USER´S MANUAL
EFS-150

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1 Introduction

The EFS-150 incorporates all the best a fixed v-groove splicer can offer.

NOTE: The EFS-150 is a high precision instrument and should always be handled with care!

2 Disclaimer

Emitor AB reserves the right to modify the product in any way without prior customer notification or any other form of notice.

In no event shall Emitor AB be liable for any damages of any type, incidental, indirect, consequential or other, originating from or relating to this manual or the information contained herein. While Emitor AB tries to make the user manual complete and accurate, it may contain mistakes, and the user uses it solely at his or her own risk.

3 Abbreviations and acronyms

The following abbreviations and acronyms have been used in the text:

Abbreviation	Explanation
B/W	Black and white
AC	Alternating current
DC	Direct current
MM	Multi mode
MMF	Multi mode fiber
SM	Single mode
SMF	Single mode fiber
RH	Relative humidity

4 Application

Splicing and protection of most common types of SMF and MMF.

5 Technical data

Weight: 1.8 kg
Dimensions: 176x166x100 mm
Alignment:
Axial: Automatic
Radial: Fixed v-groove
Fusion technique: Arc fusion
Process: Automatic
Typical Loss: SMF 0.03dB
MMF 0.01dB
Splice Programs: 2 factory defined
6 user defined
Display: 71x49mm B/W

Power source:
Battery: 9.6V DC
Power supply: 90-260V AC / 9V DC
Operating environment:
Temperature 0°C to 45°C
Humidity max 95% RH, non-condensing
Storage environment:
Temperature -20°C to 60°C
Humidity max 98% RH, non-condensing
Heat oven (optional):
Weight: 0.18kg
Dimensions: 103x54x56mm

6 Fusion splicer components

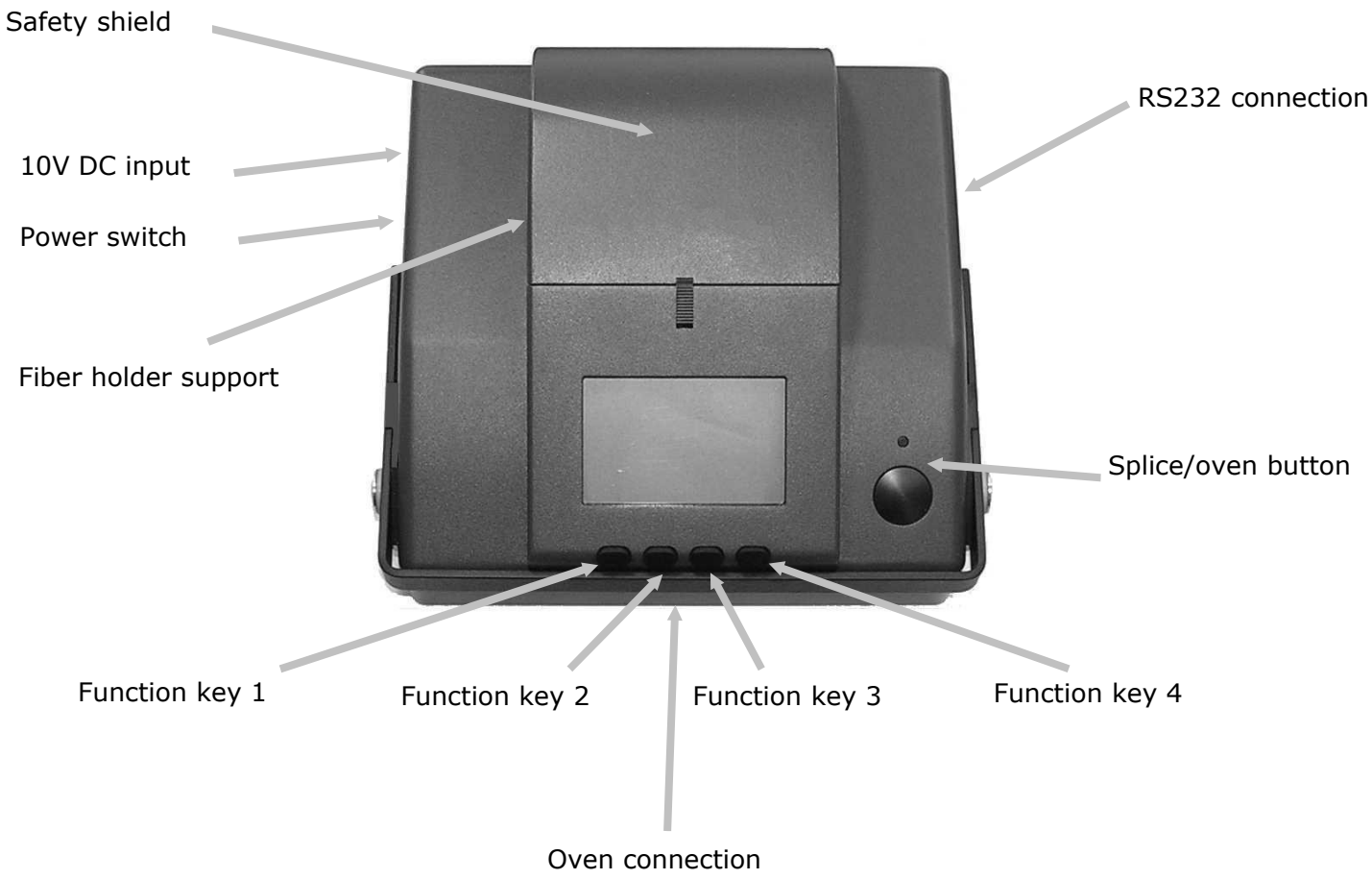
The following components are standard for splicing in the field:

Item	Description	Quantity
1	EFS Splicer	1
2	Heat oven	1
3	Power supply	1
4	Fiber cleaver	1
5	Battery charger	1
6	Battery	1
7	Fiber holders 250-400µm primary coating	1 pair
8	RS232 cable	1

Table 1. Standard components of the EFS-150 fusion splicer

7 Exterior

Figure 1. Features on the EFS-150



8 Basics

NOTE: The EFS-150 is a rugged field instrument designed to withstand field environment. However, to ensure best performance, it is important to keep maintenance as described in chapter 16 "General maintenance".

9 Order of operation

- Connect the splicer to a power source
- Turn on the splicer
- Select proper splice program
- Prepare the fibers
- Splice the fibers
- Analyze the splice
- Remove the fiber
- Protect the splice

10 Connecting the splicer to power

Connect the power supply or the battery to the power input on the left side of the splicer.

11 Starting the splicer

Start the splicer by pressing the button on the left side of the splicer away from you.

12 Fusion splicer menus

The menu system is shown in figure 7.

- Setup - menu. Setup of splice, oven and global parameters.
- Reset - function. Reset the alignment motors to start position.
- Func - menu. Miscellaneous functions as arc cleaning, environmental calibration etc.
- Info - menu. Version information and IP address.

Figure 2. The main menu

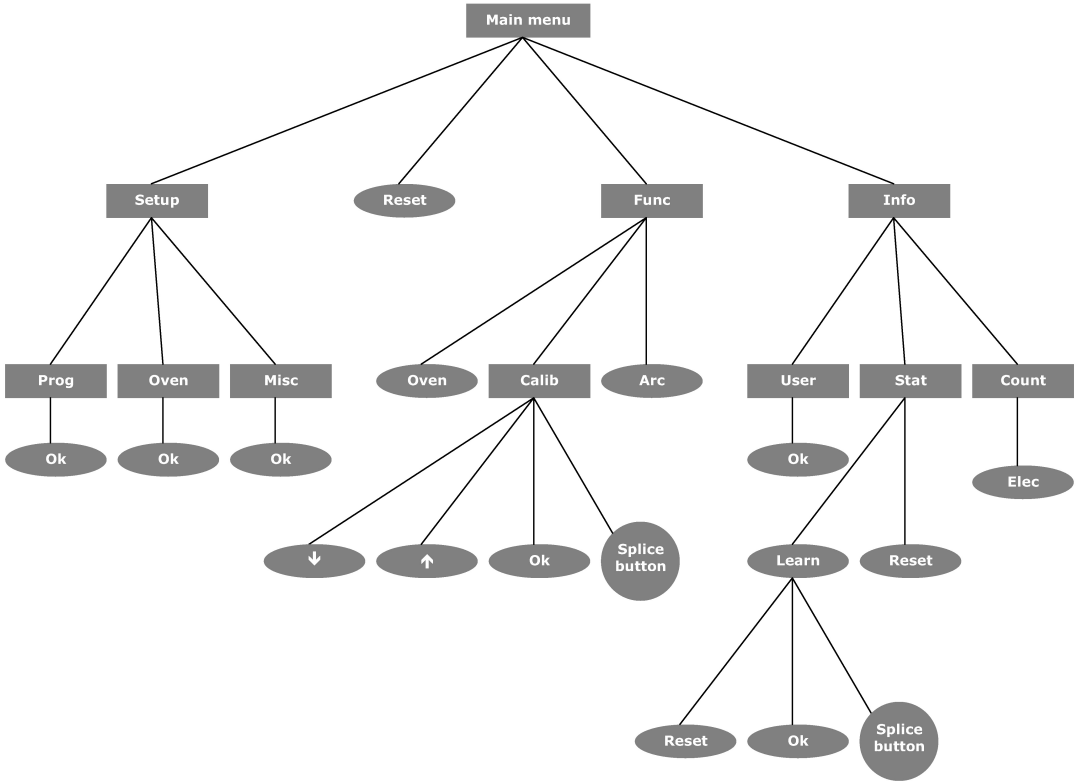


Figure 3. Accessible commands from the fusion splicer menus

12.1 Setup menu

The Setup menu consists of four selections buttons, Prog, Oven, Misc and ⏎.

Figure 4. Setup menu

- Prog - menu. Selection of splice program.
- Oven - menu. Configuration of oven parameters. Each splice program will have its own settings.
- Misc - menu. Configuration of global parameters.
- ⏎ - button. Return to the main menu.

12.1.1 Prog menu

The Prog menu consists all splice programs.
Browse with the ↓ and ↑ buttons and confirm the selected program with the Ok button.

Figure 5. Prog menu

- ↓ - button. Browse down in the program list.
- ↑ - button. Browse up in the program list.
- Ok - button. Confirm selection of the currently highlighted program and return to the setup menu.
- ↵ - button. Return to the setup menu.

See chapter 12.1.5 for further details.

12.1.2 Oven menu

The oven menu consists of three parameters - heat, heating time and fan time. Valid values for these parameters are presented in Table 2 on page 15.

Browse down with the ↓ button and modify the value with the ↻. Press the Ok button to store all changes.

Figure 6. The oven menu

- ↓ - button. Browse down in the list of parameters.
- ↻ - button. Modify the value of the highlighted parameter.
- Ok - button. Store current selection of all oven parameters and return to the setup menu.
- ↵ - button. Return to the setup menu.

12.1.3 Misc menu

The Misc menu consists of five parameters - pause, estimate, pull test, oven and language. Valid values are presented in Table 2. Oven and miscellaneous parameters

Browse down with the ↓ button and modify value with the ↻. Press the Ok button to store all changes.

Figure 7. The misc submenu

- ↓ - button. Browse down in the list of parameters.
- ↻ - button. Modify the value of the highlighted parameter.
- Ok - button. Store current selection of all misc parameters and return to the setup menu.
- ↵ - button. Return to the setup menu.

12.1.4 Oven and miscellaneous parameters

List of Oven menu and Misc menu parameters.

Oven parameters	Explanation	Allowed values
Heat	Heat in percentage of maximum	50, 60, 70, 80, 90 and 100%
Time	Duration of heating sequence	30, 40, 50, 60, 70, 80, 90 and 100s
Fan time	Duration of cooling sequence	off (no fan), 10, 20 and 30s

Miscellaneous parameters	Explanation	Allowed values
Pause	Yes = Enable pause after prefuse with display of cleave angles	yes, no
Estimate	Yes = Enable estimation	yes, no
Pull test	Yes = Enable pull test	yes, no
Oven	Yes = Enable oven toggle mode	yes, no
Language	Language selection	Available languages depend on software revision.

Table 2. Oven and miscellaneous parameters.

12.1.5 Selecting splice program

The splicer is pre-programmed with eight splice programs, three factory set programs and five user defined programs. The user defined programs can be modified by the user.

Program 1 (SMF) is intended for most SMF types, program 2 (MMF) is intended for most MMF types and program 3 (G655) is intended for fiber types with doped claddings as e.g. NZDF, DSF or LEAF.
When selecting a user defined program for the first time, use the learn function according to chapter 12.3.2.1 "Learn mode"

- Press Setup followed by Prog to access the program list
- Press ↓ or ↑ to select the desired program
- Press Ok to confirm the selection or ⏎ to return to the main menu without changing settings.

12.2 Func menu

The Func menu, available from the main menu, consists of four buttons, Oven, Calib, Arc and ⮠.

Figure 8. The Func menu

- Oven - function. Start the oven. The EFS-150 will return to splice mode after the action.
- Calib - menu. Environmental calibration of the splicer when switching between environments.
- Arc - function. Activate a cleaning arc between the electrodes and reset the electrode cleaning counter.
- ⮠ - button. Return to the main menu.

12.2.1 Calib menu

In the Calib menu, the splicer can be calibrated to compensate the arc for environmental conditions. The calibration is global and valid for all currents in all splice programs.

NOTE: The splicer calibrates itself every splice during normal operation. Therefore it is recommended to use the Calib menu **only** when switching between large variations in splicing conditions as e.g. from low altitude to high latitude.

Automatic compensation:

- Set the splicer to the splice program suitable for the fiber type you are using
- Prepare a fiber in the fiber holder without cutting it
- Put the fiber holder in the splicer. The fiber should now stretch over the v-groove (both left and right side)
- Close the splicer and press Func followed by Calib
- Press Splice
- The splicer will test the fiber and a suggested compensation will be displayed
- Press Ok to accept or ↵ to cancel

Manual compensation:

- Modify the compensation value with ↓ and ↑ and confirm the compensation with the Ok button.
-

Figure 9. The Calib menu

- Splice - Start automatic environmental compensation.
- ↓ - button. Decrease the compensation by 7%.
- ↑ - button. Increase the compensation by 7%.
- Ok - button. Store the displayed compensation.
- ↵ - button. Return to the Func menu.

12.3 Info menu

The Info menu shows software version.
The menu consists of four buttons, User, Stat, Count and ⮠

- User - menu. Edit user information for the splice data storage.
- Stat - menu. Present splice statistics and enter the learn function.
- Count - menu. Display various counters available to the user.
- ⮠ - button. Return to the Main menu.

12.3.1 User menu

The User menu shows four alphanumerical characters to create a "label" for the splice log. This "label" is attached to every splice in splice log and can be used as a tool to identify splices.
The menu consists of four buttons, Ω, ↓, Ok and ⮠

Figure 10. The User menu

- Ω - button. Modify the highlighted alphanumerical character.
- ↓ - button. Move the cursor to the next position.
- Ok - button. Store the set label.
- ⮠ - button. Return to the Main menu.

12.3.2 Stat menu

The Stat menu shows statistical information about splices since last reset of the statistical counter.
The statistical counter is reset in this menu.
The learn function is used for optimizing splice program parameters for new fiber types. The learn function is only available in the user programs.

Figure 11. The Stat menu

- Learn - mode. Set up parameters and the splicer for a new fiber type
- Reset - button. Reset the statistical counter
- ↵ - button. Return to the Info menu

12.3.2.1 Learn mode

The learn function is used to manually set up a user program according to a new fiber type.

1. Set up a loss measurement equipment
2. Select a new splice program for the new fiber.
   Prog 4-5 are copies of program 1 (SMF) and prog 6-8 are copies of program 2 (MMF)
3. Enter the Calib menu by pressing Func and Calib. Edit the heat of the splice program by pressing ↑ or ↓ and Ok when done.
4. Prepare and insert the fiber in the splicer
5. Switch to learn mode by pressing Info, Stat and Learn
6. Splice the fiber
7. Measure the insertion loss
   -If the loss is not acceptable, press Reset and go back to step 3
   -If the loss is acceptable, continue
8. Press Ok.
   NOTE: No indication is given on the screen when Ok is pressed, this is normal
9. Press Reset
10. Repeat from step 6 until 3 accepted splices are done.
11. The splicer will automatically return back to normal mode after 3 successful splices and will be ready for use

12.3.3 Count menu

The Count menu shows the counters:

- The statistical counter
- The total counter
- The cleaning counter and cleaning interval
- The electrode counter and electrode replacement interval

By pressing Elec, the electrode counter is reset after successful electrode replacement.

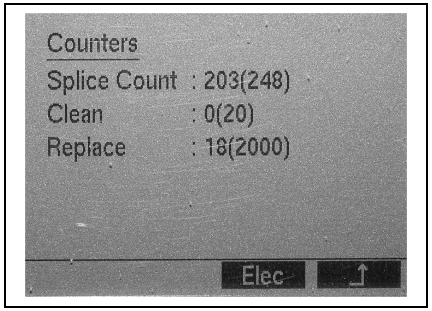


Figure 12. The Count menu

- Elec - button. Reset the electrode counter
- ↵ - button. Return to the Info menu

13 Preparing the fiber

Often, incorrect handling or preparation causes splice loss. It is crucial to keep tools and fiber clean; the invested time used in fiber and tool handling is more than compensated for in reduced troubleshooting effort.

13.1 Protective sleeve

- Before preparing the fiber for splicing, make sure to put the protective sleeve in place.

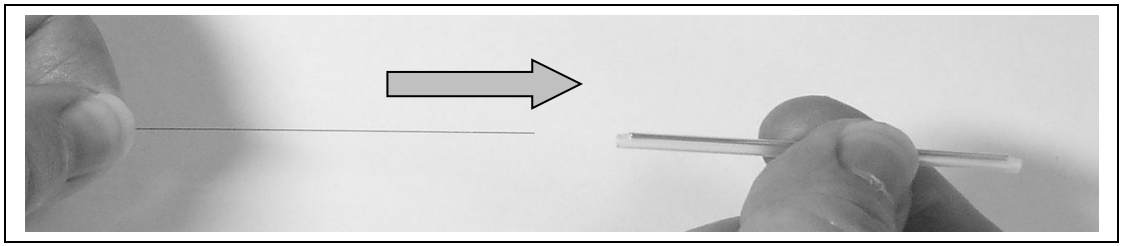


Figure 13. Introduction of the protecting sleeve

13.2 Stripping the fiber

- Hold the stripping tool to the edge of the fiber holder. Press the handles together and pull firmly away from the fiber holder to remove the coating.

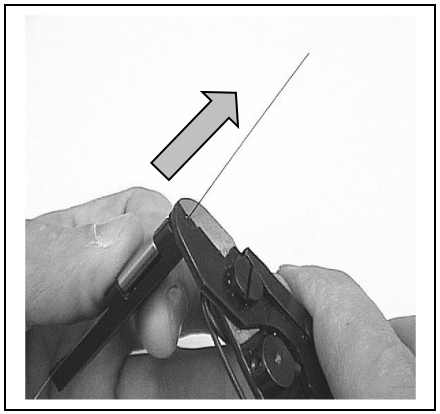


Figure 14. Stripping the fiber

13.3 Cleaning the fiber

- Use a pair of tweezers equipped with cotton buds soaked in alcohol (according to picture) or a similar tool
- Press the tweezers together and clean the fiber with by moving the tweezers from the fiber holder towards the end of the fiber
- Repeat, but rotate the tweezers
- A squeaking sound indicates that the fiber is clean

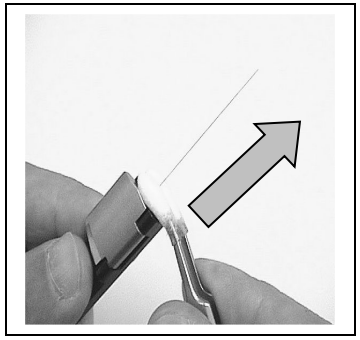


Figure 15. Cleaning the stripped fiber

13.4 Cleaving the fiber

- Position the fiber holder in the cleaver. Insert the fiber holder from above, **not** from the side.
- Check that the fiber holder is properly in place
- Move the knife towards you
- Close the cleaver lid

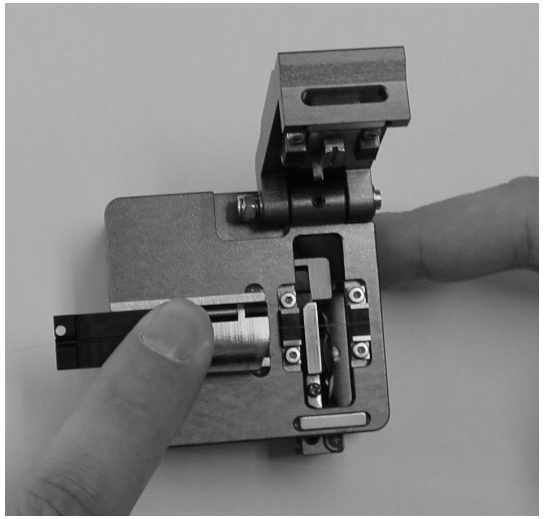


Figure 16. Loading the cleaver

- Move the knife to score the fiber
- Lift the lid and remove the fiber holder.

  Caution: Make sure not to contaminate the end of the fiber!

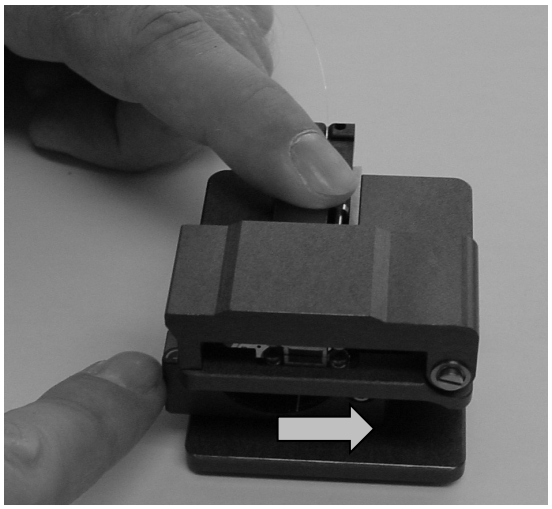


Figure 17. Scoring and cleaving the fiber.

- Remove the cut-off piece and dispose of it safely

The fiber is now prepared for splicing

14 Splicing

Select the proper splice program. See Chapter 12.1.5 "Selecting splice program".

- Make sure a reset has been performed since last splice.
- Place the fiber holder
  - Keep the fiber holder at an angle and move it passed its intended resting place.
  - Fold the fiber holder down until it makes contact with support surface.
  - Gently pull the fiber holder back until it snaps in place.
- Close the clamp to fix the holder.
- Repeat for the other fiber holder

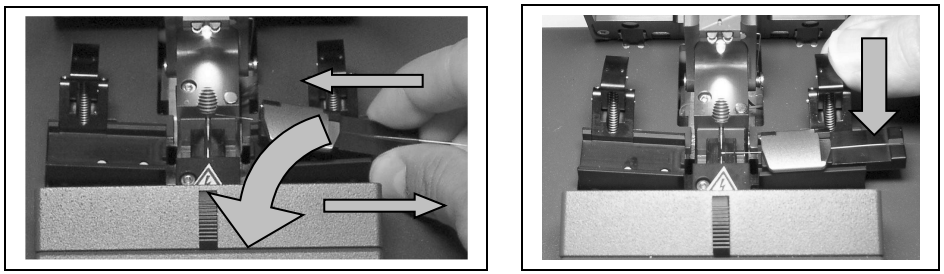


Figure 18. Insertion of the fiber holder in the fusion splicer

- Lower the fiber pressure foot slowly and lock the fibers in position
- Close the safety shield

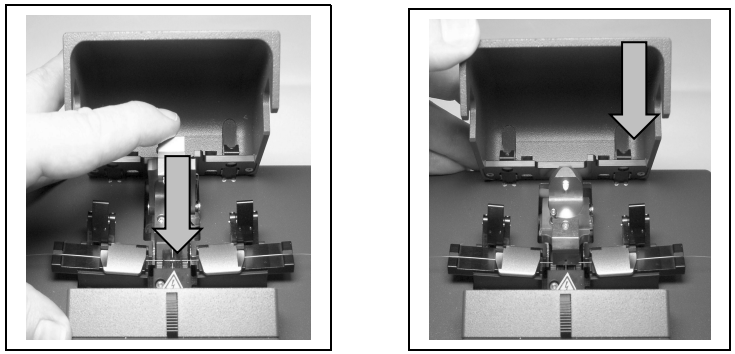


Figure 19. Final preparation before splicing

The fiber should now be visible in the monitor.

- Are the fibers clean?

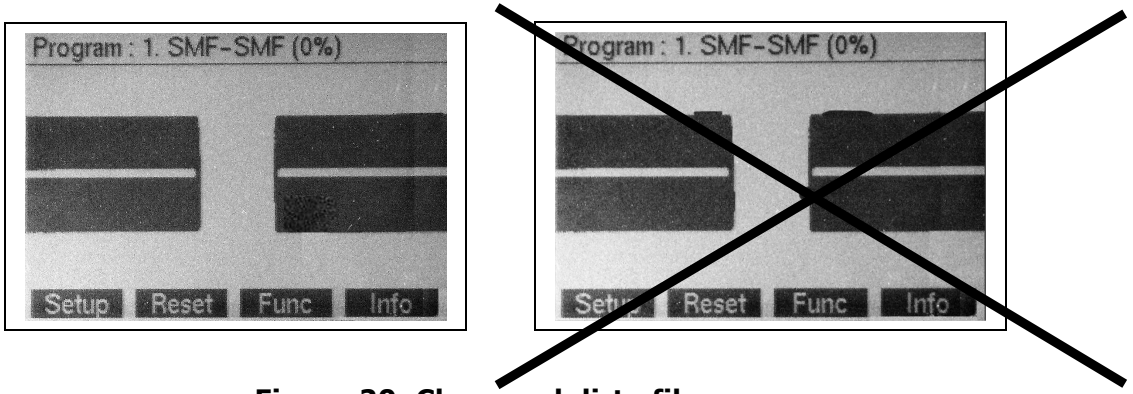


Figure 20. Clean and dirty fiber

If not, re-do the stripping, cleaning and cleaving procedure

- Are the cleave angles OK?

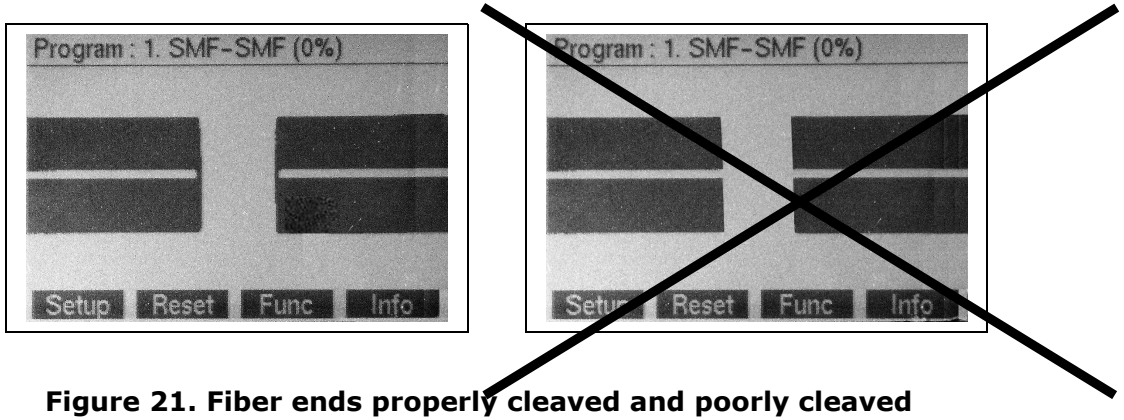


Figure 21. Fiber ends properly cleaved and poorly cleaved

If not, repeat the stripping, cleaning and cleaving procedure.

- Are the fibers properly aligned?

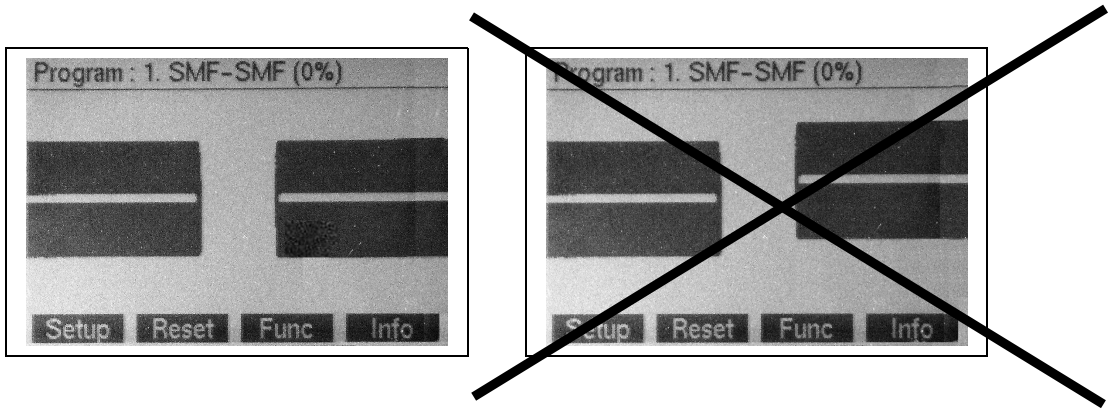


Figure 22. Fibers properly aligned and fibers not properly aligned

If not, make sure the fiber holders are properly snapped into place and that the fiber pressure foot is down properly.
If this does not help, clean the v-groove according to chapter 15.6. "Cleaning the v-groove of the fusion splicer".

- When ready, press the splice button. The fibers will be spliced automatically.

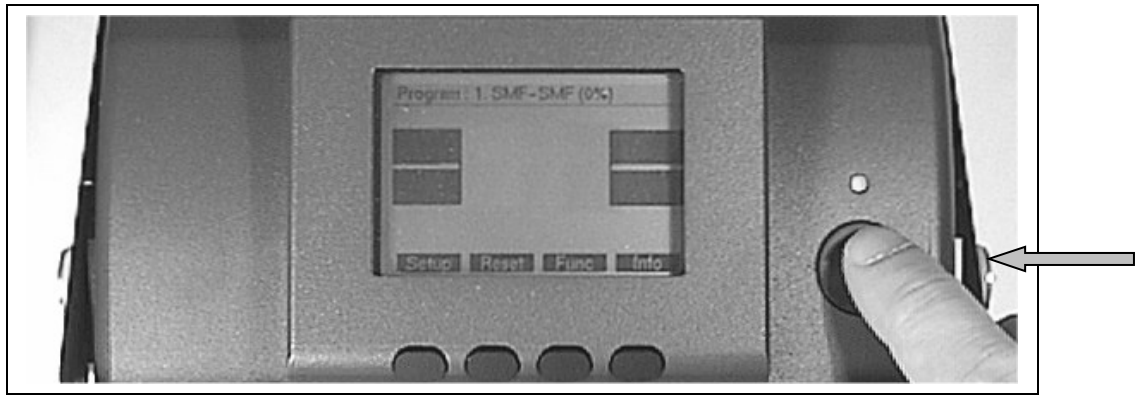


Figure 23. Splice button for initialization of the splicing process

- The splice should look like in fig. 29.

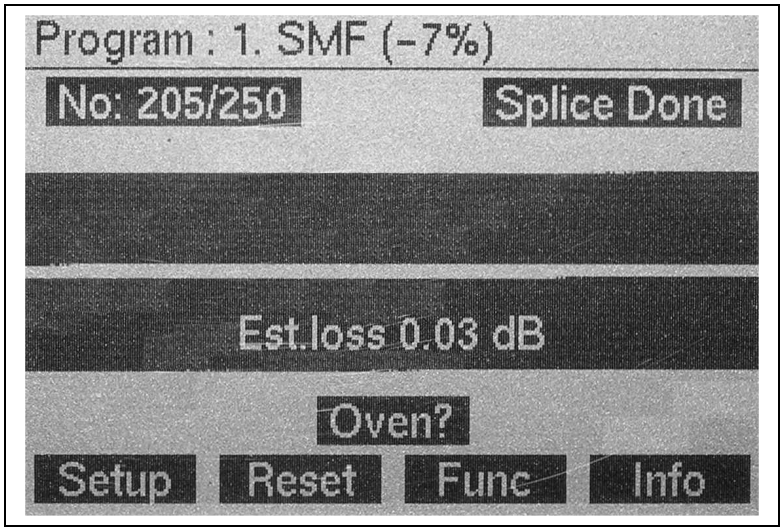


Figure 24. A finished splice

- Open the fiber holders to release the fiber.
  NOTE. Do not remove the fiber holder, only the fiber from the holder.

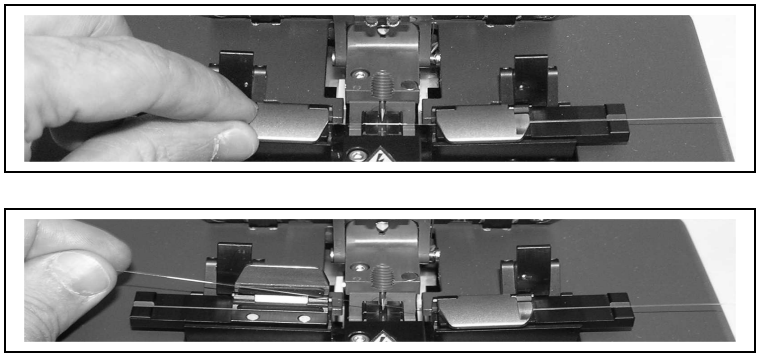


Figure 25. Remove the fiber with open fiber holders

- Protect the splice according to chapter 14.1 "Shrink sleeve splice protection".

14.1 Shrink sleeve splice protection

The oven snaps into position on the fusion splicer, on the front side.

The splicer has two modes – splice mode and oven mode.

OVEN MODE
Recommended when the heat oven is attached

The splice button will toggle between "oven"-function and "splice"-function.
The oven is started after every splice by simply pressing the splice button.

SPLICE MODE
Recommended when no heat oven is attached

The splicer does not toggle between "oven" and "splice".
The splice button will function only as a splice button with no oven function.

In case the splicer is not in Oven Mode, the oven can also be initiated by pressing Func and Oven from the splicer main menu. The splicer displays the text "Oven is on" as long as the oven is activated, but reverts immediately to splice mode and is ready for additional splices even with the oven on.

- Center the protective sleeve over the splice.
- Lower the splice in to the heat oven while pulling gently to keep the fiber stretched.
- Make sure the oven is ready for usage, and the text "Oven?" is displayed.
- Push the fuse/oven button to start the oven. The splicer will start the oven and is immediately ready for the next splice.
  NOTE: In some weather conditions, one heating cycle may not be sufficient to shrink the sleeve. In this case, initiate one more cycle by pressing Func and Oven from the main menu.
- In case the splicer is not in Oven mode, the oven can also be started by pressing Func and Oven from the main menu. Observe that the oven is started directly when Oven is pressed. See chapter 12.2 Func menu for details.

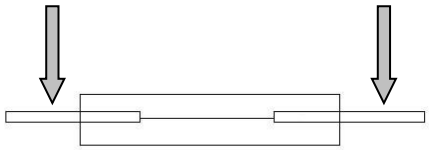


Figure 26. (a) Schematic picture of a protective sleeve moved into proper position covering the splice.

(b) Make sure the splice/sleeve is inserted in the oven with a firm downward movement.

Figure 27. Oven ready for operation. Press the splice/oven button to start the heat oven

15 General maintenance

In the table below, maintenance actions are listed

Action	Periodicity (number of splices)	Paragraph
Cleaning electrodes (program)	20	15.1.1
Cleaning electrodes (mechanically)	200	15.1.2
Replacing electrodes	2000	
Cleaning cleaver	25	15.2
Rotating cleaver blade	1000	15.3
Replacing cleaver blade	After using all 12 pos	15.4
Adjusting cleaver blade height	After switching blade	15.5
Cleaning the v-groove of the fiber splicer	When needed	15.6
Greasing the oven with silicon grease	When needed	15.7

Table 3. Maintenance actions and recommended interval

15.1 Electrode cleaning

To maintain a stable arc that guarantees good results, the electrodes must be kept in excellent condition. Therefore it is essential that the electrodes are cleaned on a regular bases. The electrodes should be cleaned by arc after 20 splices and mechanically after 200 splices.

15.1.1 Arc cleaning

- Remove all fiber from the splicer.
- Press the button sequence Func and Arc from the main menu to start arc cleaning.
- Repeat arcing 4-5 times or until no sizzling sound can be heard from the electrodes.
- The user will be prompted automatically to repeat arc cleaning after another 20 splices.

15.1.2 Brush cleaning

- Brush the electrodes gently with a fiberglass brush.
  Brush gently along the electrode toward the tip thus avoiding to damage the tip and the other electrode.

- Clean the electrode pair according paragraph 15.1.1 Arc cleaning

15.2 Cleaning the fiber cleaver

- Use a cotton bud soaked in alcohol
- Wipe gently along sides of the edge of the knife

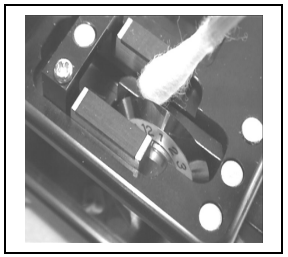


Figure 28. Cleaning of the cleaver blade

15.3 Rotating the fiber cleaver blade

- Loosen the screw in center of the blade

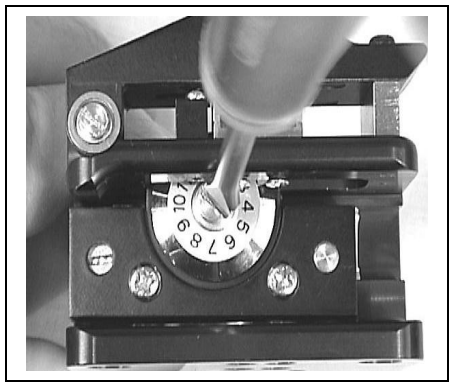


Figure 29. Loosening of the cleaver blade

- Rotate to desired position

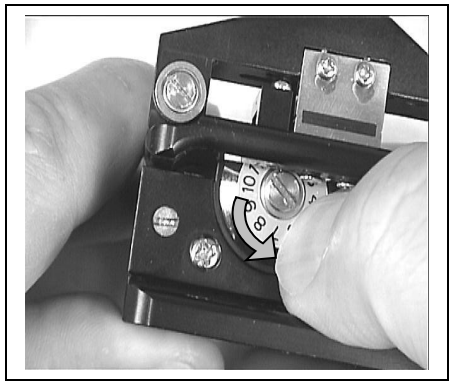


Figure 30. Rotation of the cleaver blade

- Tighten the screw in the center of the blade.
  Note: Make sure that the blade does not rotate during tightening.

15.4 Replacing the cleaver blade

- Place the cleaver tilted on a table
- Remove the screw in the center of the circular blade

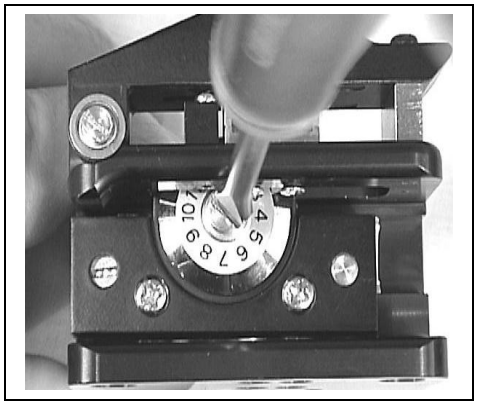


Figure 31. Loosening of the cleaver blade

- Use a pair of tweezers to remove the blade

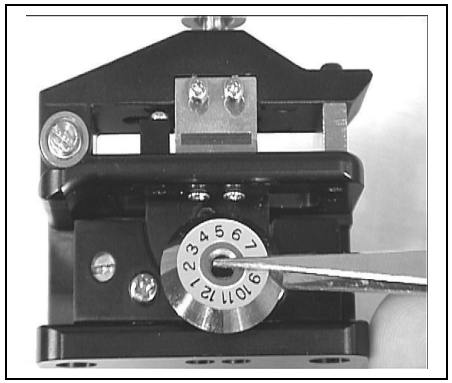


Figure 32. Removal of the cleaver blade

- Use a pair of tweezers to mount a new blade

- Fix the screw with the blade in pos 1

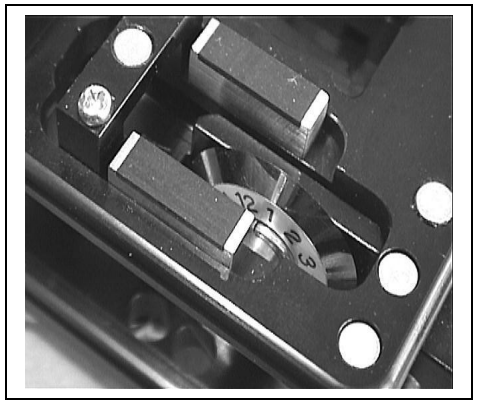


Figure 33. Fixed blade in position 1 (see the digit on the cleaver)

- Adjust blade height according to paragraph 15.5 if necessary

15.5 Adjusting the cleaver blade height

- Put stripped fiber in the cleaver
- Close the lid
- Slide the blade slowly passed the fiber and observe if any movement of the fiber can be detected.
  When the knife is passing it will cause the fiber to move. When the movement is barely noticeable with the naked eye, the height is correctly adjusted.
- If the adjustment is not correct, proceed with height adjustment.

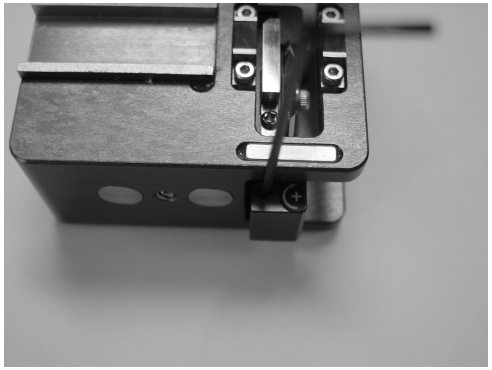


Figure 34. Cleaving blade adjustment

  - Adjust the blade height by rotating the adjustment screw
    NOTE: The adjustment is very sensitive.

- Check blade height with fiber in the cleaver
- If the position not ok, repeat the adjustment until a satisfactory result has been obtained

15.6 Cleaning the v-groove of the fusion splicer

The function of the high precision surface of the v-groove can be influenced by dirt. Whenever there is a consistent problem with fiber offset, try cleaning the surface as follows.

To clean the v-groove proceed as follows:

- Cut a plastic cotton bud in two with a hobby knife at a sharp angle.
- Use the sharp edge of the bud to clean the v-groove.
- Move sharp end of the bud from the outer edge inwards a few times. Make sure enough pressure is applied to release possible groove contaminants from both sides of the groove.

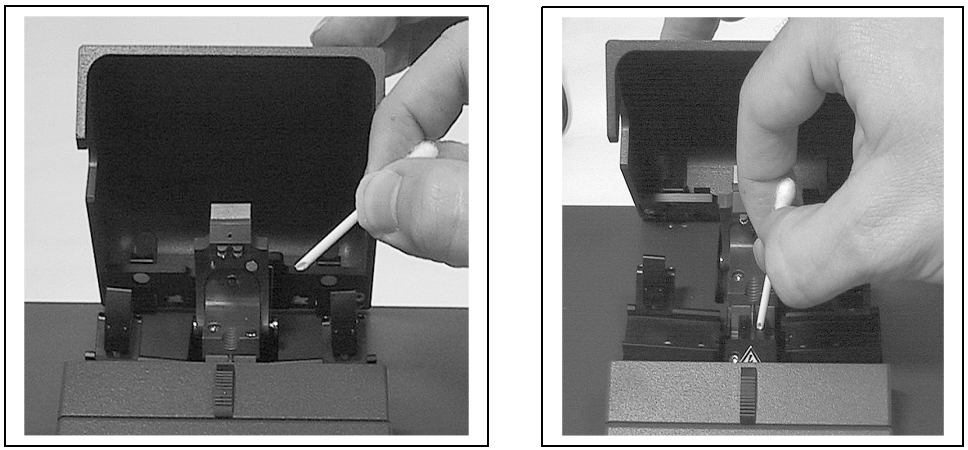


Figure 35. Cleaning the v-groove

15.7 Oven maintenance

The oven needs to be cleaned and greased with regular intervals, to make removal of the shrink sleeves possible. Use silicon grease and apply it to the bottom of the oven with a cotton bud. See below.

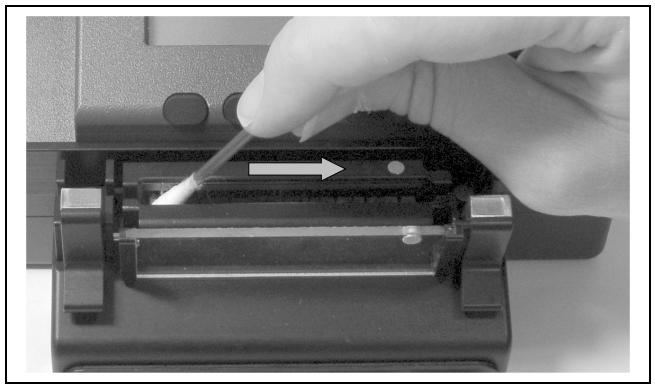


Figure 36. Lubricating the oven with silicon grease

16 Troubleshooting

Problem	Cause	Corrective measure
Splicer does not turn on	-Power source not connected -Broken power source -Broken fuse -Battery too weak	-Connect power source -Check output voltage from power source (9V) -Return splicer for switch of fuse -Recharge the battery
Excessive fiber length	-Splicer not reset -Incorrectly cleaved fiber	-Reset splicer -Repeat cleaving
Alignment does not start	-Dirty fiber -General error	-Redo the fiber preparation -Power off/on
Bad cleave	-Dirty cleaver blade -Incorrect height of the cleaver blade -Cleaver blade worn	-Clean the blade with alcohol -Adjust the blade height -Rotate blade to new position
Too much offset	-Dirty v-groove -Dirty fiber holder -Worn fiber holder	-Clean the v-groove of the splicer (see chapter 15.6) -Clean the fiber holders of the splicer -Replace the fiber holder(s) of the splicer
Oven doesn't work	-Blown fuse or unknown cause	-Check oven parameters. -Return the oven for repair

Table 4. Troubleshooting suggestions