, Sumitomo, and Fitel fusion splicers
- 900  $\mu$ m boot protects splice for easy cable management
- Includes color-coded 900  $\mu$ m buffer, boot, cleave protector, and extended dust cap for easy fiber identification



All ferrules are made of zirconia. Fusion splice sleeve and connector boot are included with each SOC.  
*Note: The Greenlee Communications SOC requires the use of a fusion splicer with removable fiber holders.*

Using a factory-terminated and pre-polished connector, the Greenlee Communications SOC provides a connection meeting or exceeding industry standards for loss and back reflection. The splice-on connector is provided with a factory cleaved 900  $\mu$ m fiber stub to ensure ease of use and optimal performance. The unique 900  $\mu$ m boot allows the entire splice to be concealed and protected, allowing for a simpler cable management system within the rack or enclosure. To terminate, just remove the cleave protector, place the connector into the holder, place the holder in the splicer, preload the field fiber, and the SOC is ready to be terminated.

### Specifications

Connector Type	SM/APC	SM/UPC	MM/62.5um	MM/50um	MM/OM3	MM/OM4
Insertion Loss (max.)	0.3 dB		0.4 dB			
Optical Return Loss	>65 dB	>55 dB	35 dB (typical)			
Ferrule Type	All zirconia pre-polished ferrules					
Color Code	Green	White	Beige	Black	Aqua	Magenta
Operating Temperature	-40 °C to +85 °C					
Industry Standards	RoHS Compliant, Telcordia GR-326-CORE Compliant					

### Compatible Fusion Splicers

The following SOC adapters allow the Greenlee Communications splice-on connectors to be used in select competitive fusion splicers.

Manufacturer	AFL			Sumitomo	Fitel	INNO	FIS	
Model	FSM11 (S/M)	FSM-17S	FSM-18S	Type-25e (U/S/M)	S122(A/C/M/)	IFS10	CA3	
			FSM-19S	Type-39FH	S121 (A/M)			IFS15
			FSM-60(S/R)	Type-46	S123 (C/M)			
			FSM-70(S/R)	Type-66	S153			
			12S	Quantum (Q101-CA)	S178A			
Compatible fiberTOOLS SOCs	All versions	SC and LC only	SC, LC, and ST only	All versions	All versions	All versions	All versions	

Greenlee SOC Adapter	Description	Part No.	UPC No.
AFL SOC adapter	AFL/FUJIKURA SOC adapter	52075260	13044
FITEL SOC adapter	FURAKAWA/FITEL SOC adapter	52075281	20523
SUMI SOC adapter	SUMITOMO SOC adapter	52075282	20585
INNO SOC adapter	INNO SOC adapter	52075283	20608
FIS SOC adapter	FIS SUPER COUGAR SOC adapter	52075284	20622

## 5.9 Greenlee Communications SOC Holder



### Metal Injection-Molded SOC Holder

Dimensions L x W x H: 0.466" x 0.633" x 0.248" (37.2 mm x 16.1 mm x 6.3 mm)

## 5.10 Greenlee Communications SOC Tips

### General Tips

- There is some play in the fit of the SOC holder. This allows for minor adjustments when “Fiber Load” or “Fiber Feed” errors occur while splicing.
- Always perform an arc calibration prior to starting an SOC project.
- Occasionally, the fiber coming from the back of the SOC may be shifted to one side. If this occurs, gently center the fiber using your fingers or the provided fiber alignment tool, being careful not to touch the cleaved end of the fiber.

### Splicer-Specific Tips

Manufacturer	Splicer Model	Tips
AFL/ Fujikura	FSM-18S	• To assist in fiber positioning problems due to fiber curl, release the right-side V-groove clamp from the hood to hold fiber in place during hood closure.
	FSM-60(S/R)	
Sumitomo	Type-39FH	• Turn off the tension test in order to prevent damaging the finished splice. • Turn off the arc pause to splice correctly.
	Type-66	• To assist in fiber positioning problems due to fiber curl, release the right-side V-groove clamp from the hood to hold fiber in place during hood closure.

## 6.0 FUSION SPLICER TROUBLESHOOTING

### Motor Overrun

- Fiber is set too far back and does not reach the splice point.
- Fiber is not set correctly into bottom of the V-groove.
- Fiber cleave length is too short.

### Large Cleave Angle

- Bad Fiber End Face or Cleave angle it set too low.

### Fiber Offset

- Dust or dirt is on the V-groove or on the fiber clamp; cleaning required.
- Dust or dirt on optical fiber surface; cleaning required.

### Q-Tipping

- Fibers were not close enough during splice for arc discharge to melt fibers together.

### Fan Out Kits

- Often fiber will piston within the fan out tubing and prevents fibers from splicing. The fiber fan out tubing moves but the optical fiber itself does not.

### High Estimated Loss

- Insufficient fiber cleaning, bad cleave angle, dust or dirt on the camera lens, faulty electrodes, splice mode is unsuitable for optical fibers in splicer, or inadequate arc power being discharged.



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