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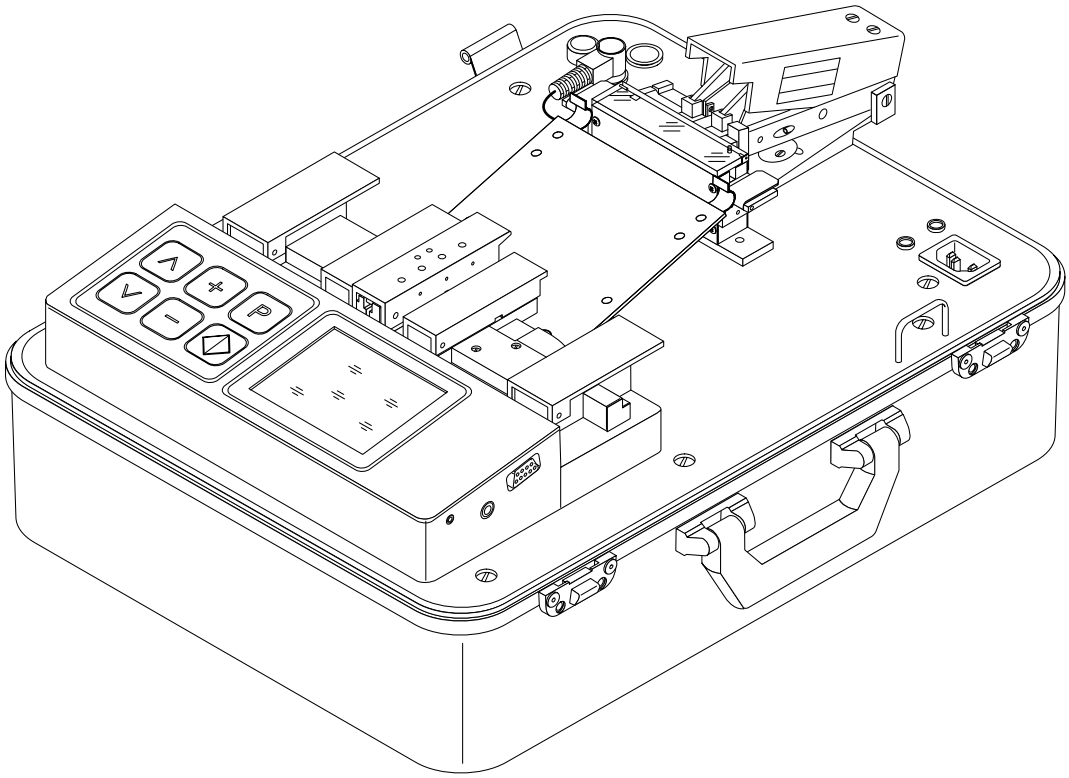
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SIECOR

Operating Instructions

for Fusion Splicer M90/Series 5000



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The pages of these Operating Instructions will not be exchanged.
Modifications will be provided in the form of supplementary sheets.
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Edition 02/97

Published by

Siecor Corporation
489 Siecor Park
P.O Box 489
Hickory, NC 28603-0489

For US and Canada 1-800-743-2673
International 704-327-5000
FAX 704-327-5973

Printed in Germany

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Notes on these Operating Instructions

Please read these Operating Instructions carefully and note the recommendations they contain. This will ensure your splicer remains free of fault. Use the information set out in the Operating Instructions to perform the necessary regular care and maintenance of your splicer. Avoid damage by using extreme care.

If you are in doubt about any points, contact the relevant service center. The trained experts available at these centers should be able to assist.

Incorrect or incomplete maintenance can impair the operation of your splicer.

The manufacturer's warranty obligations for the splicer shall be rendered null and void if the unit has been tampered with by unauthorized persons.

Warranty

The Siecor M90 Fusion Splicer is warranted against defects in material and workmanship for a period of one year from date of shipment. Any M90 found to be defective during the warranty period may be returned, transportation prepaid, to the factory for repair without charge.

This warranty does not apply to units which have been repaired or altered by an unauthorized person, or which have been subject to misuse, negligence or accident.

A complete explanation of Siecor corporation´s warranties, and terms and conditions of sale may be found on the reverse side of Siecor´s Quotations, Order Acknowledgement and/or invoice forms and only the Warranty appearing thereon is to be considered Siecor´s Warranty.

All inquiries regarding repairs or replacement parts should be directed to the Customer Service Department, SIECOR CORPORATION, 489 Siecor Park, Hickory, NC 28603-0489; (704) 327-5000. This will assure you the fastest possible service.

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Definition of Warning Terms

Danger	Within the scope of these Operating Instructions and the warning notices on the products themselves, death, serious injury or substantial damage to property will occur if the relevant precautionary steps are not taken.
Warning	Within the scope of these Operating Instructions and the warning notices on the products themselves, death, serious injury or substantial damage to property can occur if the relevant precautionary steps are not taken.
Caution	Within the scope of these Operating Instructions and the warning notices on the products themselves, minor injury or damage to property can occur if the relevant precautionary steps are not taken.
Note	Within the scope of these Operating Instructions, important information on the product or the relevant part of the Operating Instructions to which particular attention should be paid.
Qualified personnel	Within the scope of these Operating Instructions, persons familiar with the commissioning, operation and maintenance of electrical devices and possessing the qualifications relevant for their work.

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Password Request

The splicer must be opened in order to activate or deactivate the password request.

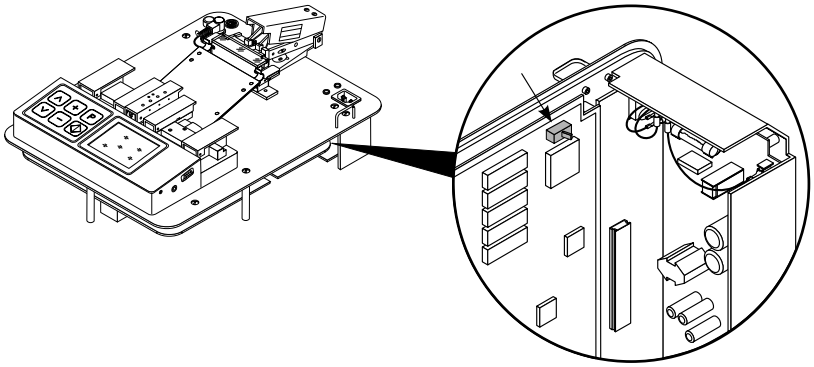
> Danger
>
> The fusion splicer or electrically operated accessories must not be opened except by suitably qualified personal. Switch off fusion splicer. Pull power supply plug and 12-V lead.

Open the front panel

see section 7.

Activating the password request

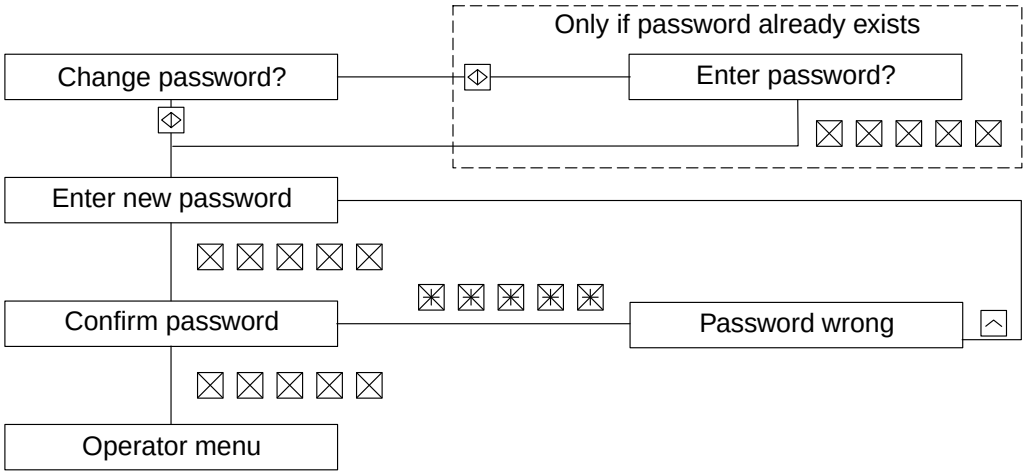
The PC board which is now visible (see figure) contains a switch for activation or deactivation of the password. If the password request is deactivated, the stored password is deleted when the equipment is switched on again. However, the old password is retained if you reactivate the password request **before** the equipment is switched on and off. On renewed activation of the request there is no password stored. It is therefore necessary to define a new password first (Parameter “Password”, see below).



Switch **“off”:** request activated.

Entering the password

A password consists of an arbitrary sequence of five input keys. If you try to change a parameter while the password request is activated, the message “Enter password” appears. If an incorrect password is entered, the change of parameter is rejected. This applies also to a change of password, i.e. a new password cannot be defined unless the current password is known. To redefine the password, activate the parameter menu, select the parameter “Password” and proceed according to the following flow chart:



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Getting to Know the M90 Splicer

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Scope of Delivery

Basic unit	With LID system	
Fiber guides	Fiber guide 250-900 µm: for clamping fiber on glass, for coatings from 250 µm to 900-µm diameter.	2 x
	Fiber guide 250 µm: for clamping fiber on coatings with 250-µm diameter	2 x
AC power cord	Stored in case lid	1 x
Working light	Stored in case lid	1 x
Tool bag	Consisting of:	
	Tool roll	1 x
	Syringe with index-matching fluid	1 x
	Hexagon socket head wrench, size 2.5	1 x
	Cleaning tips	1 x
	Electrode cleaning tool	1 x
	Emery paper strip for electrode cleaning tool	10 x
	Cleaning tool for LID system	1 x
	Groove cleaner for LID system	10 x
	Leather cloth for swab holder	10 x
	Leather cloth for monitor	1 x
	Dusting brush	1 x
	Nylon tweezers	1 x
	Hexagon socket head wrench, size 1.5	1 x
	Hexagon socket head wrench, size 5	1 x
	Open-end wrench 6 x 7	1 x
	Spare electrodes	2 x
	AC power fuse, medium time-lag 2.5 A	1 x
	Battery fuse 10 A	1 x
	Screwdriver, size 3	1 x
	Hexagon socket head wrench, size 2	1 x
	Wrench for splicing case	2 x

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General

The microprocessor-controlled fusion splicer is employed to produce mechanically strong, durable and low-loss connections between optical fibers.

Fiber diameter

It is possible to connect single-mode fibers, dispersion-shifted single-mode fibers and multimode fibers up to a maximum coating diameter of 900 µm. The splicer is designed for the standard fiber outside diameter 125 µm (without coating). If you want to fuse other fiber diameters, please contact the manufacturer.

Automatic fiber positioning

The fibers are positioned and fused automatically. This ensures consistently good results irrespective of the operator. Two mutually independent processes for positioning and automatic splice loss calculation are incorporated into the splicer. The proven LID system (**LID** = **L**ocal **I**njection and **D**etection) allows the user to perform exact core-to-core positioning of the fiber ends so that usable splice results can also be obtained in the case of single-mode fibers with eccentric cores. It also allows the user to measure the splice loss at the operating wavelength of 1300 nm. If the LID system cannot be used (e.g. in the case of tight buffered fibers), the finished splice is analyzed with the **L-PAS** video system (**L**ens **P**rofile **A**lignment **S**ystem) and the splice loss likewise given in dB.

Automatic fusion time control

The LID programs with automatic fusion time control measure the light transmitted through the fusion point during the fusion process. The optimum fusion time for each individual splice is thus selected automatically.

Flexible software

The splicer is equipped with a flexible software package that allows the user to adapt it to all conceivable applications:

The following programs are provided:

- LID programs with automatic fusion-time control for minimum splice loss
- L-PAS programs for special fiber types
- Special programs with preselectable fusion time and programmable fusion current profile
- Attenuation splice program for making attenuators up to 10 dB

Splicer shutdown

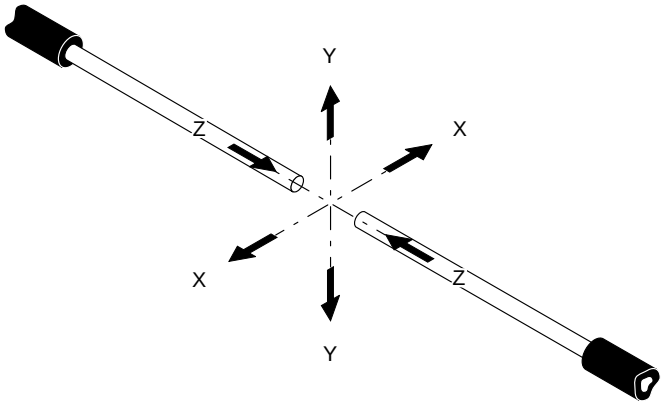
The splicer shuts down automatically 30 minutes after the last operation in AC power mode. In battery mode, the operator can select the shutdown time himself.

Accessories

At the customer's request, the splicer can be equipped with various accessories such as a battery, cleaver and splice tray holder. For accessories, see section 7.

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Definition of X, Y, Z directions

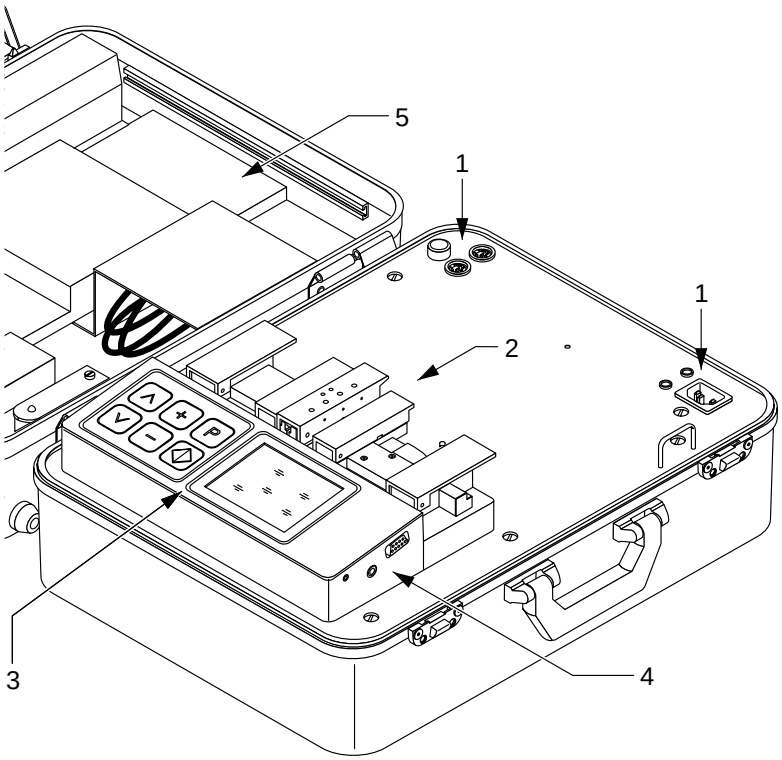


Fiber Direction

Overview of Modular Units

Modular units

The splicer is made up of service-friendly modular units.



1 Power supply
2 Fusion unit
3 Monitor and control panel
4 Input/output
5 Case lid

Overview of the Fusion Splicer Modules

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The mechanical and electronic systems are housed in a sturdy aluminum case.

The splicer can be powered by connecting it to mains voltages of 95 V to 260 V and 50 Hz to 60 Hz, the integral AC-line adapter selecting the correct voltage/frequency range automatically.

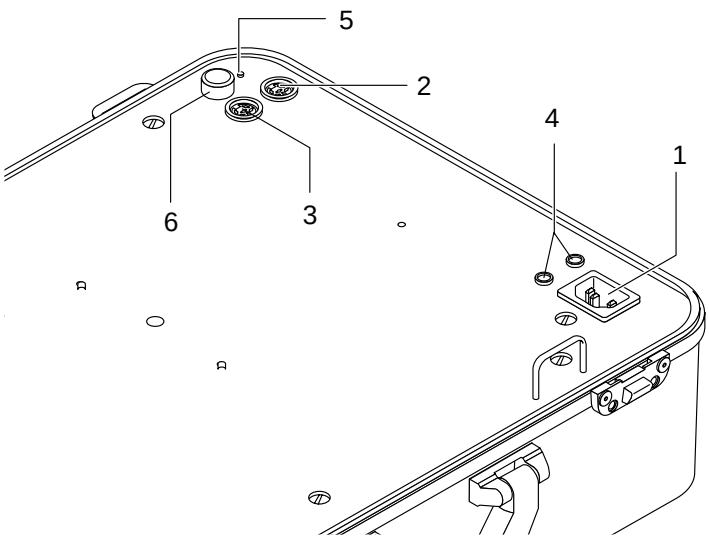
If the splicer cannot be powered from the mains, it can be operated by a battery instead (accessories). If the lead-acid battery is fully charged, operation can be sustained for 3-4 hours if no additional load (e.g. working light or heatshrink oven) is connected. When the battery is run down it can be recharged by means of the integral charger even if the fusion splicer is switched off. The splicer can still be used while charging is in progress.

The splicer can also be operated from an external 12-V power supply.

Power Supply

Overview

The terminal panel is located in the rear third of the splicer and features the sockets for the power supply, charging indicator and mains switch ("I").



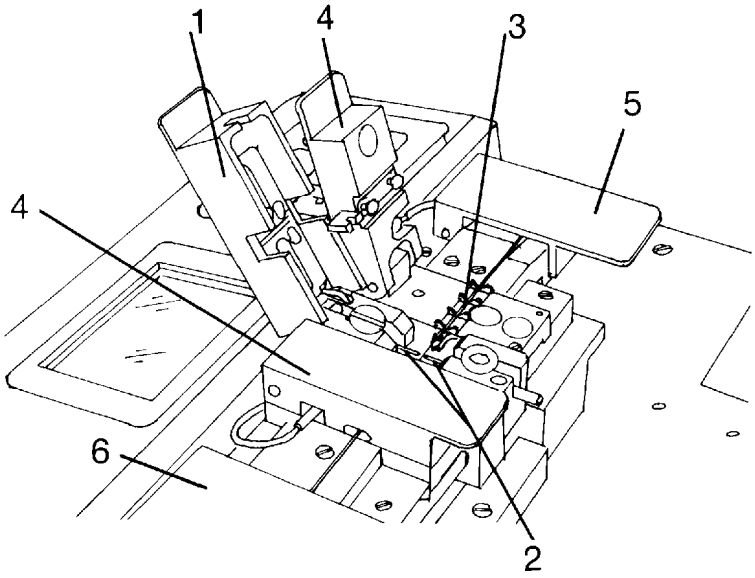
1 AC power connector
2 Connection for working light
3 Connection for heatshrink oven
4 Input, 12-VDC (red +, black -)
5 Charging indicator
6 Mains switch

Overview of Power Supply

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Splicing Unit

Overview



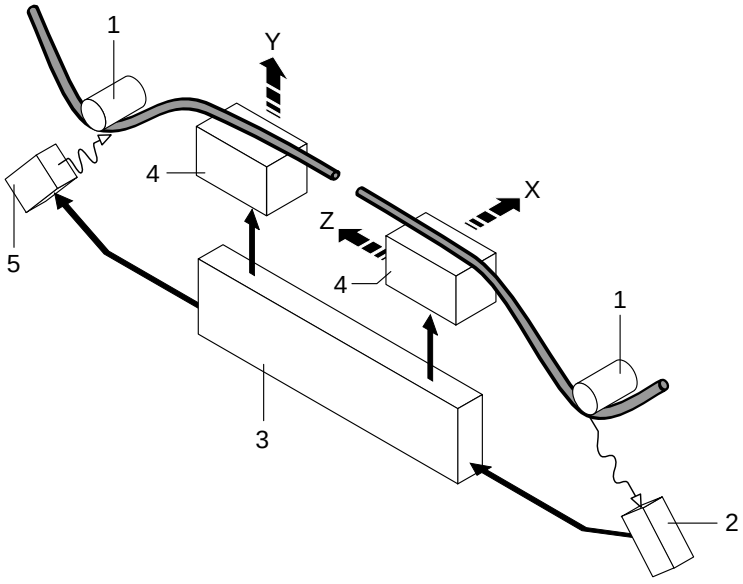
Fusion unit
1 Electrode flap with illumination
2 Electrodes
3 Fiber guides
4 Holder flap

LID system
5 Transmitter
6 Receiver

Overview of Fusion Unit

LID system The LID system allows exact core-to-core positioning. It consists of a transmitter and a receiver. The optical fibers that are to be connected are inserted into the transmitter and receiver. Located in the LID flaps there are the mandrels for bending the optical fibers.

Principle Light can normally be launched into the core of a straight fiber only at its end face. If the fiber is bent around a sufficiently small radius, however, such as occurs here at the mandrels of the holder flaps, light can be launched into or extracted from the fiber through the primary coating.



X X axis
Y Y axis
Z Z axis
1 Mandrel
2 Receiver (photodiode)
3 Microprocessor
4 Positioning elements
5 Transmitter (LED)

Principle of the LID System

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Launching/ extracting the light

At the radius of the mandrel on the transmitter side, the light from an LED is radiated into the optical fiber at a wavelength of 1300 nm. Part of this light is transferred into the core of the second optical fiber at the splice point. The light emerges again at the receiver's mandrel and strikes a photodiode.

Optical power as an electrical signal

The extracted optical power is proportional to the transmission at the splice point. Following conversion to an electrical signal it can be used for automatic alignment of the fiber ends and for automatic control of the splicing process itself.

Coating diameter

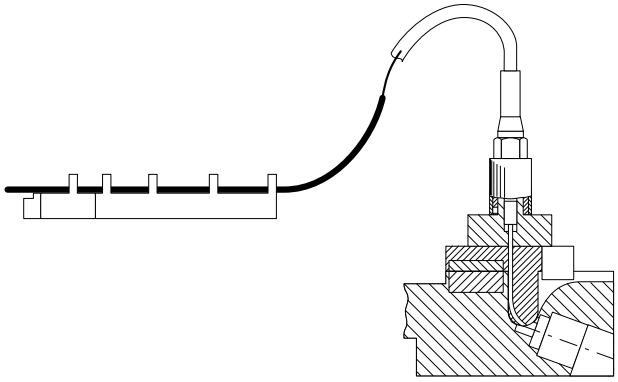
Your splicer is equipped with a LID system for coating diameters of 250 µm.
The following options are available for fusing fibers of diameters 400, 500 and 900 µm:

- You can align and fuse the fibers fully automatically by selecting the "Fixed parameters (video)" program group in the Parameter menu. This program aligns the ends of the fibers using the video camera, the LID system not being required.
- Align the optical fiber manually.
- Use an external optical attenuation test set, the test set being connected to the splicer's external LID input. In this case, you can perform fully automatic fusion by selecting the "Fixed parameters (LID)" or "Variable fusion curve" program group in the Parameter menu and switching there to an external LID system (see section 3).

> Note
>
> When using the internal LID system, use only optical fibers with the correct diameter (250-µm coating)

Pigtail adapters

To fuse pigtails to fibers, pigtail adapters are available for various connector types, allowing the LID system to be used (see section 8).



Pigtail adapters
e.g. for:
D4 plugs
LSA plugs
ST/II plugs
SC plugs
DIN plugs
FC plugs
E2000 plugs

Pigtail adapter

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Monitor and Control Panel

Monitor

The monitor used is an **LCD** (**L**iquid **C**rystal **D**isplay) screen subdivided into three areas.

Subdivision

The upper third and middle third of the monitor show the fiber pair in the X plane and Y plane respectively, unmirrored in each case.
The bottom third contains two lines of text for displaying the current program step and message texts.

During the self-test at switch-on and during parameter setting, the monitor switches to full-page text display mode.

Reference line

Located in the middle of the monitor and at right angles to the X and Y observation directions are two dashed lines. The inside edges of these lines indicate the approximate required position of the fiber ends for manual positioning.

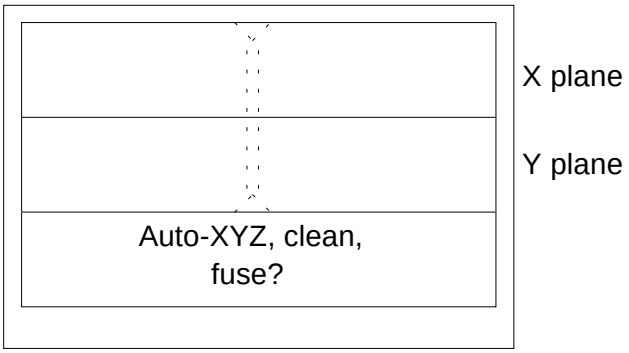
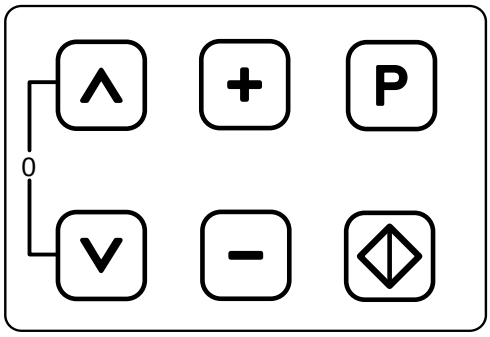


Image Area with Reference Line and Monitor Display

Control panel

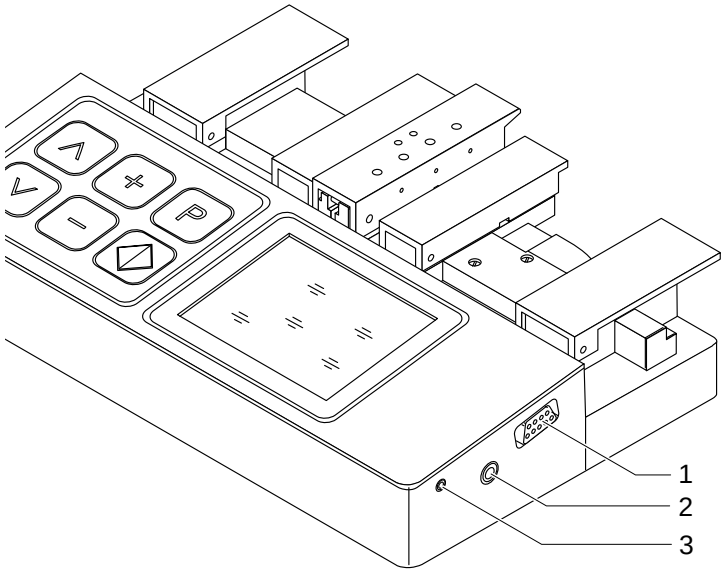


Control Panel Buttons

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Inputs / Outputs

Overview



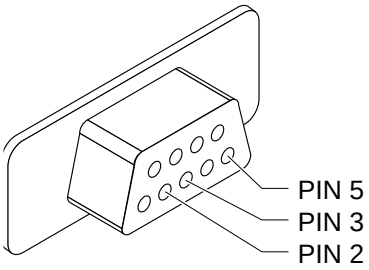
1 RS 232 interface
2 External video output
3 External LID input

Inputs and Outputs

RS 232 interface

The RS 232 interface can be used to print out the splice values and splicing parameters or to transfer these to a computer with appropriate terminal software.

Pin assignment



PIN 2: RXD
PIN 3: TXD
PIN 5: Ground

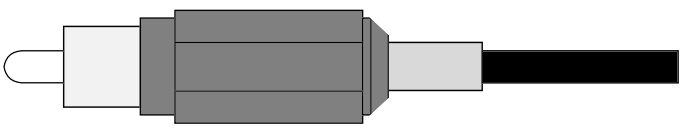
RS 232 Interface

External video output

An external monitor of European standard **CCIR** (625 lines, 50 Hz) with an input impedance of 75 Ω or higher can be connected to the video output.

RF cable

A cinch plug and an RF cable (75 Ω) must be used to connect the external monitor.



Cinch Plug

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External LID input

The LID system cannot be employed for optical fibers of diameter > 250 µm over the coating or for optical fibers with a color coating impermeable to light.

If you have an external attenuation test set, you can nevertheless still perform fully automatic fusion by selecting the "Fixed parameters (LID)" or "Variable fusion curve" program group in the Parameter menu.

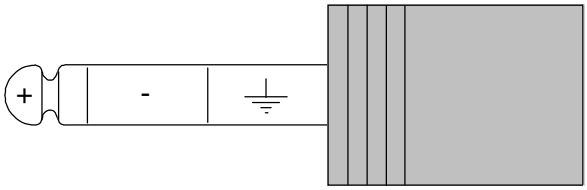
The external attenuation test set must have the following features:

Permissible output voltage U_{out}	$0\ V \leq U_{out} \leq 10V$
Voltage level	Variable DC voltage
Wavelength	800 - 1600 nm *
Settling time (rise or fall time of output voltage)	10 ms - 500 ms *
Signal-to-noise ratio of output voltage	>20 dB
Recommended output voltage range for automatic mode	$1\ V \leq U_{out} \leq 10\ V$

* can be set in Parameter menu

Jack plug

A two-pin or three-pin plug of diameter 3.5 mm and a shielded cable must be used for connecting the external analog attenuation test system.



Connecting the Plug

The "-" and "Ground" connections are interconnected in the splicer.

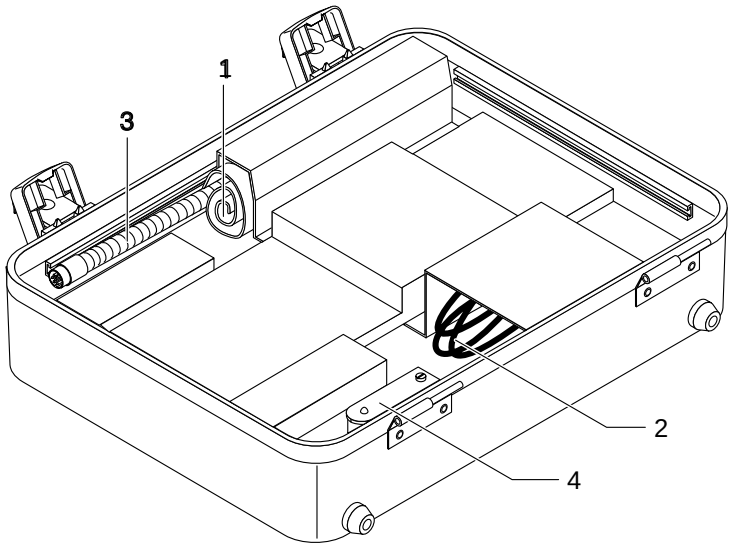
If your external attenuation test set has a settling time of 10 ms, the splicer functions automatically at the original speed. If the settling time is very long, e.g. 200 ms, the positioning procedure can take significantly longer.

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Case Lid

Overview

The case lid houses as standard the working light, the AC power cord, the tool bag and the 250-µm fiber guides (two items).

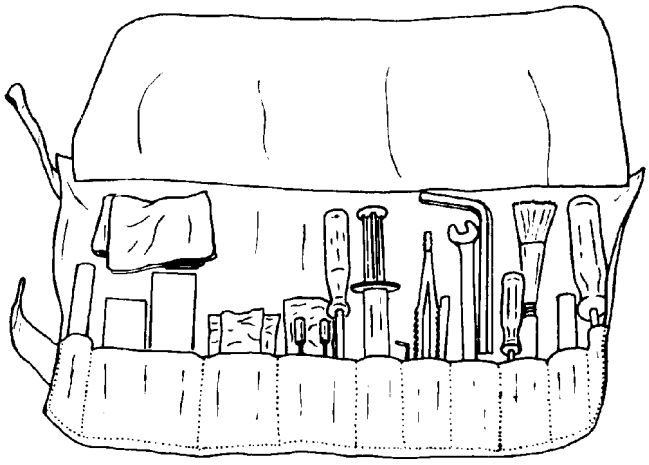


1 Tool bag
2 AC power cord
3 Working light
4 Storage container for fiber guides

Overview of Case Lid

Tool bag

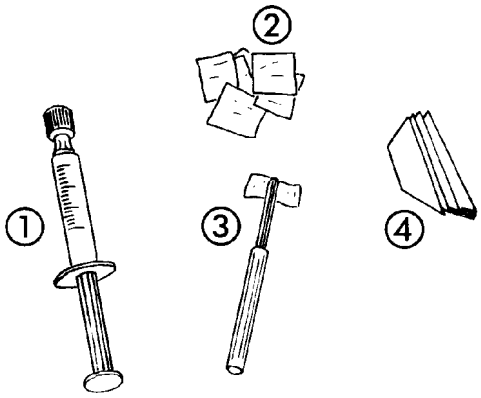
The tool bag houses all the tools required for care and maintenance.



Overview of Tool Bag

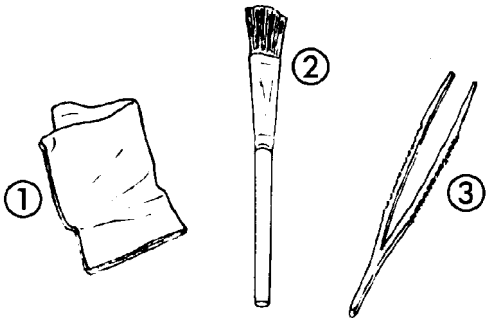
Caution
The AC power cord and tool bag must not project out of the holders!

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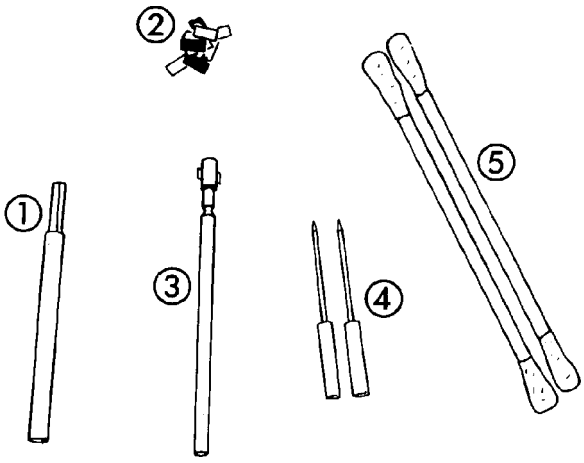
1 Syringe with index-matching fluid
2 Leather swabs for cleaning tool
3 Cleaning tool
4 Groove cleaner

Tools for LID System



1 Leather cloth
2 Dusting brush, size 1
3 Nylon tweezers

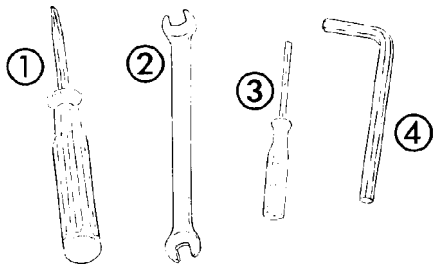
Tools for Fiber Guide/Optical System



1 Hexagon socket head wrench
2 Emery paper strip
3 Cleaning tool
4 Spare electrodes
5 Cleaning tips

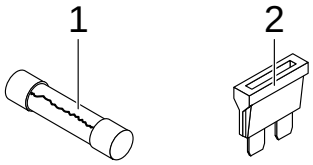
Tools for Electrodes

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1 Screwdriver, size 3
2 Open-end wrench, sizes 5.5 and 7
3 Hexagon socket head wrench, size 1.5
4 Hexagon socket head wrench, size 5

Other Tools



1 AC power fuse (medium time-lag 2.5 A)
2 Battery fuse (10 A)

Fuses

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Technical Specifications

Fiber require-ments	Single- and multimode fibers with 125-µm glass diameter and a coating diameter of 250 to 900 µm
Positioning	In X/Y axis through high-resolution piezo-ceramic posi-tioners with 120-µm travel (resol. < 0.1 µm) In Z-axis through two stepping motors each with feed travel of 3 mm plus high-resolution piezo-ceramic positioner with 30-µm travel (resolution < 0.1 µm)
Video system	High-resolution video system with 2-axis imaging system 4" LCD color monitor 75x magnification
Operating temp.	- 5 ° C to + 45 ° C
Storage temp.	- 20 ° C to + 70 ° C
AC power supply	95 - 260 V through automatic voltage range selection 50 - 60 Hz, max 100 VA
Microprocessor	80C537 (Siemens)
Connecting jacks	For heatshrink oven and working light
Battery	Lead-acid battery as special accessory: 12 V, 6.5 Ah for appr. 3 - 4 h operation per charge cycle (splicer only). Charge time: 3 hours after complete discharge, exhaus-tive discharge protection
External 12-V supply	12 - 14.5 V, max. 5 A, pro-tected against polarity rever-sal
Data memory	For 1000 splice values
Data output	RS 232 interface with variable baud rate
Monitor output	75 Ω, for external monitor of CCIR standard Connection: Cinch plug Cable length: max. 10 m
Light arc	AC voltage, fusion current adjustable from 10 - 20 mA

LID transmitter	LED, wavelength 1300 nm, temperature compensated
LID receiver	Phase-sensitive
Attenuation splice	1 to 10 dB (0.1 dB step width)
Tensile tester	Tensile load 2.5 ± 0.5 N
Realtime clock	Time and date display, battery backup
Splicer: Weight (without battery) Outside dimen-sions (L x W x H)	 14.5 kg 420 x 320 x 180 mm
Battery: Weight Outside dimen-sions (L x W x H)	 2.7 kg 160 x 110 x 70 mm
Splice time	Typically < 1 min

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Preparations

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Putting the Splicer into Operation

Opening the case

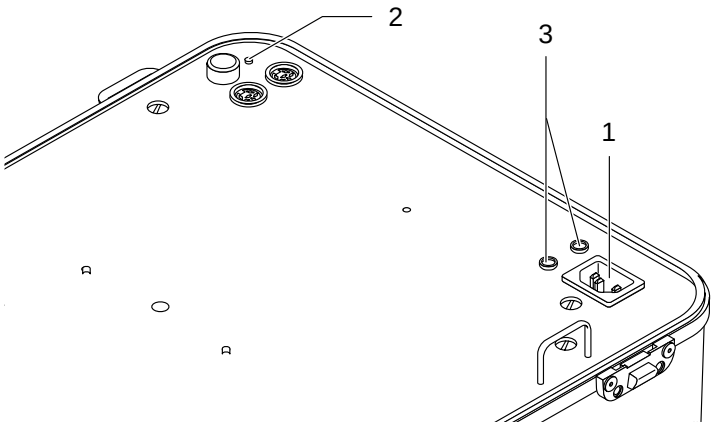
Place the splicer on a dry and firm base. Open the lid of the case, unhook it from the hinges and lay it to one side.

> Note:
>
> You are working with a sensitive, high-precision device. Ensure your working environment and the device are clean. Act with care and never use force!

Power supply

The splicer is powered by either:

- AC line connection (95 - 260 V, 50 or 60 Hz) (1),
- External 12-V power supply (3) or
- Internal battery (accessories)



Overview of the Power Supply

AC power connector

Remove the AC power cord from the lid of the case and plug it into the power socket in the splicer (1). The charging indicator (2) lights up.

> Note
>
> If the charging indicator does not light up, see Troubleshooting in section 7

12-V connection

A connecting cable is not supplied. Note the connection specifications!

> Caution
>
> The connecting cable you use must have been checked and approved by qualified personnel.
>
> Permissible voltage range of the 12-V connection: 12-14.5 VDC.
> Rating of connecting cable: 5 A.

Plug the cable into the 12-V connection sockets (3).

The connection is fuse-protected and protected against polarity reversal.

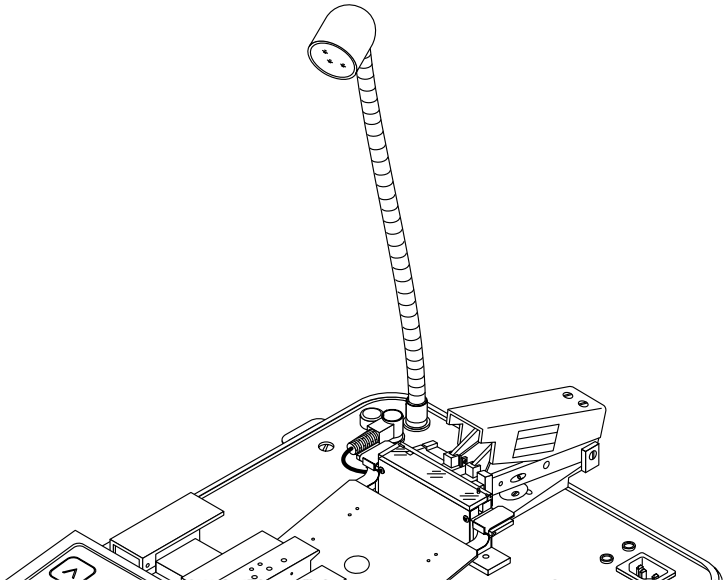
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Working light If lighting is poor, the working light can be used.

Connecting the working light

- Remove the working light from the lid of the case.
- Now insert it into the socket at the rear.
- Switch on the working light by turning the shield of the light in clockwise direction and switch it off by turning the shield in counter-clockwise direction.

> Note
>
> Only switch the working light on if you actually need to do so, since its operation will considerably reduce the operating time of the splicer in battery mode.



Connecting the Working Light

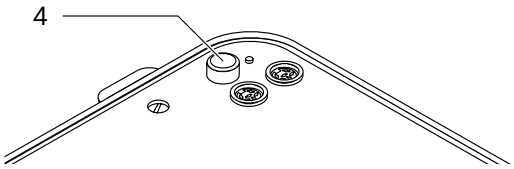
Removing the working light

- Switch off the working light and pull it out of the socket.
- Stow it away again in the lid of the case.

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Switching on the splicer, self-test

Press the mains switch (4). The monitor lights up and the microprocessor automatically runs an internal self-test. Faults detected by the test are displayed on the monitor (section 6).



Mains Switch

> Note
>
> Before continuing to put the unit into operation, you must first eliminate any faults that have been detected and displayed (section 7)

Software version

While the self-test is being performed, the installed software version is displayed on the monitor.

Battery charge level

In battery mode, the charge level of the battery is displayed in %.

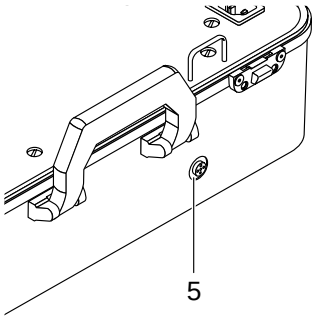
> Note
>
> You should only run the splicer from the battery if the battery charge level exceeds 30%
>
> Never stow away the splicer with the battery discharged. Recharge the battery at the end of every working day.

"Battery empty"

If the charge level of the battery falls below the minimum level, "Battery empty" is displayed on the monitor and the splicer switches off automatically. Before you use the splicer again in battery mode, you must recharge the battery (section 8).

Charging the battery

> Danger
>
> Do not cover over the venting hole (5) ! Only charge batteries in well-ventilated rooms!

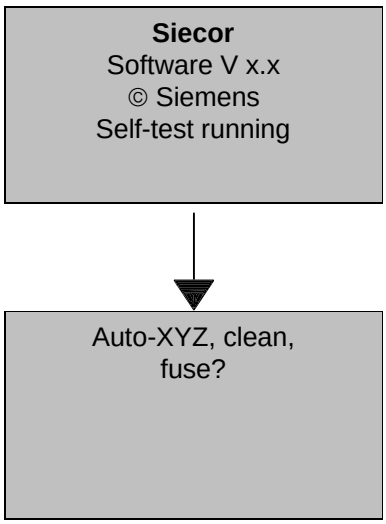


Venting Hole

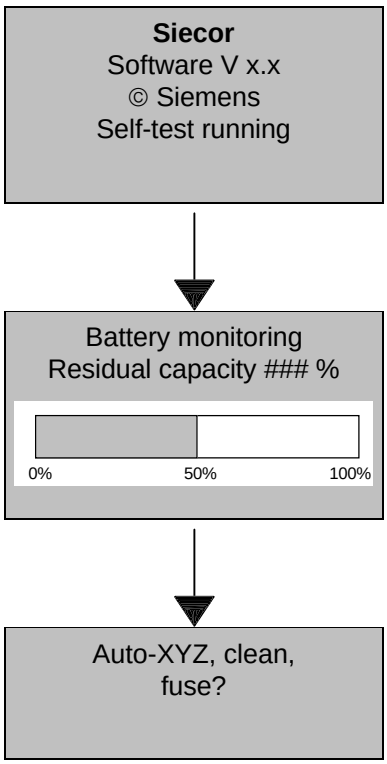
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Monitor displays after switch-on

Automatic sequence of monitor displays in AC mode



Automatic sequence of monitor displays in battery mode



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Checking the electrodes

Check the condition of the electrodes as follows:

- Ensure that there are no fibers inserted.
- Select function "Fuse?" .
- Press button ◇
- Listen out for hissing noises

Characteristics of correctly functioning electrodes

The electrodes only function correctly if:

- The arc is uniform
- No hissing noises can be heard during the fusing process and
- The electrodes are not whitened or distorted

If the electrodes are not functioning correctly, clean them as described in section 7. Electrodes which are distorted must be replaced.

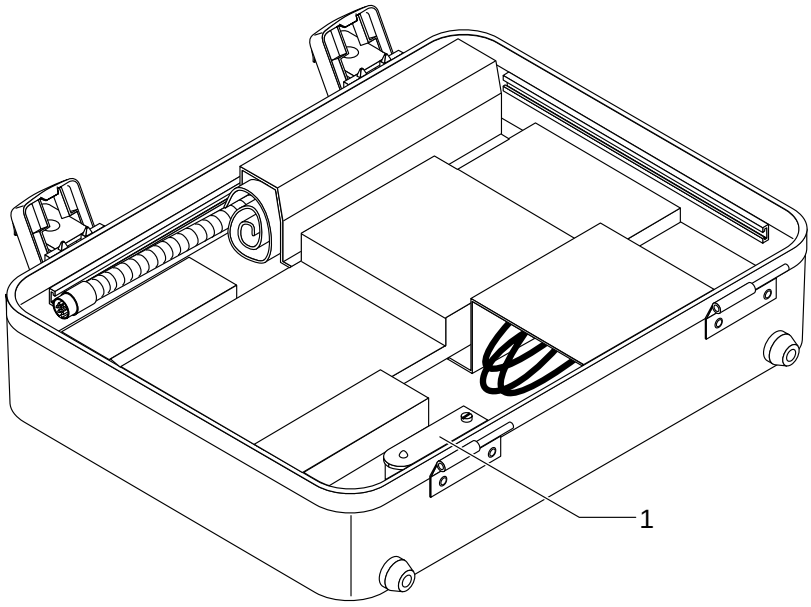
Selecting the fiber guide

There are two different types of fiber guides for the following fiber diameters:

- Fiber guide 125/900 µm for clamping on the uncoated fiber

  The fiber guide 125/900 µm is fitted at the factory and is suitable for all fibers with 125-µm glass diameter and a coating diameter between 250 and 900µm. This fiber guide is provided with a mirror in the insertion area of the coating removal edge. This makes it easier to identify the position of the fiber when inserting it.
- Fiber guide 250/900 µm for clamping on fiber coating

  This fiber guide is located in the storage container of the case lid (item 1) and can be readily replaced. It should be used when the length of the uncoated fiber of the splice is required to be less than 10 mm. The fiber guide is suitable for fibers with an outer diameter of 250 µm.

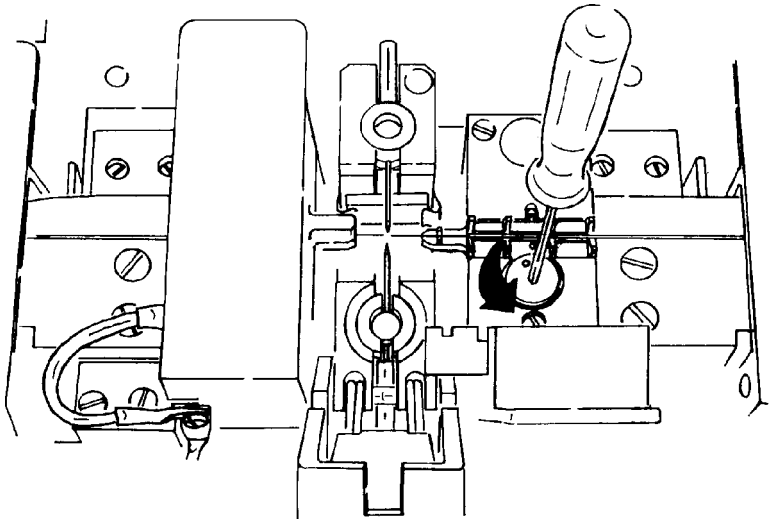


Storage Container for Fiber Guides

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Removing the fiber guide

- Remove the hexagon socket head wrench size 1.5 from the tool bag.
- Open the electrode flap and the holder flap.
- Turn the eccentric clamp through 180° (see figure) and remove the fiber guide.

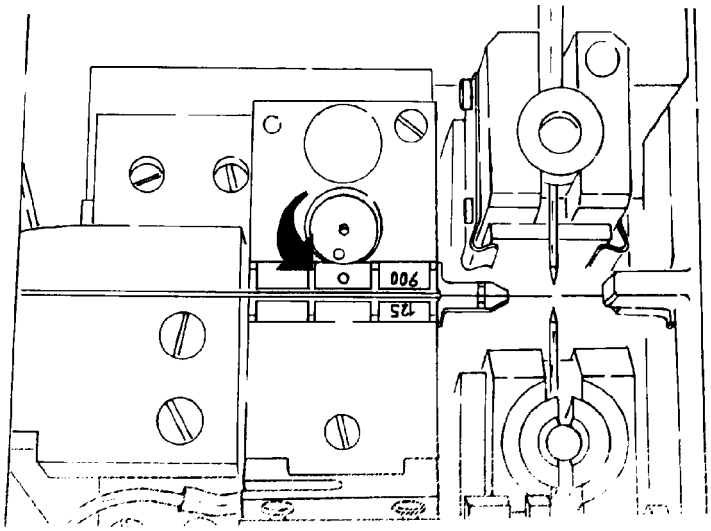


Opening the Eccentric Clamp

Note
The fiber guides must always be clean. Open only one holder flap at a time.
Close this as soon as the operation has been completed.

Installing the fiber guide

- Ensure there is no dirt in the groove.
- Insert the new fiber guide in the groove.
- Turn the eccentric clamp through 180° until the bright dot on the eccentric clamp is lined up with the mark on the fiber guide (see figure).



Fitting the New Fiber Guide

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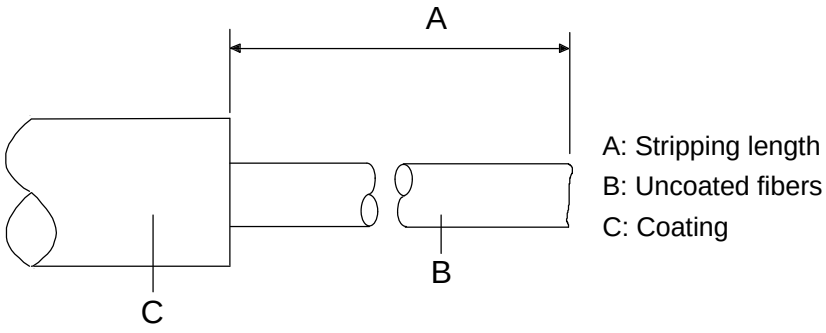
Preparing the Optical Fibers

The work for preparing the optical fibers involves:

- Stripping the coating
- Cleaning the fibers
- Preparing the end faces (e.g. with cleaver FBC-005)
  Refer to the operating instructions accompanying your cleaver.
- Assessing the end faces (monitor)

Stripping

To perform stripping, you will need a special fiber stripping tool, (e.g. stripping tool for optical fibers 0.18 / 0.30 mm 3205004-01.
Use this tool to strip off the coating over a length of a few centimeters (depending on the cleaver used).



Stripping length

Cleaning

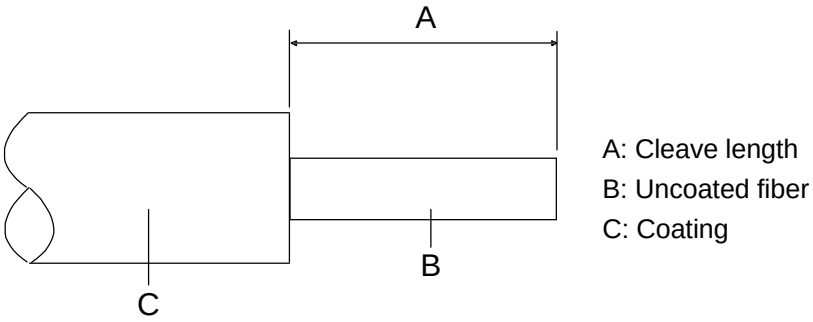
Clean the end of the fiber (coating and uncoated fibers) over a length of approx. 10 cm. Do this by wiping the fibers several times vigorously with a cleaning cloth soaked in alcohol.

Use only lint-free cleaning cloths and isopropyl alcohol.

Cleaving

Perform cleaving in accordance with the cleaver operating instructions so as to obtain the following cleave lengths:

Fiber Guide	Cleave Length (A)
250-900 µm	10.5 mm ± 0.5
250 µm	3.5 mm +1



Cleave length

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Cleave quality

The microprocessor-controlled splicer will only supply satisfactory results if high-quality fiber cleavers are also used which can ensure a cleave angle error of ≤ 0.8°.

Assessing the end faces

If you wish to inspect the end faces, insert the fibers into the splicer. Page with the ▽ button to menu item "Search for fibers" and press the ◇ button. The fibers will then appear on the screnn.



Assessing the Fiber End Face Quality

Fibers which are very dirty can be given a preliminary cleaning by dabbing the ends of the fibers onto the sticky surface of a strip of adhesive tape.

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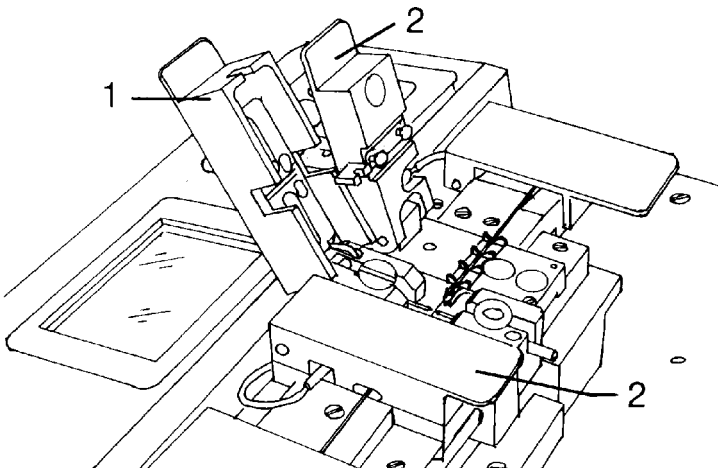
Inserting the Optical Fibers into the Fiber Holder

Ensure that you have chosen the right type of fiber guide.

Open the flaps

- First open the electrode flap (1).
- Then open the holder flap (2).

> Caution:
>
> Open the electrode flap first and then the holder flap!



1 Electrode flap
2 Holder flap

Opening the Flaps in the Correct Sequence

Checking the fiber guide

Check whether the fiber guide is clean. If not, clean it (see section 7).

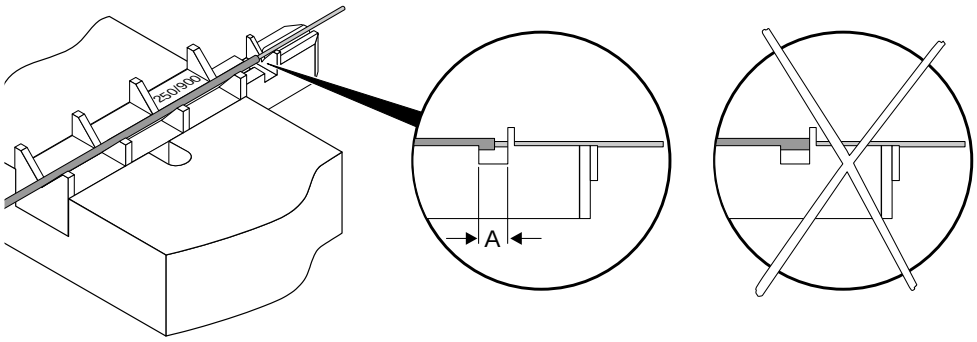
> Note
>
> Open only the flaps required for the relevant operation at any one time.

Inserting the fibers

The procedure for inserting the fibers in the fiber guide depends on the fiber guide selected. Note the prescribed cleave lengths.

Fiber guide 250-900 µm

Insert the fiber into the fiber guide so that the coating stripping edge lies within the area (A) (see figure).

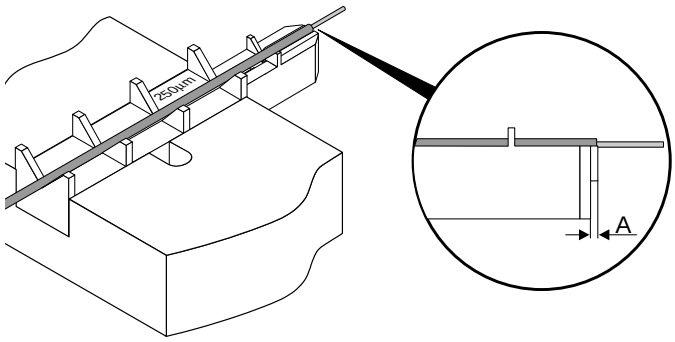


Inserting the Fiber into the Fiber Guide 250-900 µm

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Fiber guide 250 µm

Insert the fiber into the fiber guide so that the coating stripping edge lies within the marking (A) (see figure).



Inserting the Fiber into the Fiber Guide for 250 µm

Closing the flaps

- Close the flap of the fiber holder.
- Insert the second fiber in the same way (procedure as described from "Opening the flaps" onwards).
- Now close the electrode flap.

Note

To prevent the optical fibers becoming dirty, perform steps "Cleaning", "Stripping" and "Inserting into the Splicer" one immediately after the other.

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Inserting the Optical Fibers into the LID System

If the use of the LID system is not required and no tensile test is performed, the fibers need not be inserted into the LID system, e.g. in the case of fusion with program groups "Fixed parameters (video)" or fusion with external attenuation test set.

Cleanliness

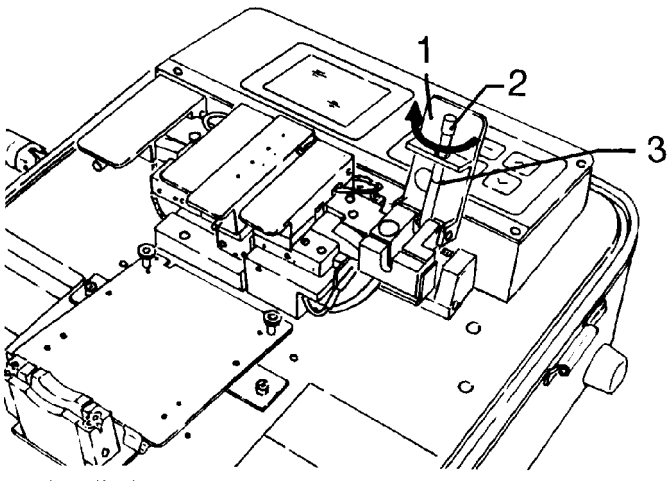
- Open the transmitter and receiver flap.

  Check the cleanliness of:
  mandrels,
  groove and
  input face / output face (see figure below).
- Clean the parts if necessary (see section 7).

> Note
>
> Maximum permissible fiber diameter: 250 µm over coating.

Index-matching fluid

To increase the efficiency of light injection and detection, the input and output areas are coated with index-matching fluid.
A metering wheel (2) is provided on the mandrel for this purpose.



1 Flap
2 Metering wheel
3 Groove (emergence of index-matching fluid)

Metering the Index-Matching Fluid

- To wet the input and output areas with index-matching fluid, turn the metering wheel (2) slowly in clockwise direction until a small drop appears in the groove of the mandrel (3).

  Top up if no fluid emerges (section 7).
- Close the flap (1) in order to wet the input and output areas with the index-matching fluid.

Inserting the fibers

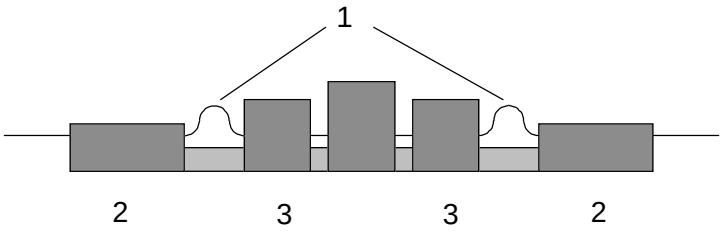
- Open the flap (1).
- Insert the fiber in the groove and hold it under slight tension.
- Slowly and carefully close the flap (1).

Now insert the second fiber into the receiver in exactly the same way.

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Inserting depressed inner cladding fibers

For fiber type "depressed inner cladding" an excess length of fiber must be left between the fiber holders and the LID flaps in order to ensure correct measurement of the attenuation.



1 Fibers with excess length
2 LID
3 Fiber holder

Inserting Fibers of Type "Depressed Inner Cladding"

LID performance check

- To check whether the LID transmitter and LID receiver are functioning correctly, insert a continuous fiber into the LID system.
- Select the "Manual fiber adjustment" function in one of the LID programs, select X or Y positioning and press button ⌖
- A level of at least 0.500 must be displayed on the monitor.
  If this is not the case, eliminate the fault (section 7).

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Parameters and Programs

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Parameter Menu

General

The Parameter menu can be used to match the parameters to the fiber type used. The Parameter menu is subdivided into "Program selection" and "Additional functions".

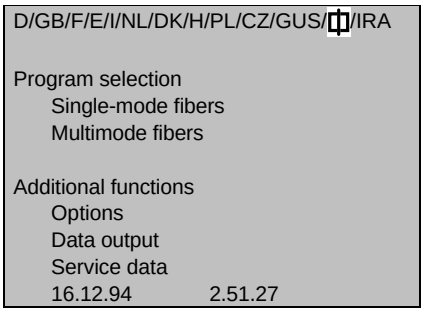
Determining the optimum parameters

- Use the default parameters for your initial attempts.
- If the results are not satisfactory, refer to the troubleshooting notes in section 7.
- If you still do not obtain satisfactory results, you should read the section "Significance of the splicing parameters" in this section to find out the effect of changing the individual parameters.

Call the menu

Pressing the [P] button allows you to access the Parameter menu with the electrode flap closed. Pressing the [P] button in the Parameter menu returns you to the normal operator guidance.

Monitor mask Parameter menu



Button functions

The buttons on the program control panel are used for selecting the parameters. These buttons have the following functions in the Parameter menu:

- [P] Enter/exit the Parameter menu
- Save value (Enter)
- Page up, move to previous line
- Page down, move to next line
- Increment value
- Decrement value

Resetting the parameters

If you hold the button depressed while switching on the splicer, all parameters in all program groups are reset to the default values.

> Note
>
> This is only possible if the password has not been activated.

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Default parameters

Cleaning current: 14.5 mA
Cleaning time: 0.1 s

	Single-Mode Fibers	Multimode Fibers
Z-gap:	7.0 µm	7.0 µm
Autofeed:	5.0 µm	5.0 µm
Prefusion current:	15 mA	13.5 mA
Prefusion time:	0.25 s	0.5 s
Fusion current:	15 mA	14 mA
Fusion time:	1.2 s	5 s
or min. fusion time:	0.8 s	-
max. fusion time:	10.0 s	-
Tensile test:	on	on
LID system:	internal	internal

The default parameters for the attenuation splice are given in section 5.

Setting the language

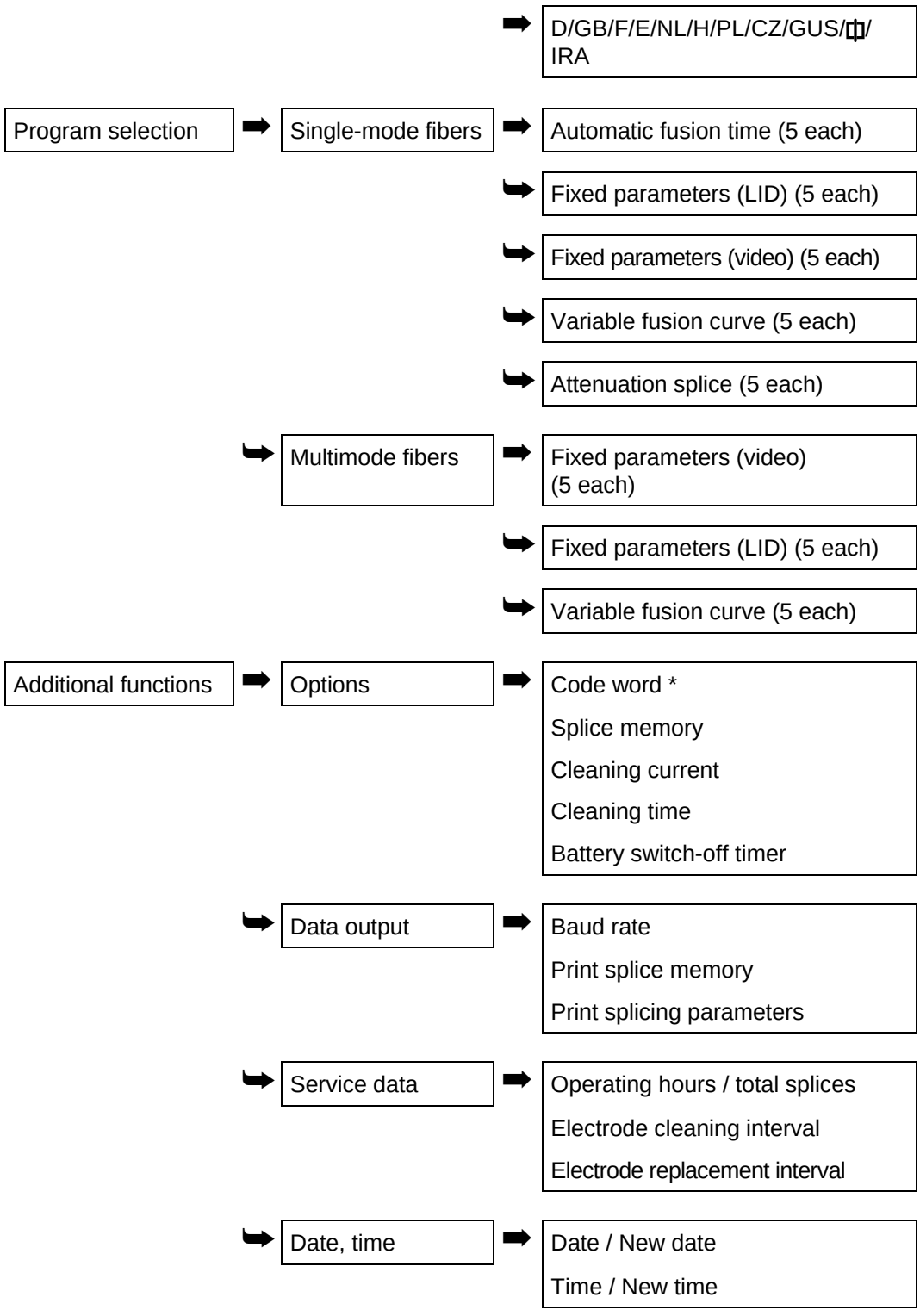
To select the language, move to the first line using the ⌃ button and press the ⌄ button as often as necessary until the required language flashes. The selected language is activated after confirming with the ⏎ button.

Abbrev.	Language	Abbrev.	Language
D	German	PL	Polish
GB	English	CZ	Czech
F	French	GUS	Russian
E	Spanish	中	Chinese
NL	Dutch	IRA	Farsi
H	Hungarian		

The available languages may differ depending on the software version installed.

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Program overview

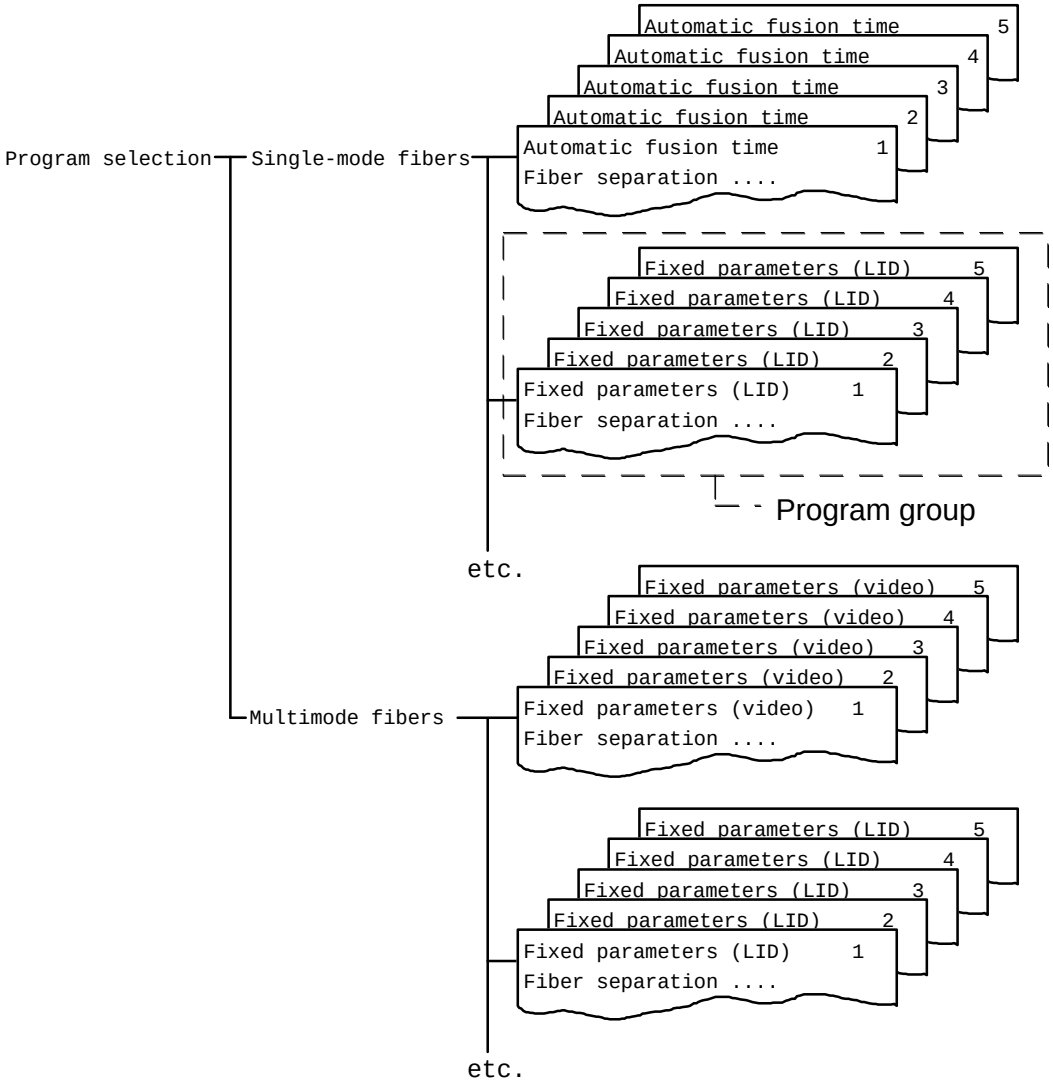


* if activated

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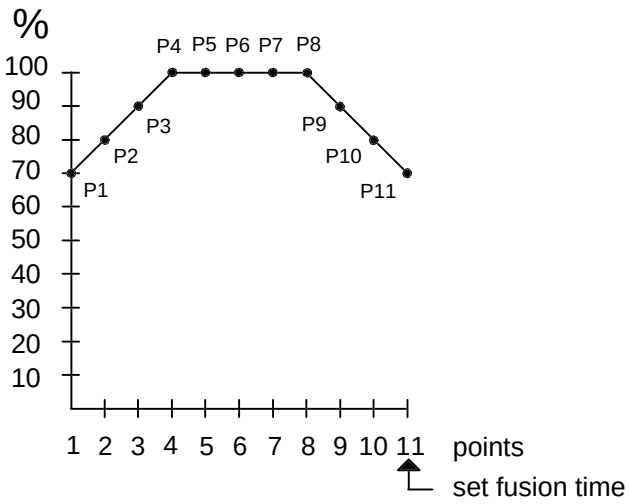
Menu Item "Program Selection"

In the menu item "Program selection" there are predefined program groups for various applications. The parameters of each program can be changed and saved. Each program group contains five programs which can naturally have different parameters.



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Description of the programs	Significance / influence / application
Automatic fusion time	The splicer uses the LID system to measure the attenuation during the fusion process. Fusion is terminated as soon as the optimum attenuation is reached. The range in which the fusion time can be varied is adjustable up to 10 seconds. A minimum fusion time of 0.8 seconds is recommended.
Fixed parameters (LID)	If automatic fusion time control is not to be used (e.g. for test purposes), the fusion time can be preset in this program group. Positioning and attenuation evaluation are performed as in program group "Automatic fusion time".
Fixed parameters (video)	This program is used to perform precision fiber positioning using the video camera. It is thus also possible to fuse fibers for which the LID system cannot be used. Alignment is performed on the basis of the outer contour and the lens effect of the fibers. Consequently, good fiber quality - particularly as regards the eccentricity of the fiber core relative to the outer contour - is essential for sound splices.
Variable fusion curve	This program allows you to influence the time profile of the fusion current. The "fusion curve" is defined by 11 points which all have the same time interval. For each individual point you can use the Parameter menu to set the required percentage of the set fusion current. 100% corresponds to the set current. The minimum percentage that can be set depends on the fusion current selected and corresponds to 10 mA.



Example of a Splicing Curve

Attenuation splice	This program group allows you to produce attenuators. The required attenuation can be set in steps of 0.1 dB over the range 0 to 10 dB. This attenuation is then realized and displayed fully automatically by a special fusion procedure.

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Description of the splicing parameters	Significance	Setting Values / Setting Range
Z-gap	Distance between the fiber ends during prefusion	2.0 - 10.0 µm
Autofeed	Inward movement of the fiber ends beyond the point of contact (overtravel)	0.0 - 10.0 µm
LID system	Selection of the LID system used. If an external LID system is used, the wavelength (nm) and settling time (ms) must also be entered.	Internal/external
Cleaning current	Temperature of the fiber ends during cleaning	10.0 - 16.0 mA
Cleaning time	Time the arc is burning during cleaning	0.05 - 0.3 s
Prefusion current	Temperature at the fiber end faces during prefusion	10.0 - 20.0 mA
Prefusion time	Time between initiation of the arc and initiation of the overall feed	0.03 - 2.5 s
Fusion current	Temperature of the fiber ends during fusion	10.0 - 20.0 mA
Fusion time	Time the arc is burning during fusion	0.0 - 10.0 s
Tensile test	Tensile test of the fused fibers.	Yes/no
Attenuation value, lead, additional time	Additional parameters for attenuation splice. See section 5, Attenuation Splice.	

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Menu Item "Additional Functions"

Menu item "Additional functions" is used to set general parameters.

Options — Submenu "Options" is located in the "Additional Functions" menu (see page 3-4). It contains common parameters for all programs.

Password — Only if activated. See supplementary sheet for explanation.

Splice memory — The following splice memory parameters can be set.

1. Splice memory off.
2. Splice memory automatic (presetting): The attenuation values are stored automatically.
3. Splice memory manual: The storage of each attenuation value has to be confirmed (see page 4-23).
4. Clear splice memory. The entire splice memory is cleared.

Cleaning current — The cleaning current can be set between 10.0 - 16.0 mA.

Cleaning time — The cleaning time can be set in steps of 0.01 seconds over the range 0.05 - 0.30 seconds.

Battery switch-off timer — The time interval in battery mode between the last button actuation and the time the splicer switches off can be set between 2 - 60 minutes.

Altitude correction — The setting for site altitude above sea level is used for automatic correction of fusion current and fusion time.

Off: Setting corresponds to a default site altitude of 550 meters above sea level.

Manual: If you select "Manual“ you must enter the true site altitude above sea level, accurate to the nearest 10 meters, in the range from 0 to 4000 meters.

Data output — Submenu "Data output" is located in the "Additional functions" menu . It is used to set all parameters relating to data storage and output.

Baud rate — The transmission speed for data output (via the RS 232 interface) can be set.

Possible parameters are:
150, 300, 600, 1200, 2400, 4800 and 9600 baud.

Print splice memory — If this parameter is set to "Yes", the stored splice values are output via the RS 232 interface.

The splice memory can store 1023 splice values.

Print splicing parameters — If this parameter is set to "Yes", all splicing parameters are output via the RS 232 interface.

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Service data

Submenu "Service data" is located in the "Additional functions" menu . It is used to display data relating to use of the splicer and to set specific service intervals.

Operating hours, total splices

Operating hours:

Displays the total operating time in hours. The value cannot be changed or cleared.

Total splices:

Displays the number of splices performed with the splicer. This value cannot be changed or cleared.

Electrode cleaning interval

Electrode cleaning interval:

This is used to enter the number of splices after which a reminder is to be issued to clean the electrodes. A value of 500 is set at the factory. Depending on the application, a value of between 50 and 700 can be chosen.

Clear counter:

"Yes" resets the counter for electrode cleaning to "0". The electrodes must be cleaned beforehand.

Electrode replacement interval

Electrode replacement interval:

This is used to specify the number of splices after which a reminder is to be issued to exchange the electrodes. This value is set to 5000 at the factory and can lie between the value set for electrode cleaning and 7000.

Clear counter:

"Yes" resets the displayed counter for electrode replacement to "0".

Service support

The submenu "Service support" is intended to give help to the craftsperson when confronted with a problem in the field. Menu-driven selection is used to check individual splicer functions. This enables the craftsperson to decide on the spot whether e.g. the splicer can be restored to normal operation simply by cleaning the lens system or whether it will have to be returned to the service center for maintenance. It also simplifies the optimization of the splice parameters.

Further information is provided in section 7.

Date, time

Submenu "Date, time" is located in the "Additional functions" menu.
It is used to set the date and time.

Date,

Date: Displays the set date.

New date

New date: Can be used to change the set date.

Time,

Time: Displays the set time.

New time

New time: Can be used to change the set time.

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Splicing

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General

> Note
>
> Ensure that all preparations for splicing have been performed correctly and completely. Otherwise turn to section 2 and perform the necessary preparations on the splicer and optical fibers.

Button functions

- [P] Switch to the Parameter menu (e.g. for program selection) or return to the last program step in the fusion program
- [⊕] Change the displayed parameters
- [⊖] Change the displayed parameters
- [◇] Reply "Yes" to displayed question. The relevant operation is initiated.
- [△] Reply "No" to displayed question or abort the current operation. Return to previous operation.
- [▽] Reply "No" to displayed question or skip indicated operation.

Selecting the Fusion Program

The various splicing programs and parameters are listed in section 3.
With this information available to you, you should now be able to specify and activate the required splicing program.

If you have not already done so, activate the required program in the Parameter menu and return with the [P] button.

Fusion program groups

The splicer provides the following program groups:

1. Automatic fusion time for single-mode fibers
2. Fixed parameters (LID) for single-mode and multimode fibers
3. Fixed parameters(video) for single-mode and multimode fibers
4. Variable fusion curve for single-mode and multimode fibers
5. Attenuation splice for single-mode fibers

Each of these 5 program groups has 5 parameter sets (programs) whose parameters can be set individually.

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Selecting the Splicing Sequence

Each splicing sequence consists of:

- Cleaning.
- Positioning (X/Y axis, Z axis).
- Fusion, with feed in Z direction.
- Assessment of splice (only with fully automatic and automatic modes).

You can choose between automatic and manual splicing sequences. The following splicing sequences can be used:

- Fully automatic.
- Automatic.
- Semi-automatic.
- Manual fiber positioning.

The flow chart under "Selecting the splicing sequence" shows how the various splicing sequences are activated (see next page).

Fully automatic

You will normally use the fully automatic splicing sequence. The selected fusion program runs automatically.

Automatic

If visible signs of dirt remain on the fiber after automatic cleaning, conclude the operation with ⌓ and select automatic mode. This allows you to clean as often as you require.

If the fiber ends are still not clean after five cleaning cycles, they must be restripped and recleaved.

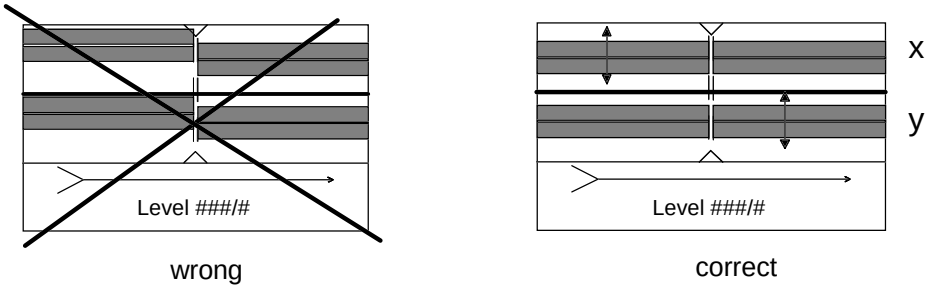
Semi-automatic

For test purposes, select semi-automatic splicing. In this mode you have to initiate cleaning, X/Y positioning, Z positioning and fusion individually.

Manual

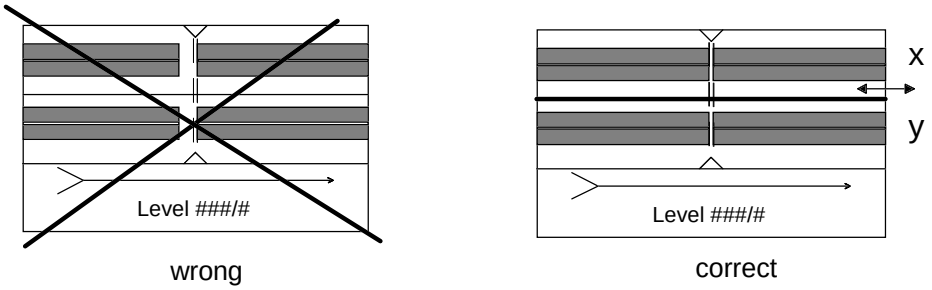
For special purposes, you can position the optical fibers manually using buttons ⊞ and ⊟.

Alignment



wrong correct

Positioning to the reference mark



wrong correct

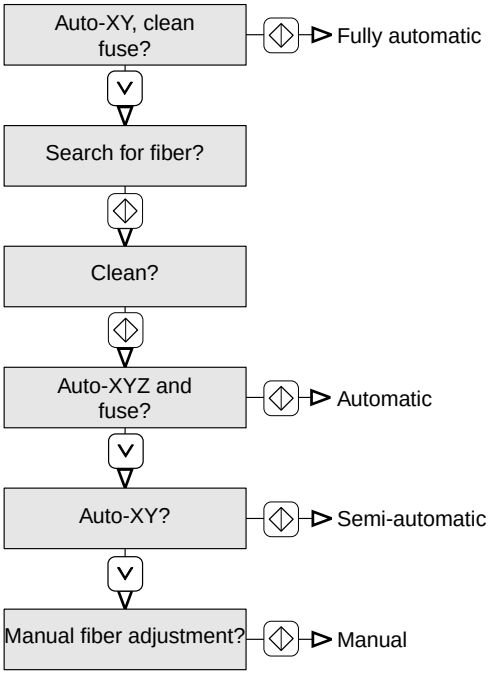
Position the fibers axially so that they coincide with the inner edges of the reference mark.

Press button ⌔ on the processor control panel until the question "fusing?" appears on the monitor.

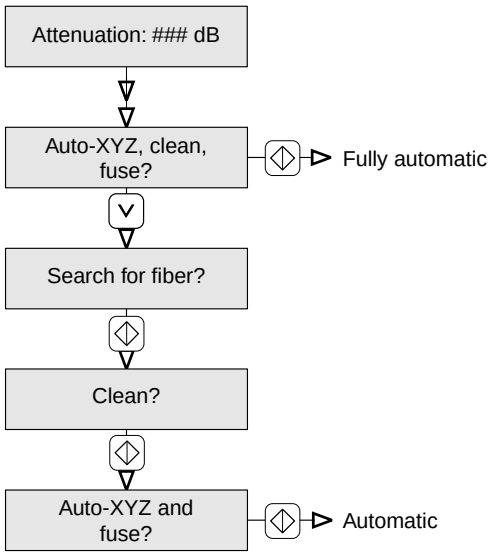
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Selecting the splicing sequence

All programs, except attenuation splice

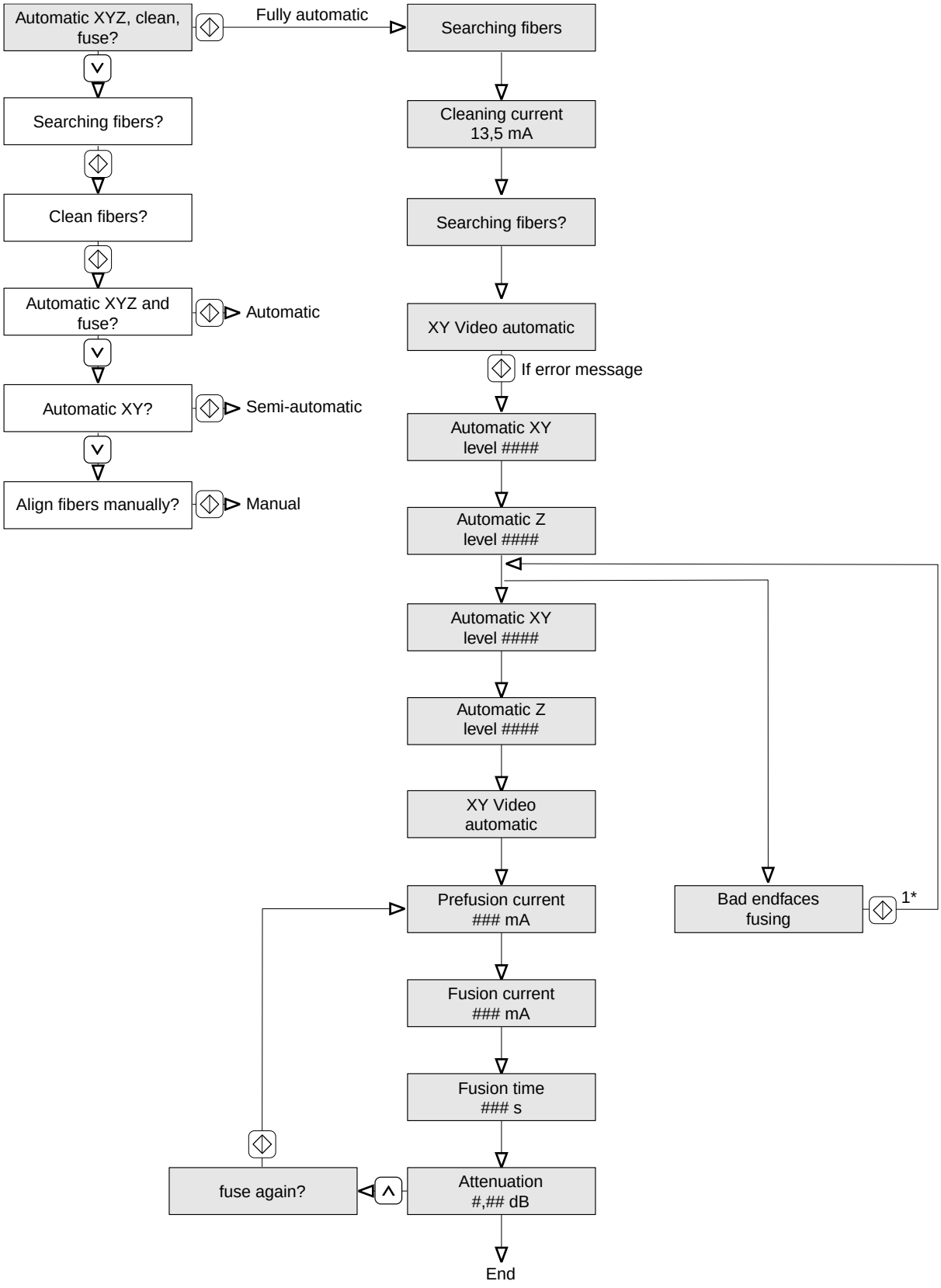


Attenuation splice



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Automatic Fusion / Fully Automatic



1* The attenuation indicator flashes if fusion is performed after the "Bad endface, fusing?" display.

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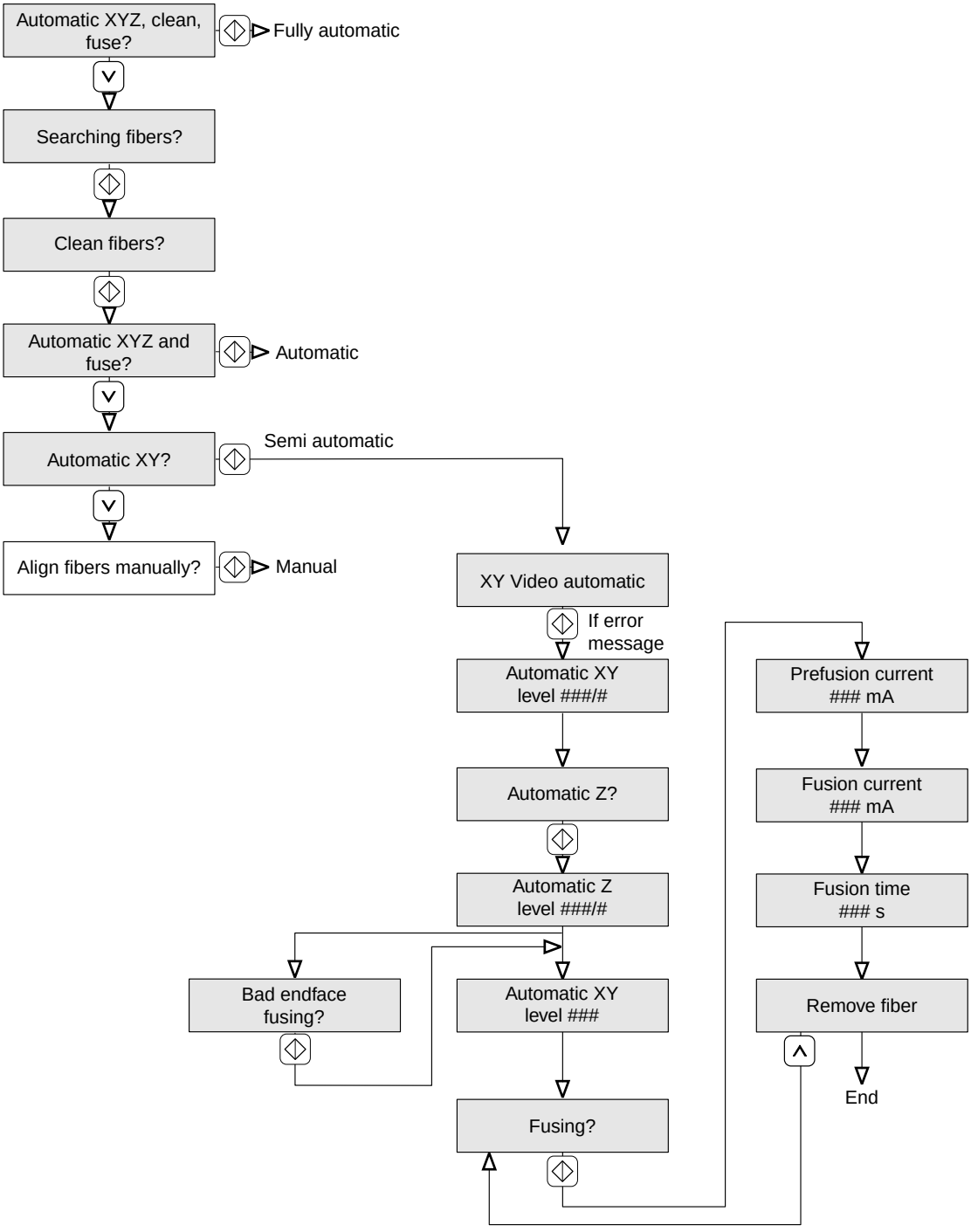
Automatic Fusion / Automatic



1* The attenuation indicator flashes if fusion is performed after the "Bad endface, fusing?" display.

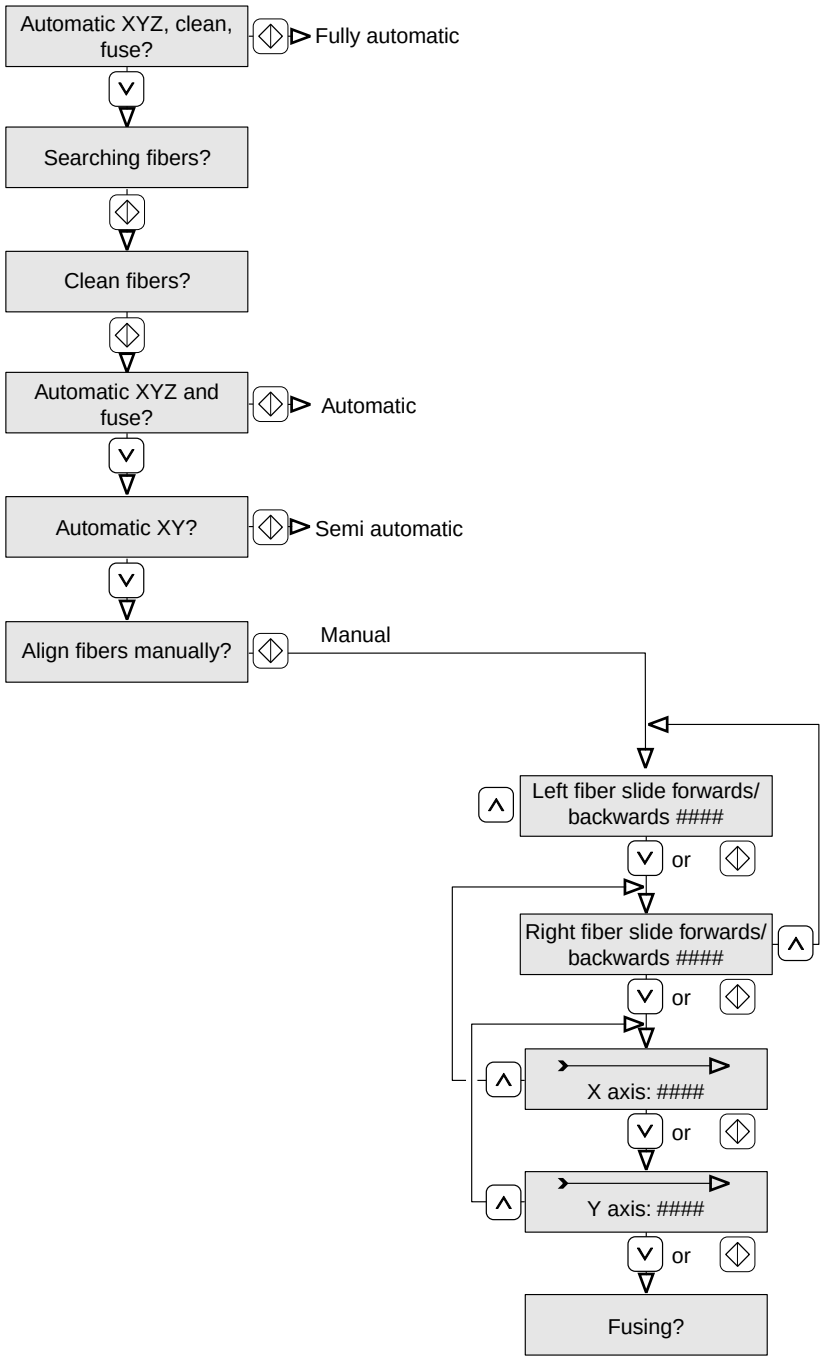
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Automatic Fusion / Semi-Automatic



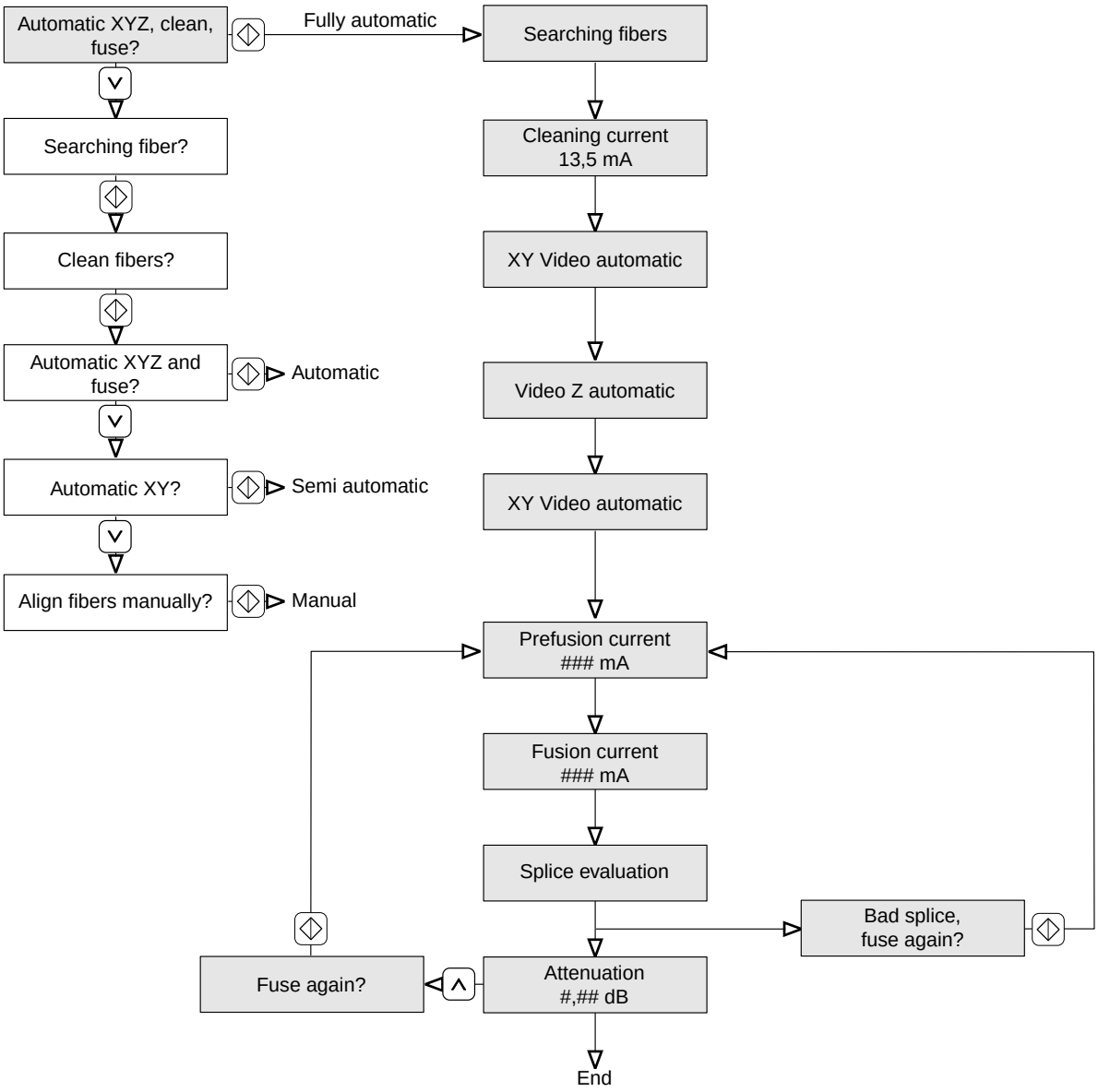
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Automatic Fusion / Manual



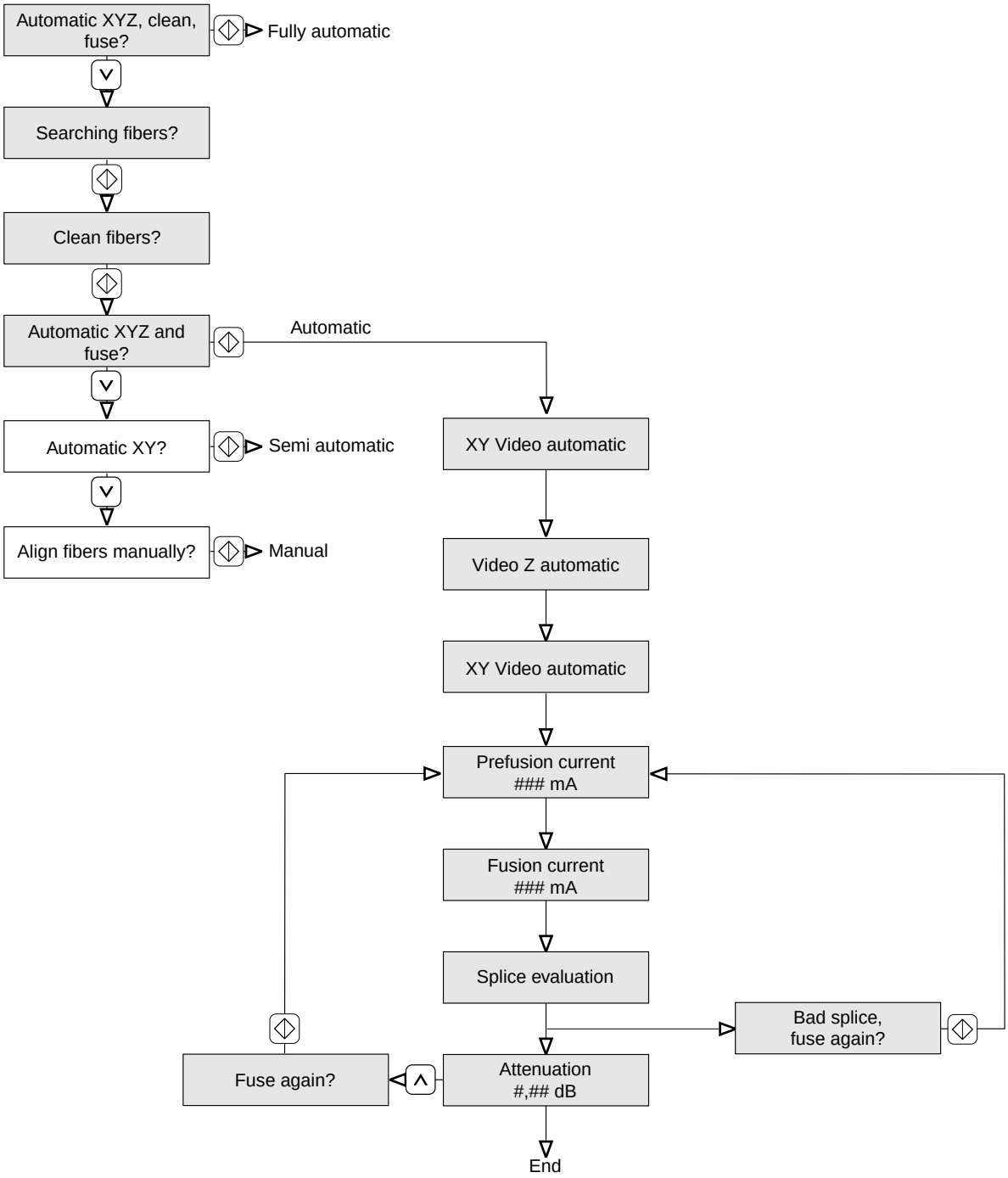
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Fixed Parameters (Video) / Fully Automatic



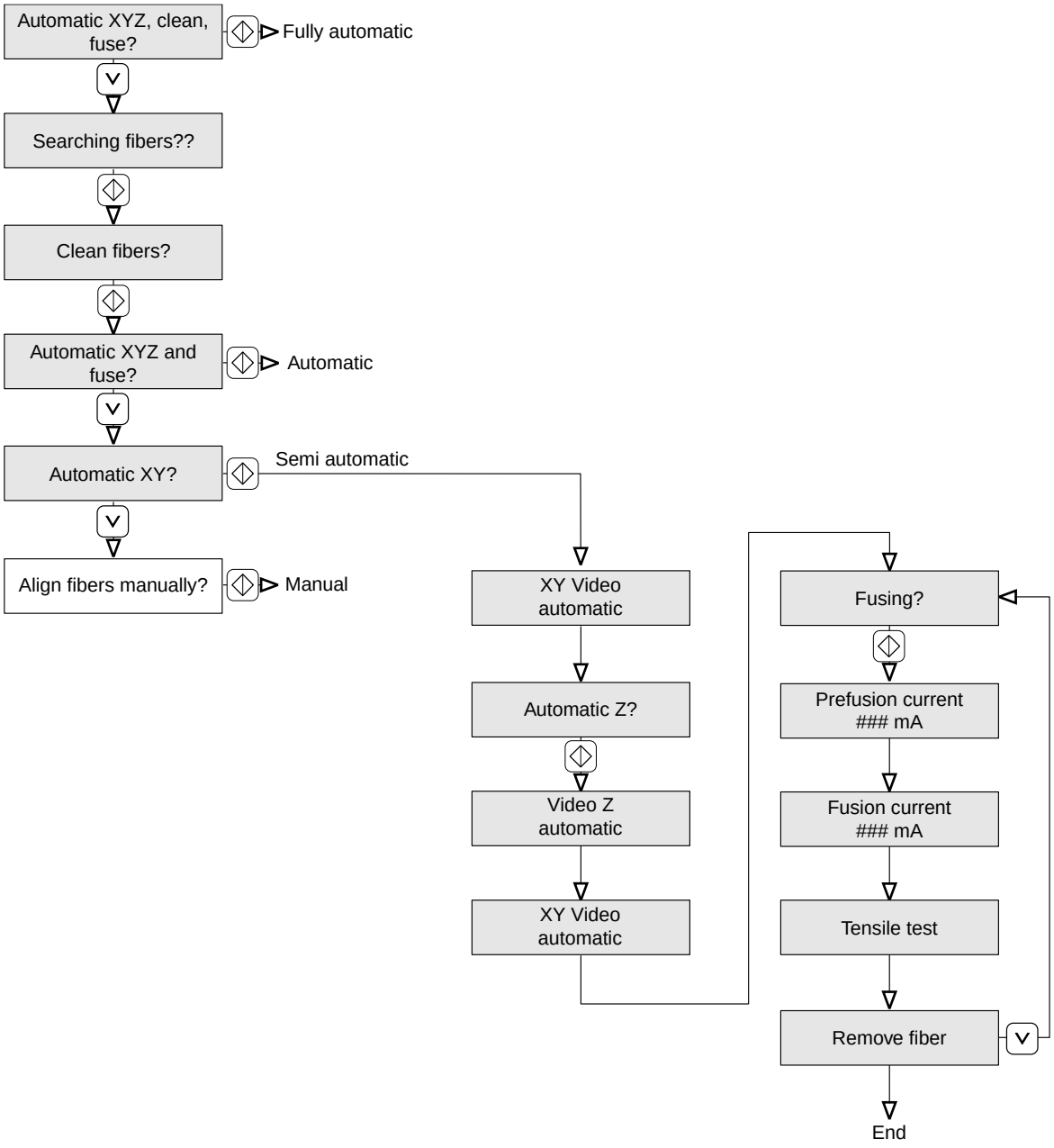
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Fixed Parameters (Video) / Automatic



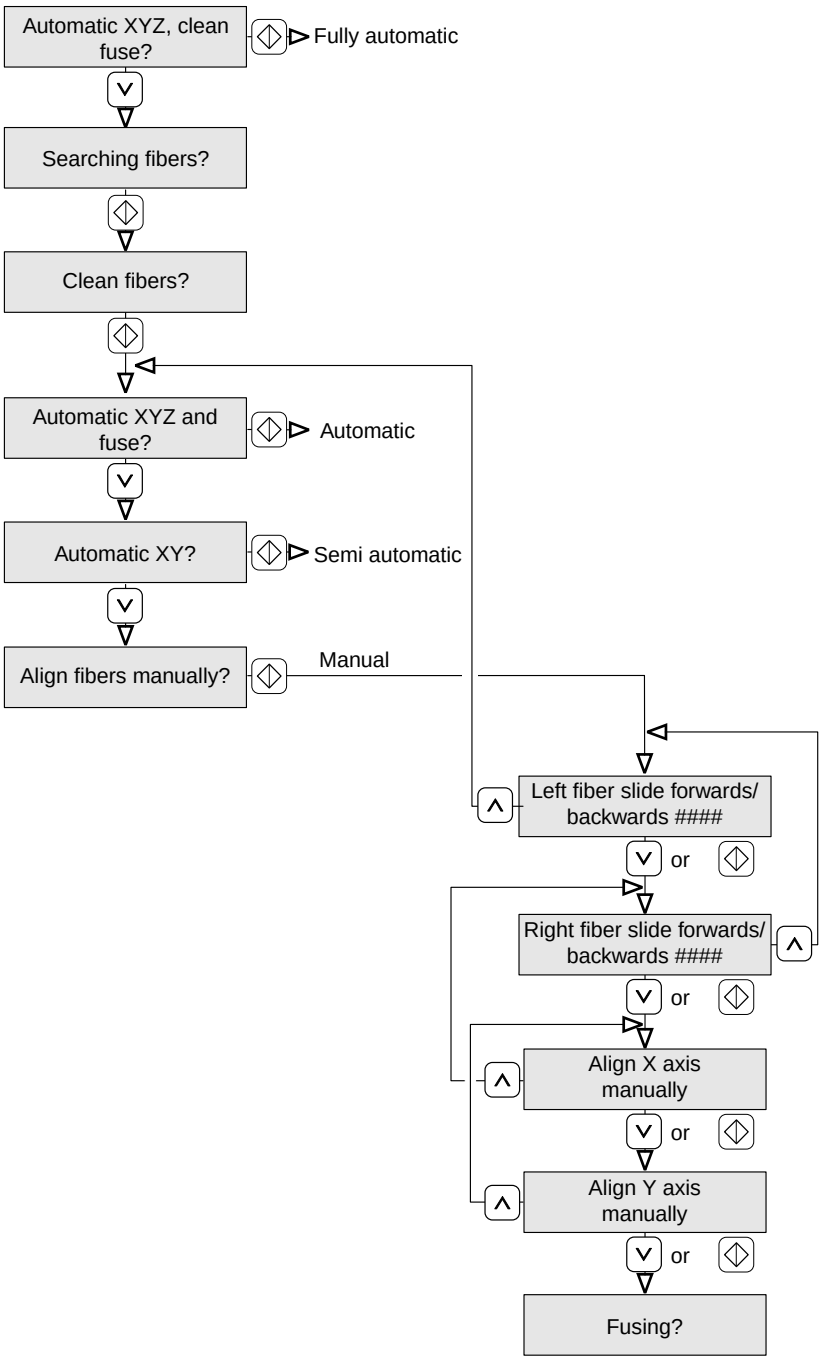
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Fixed Parameters (Video) / Semi-Automatic



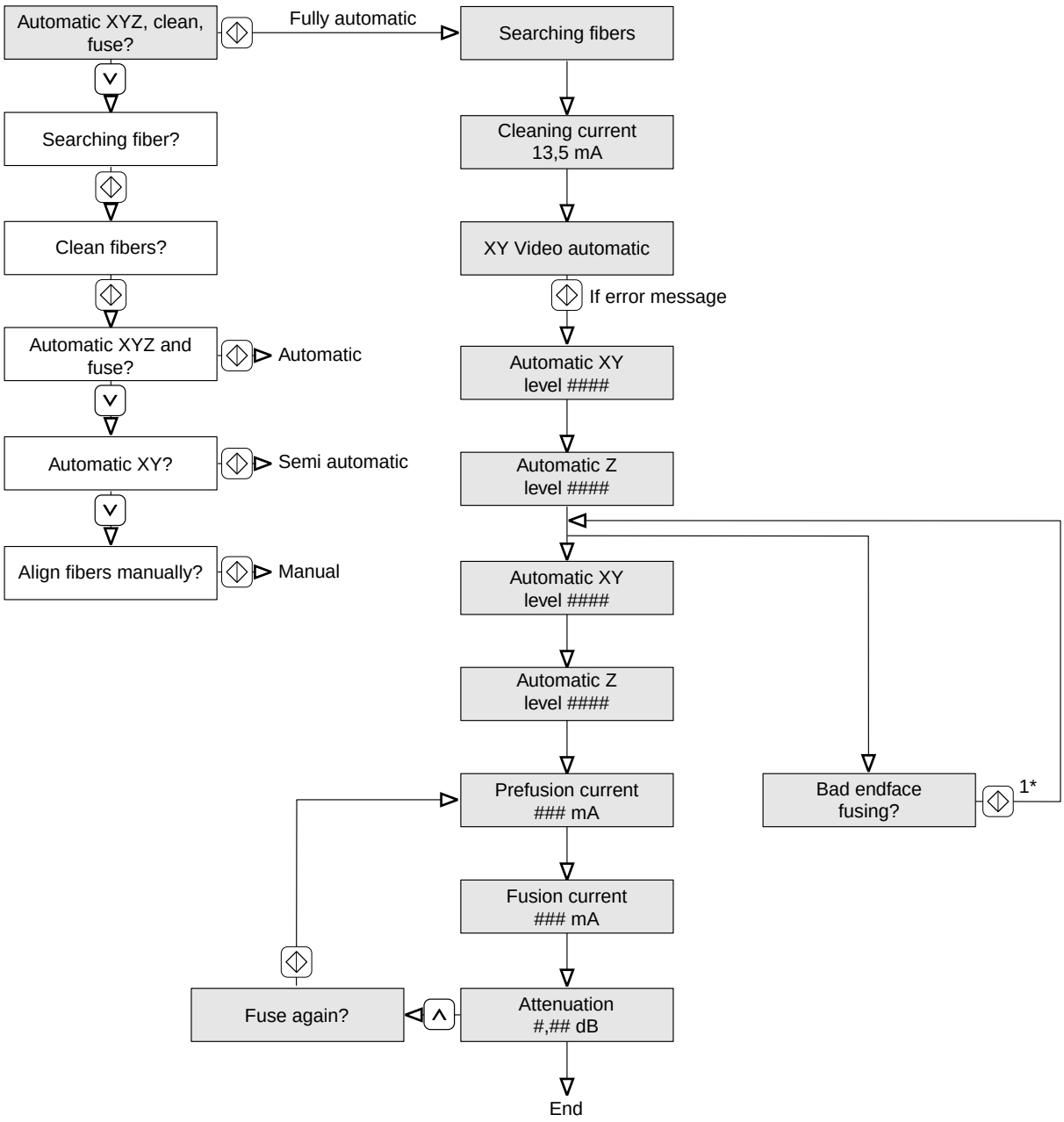
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Fixed Parameters (Video) / Manual



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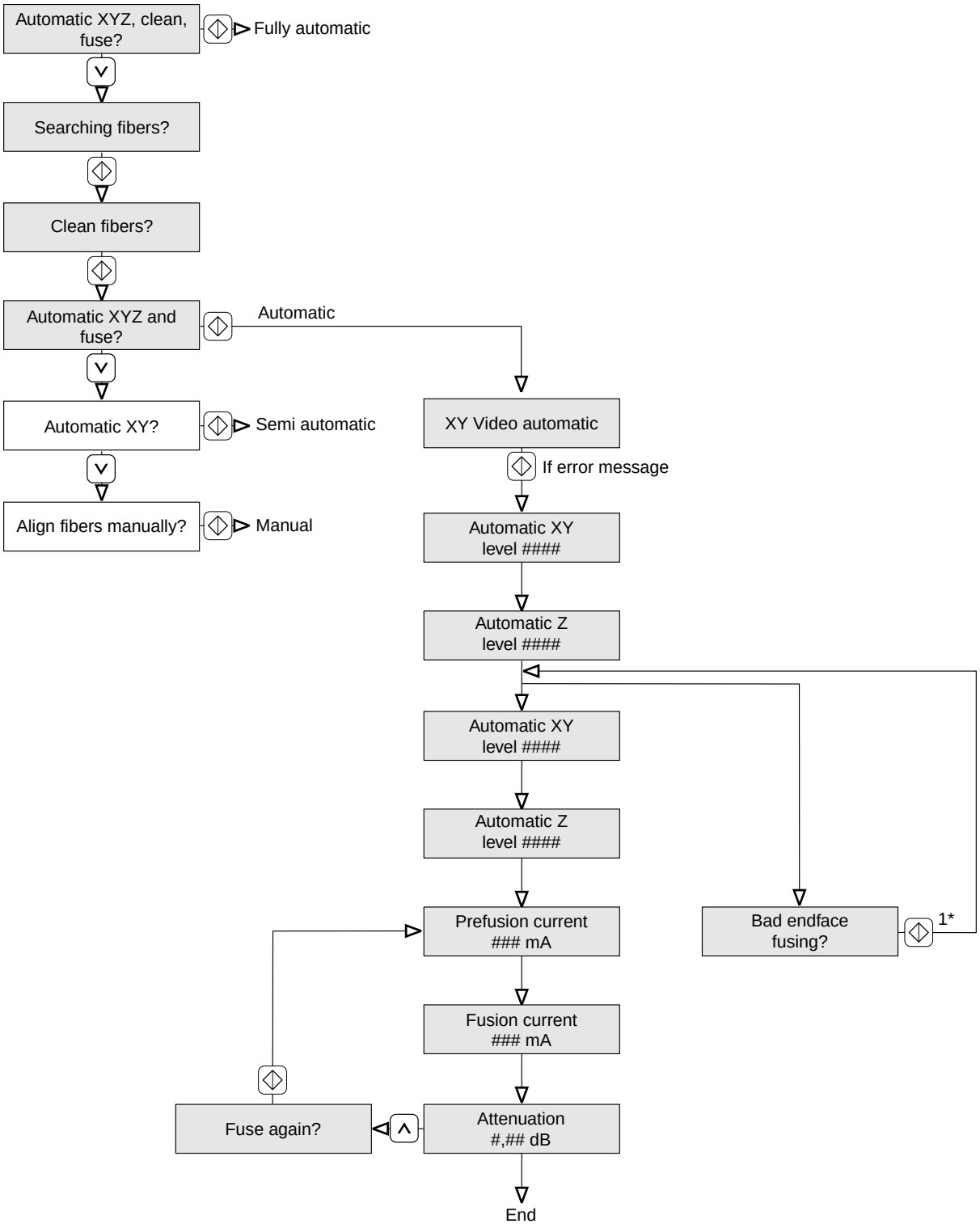
Fixed Parameters (LID) / Fully Automatic
Variable Fusion Curve / Fully Automatic



1* The attenuation indicator flashes if fusion is performed after the "Bad endface, fusing?" display.

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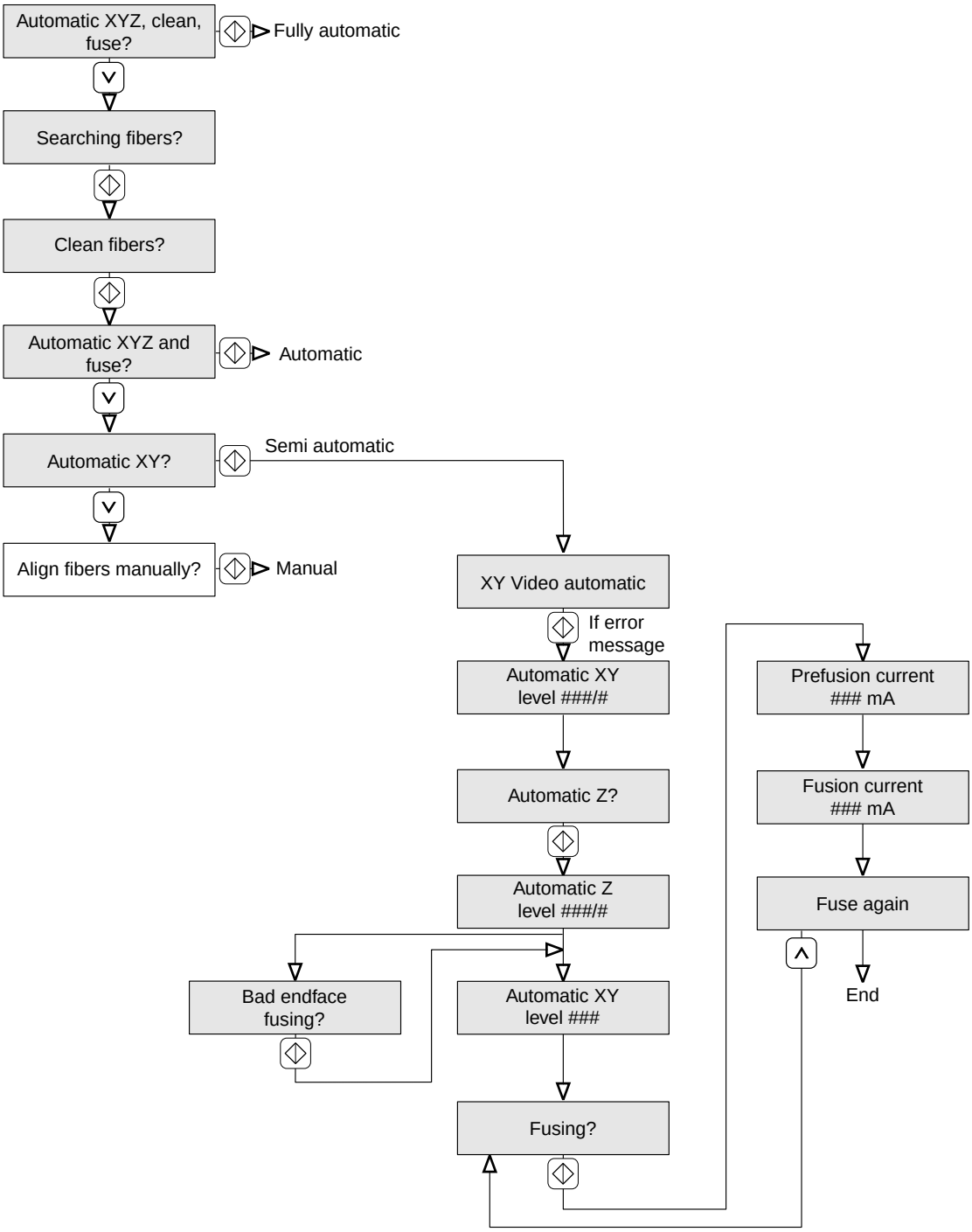
Fixed Parameters (LID) / Automatic Variable Fusion Curve / Automatic



1* The attenuation indicator flashes if fusion is performed after the "Bad endface, fusing?" display.

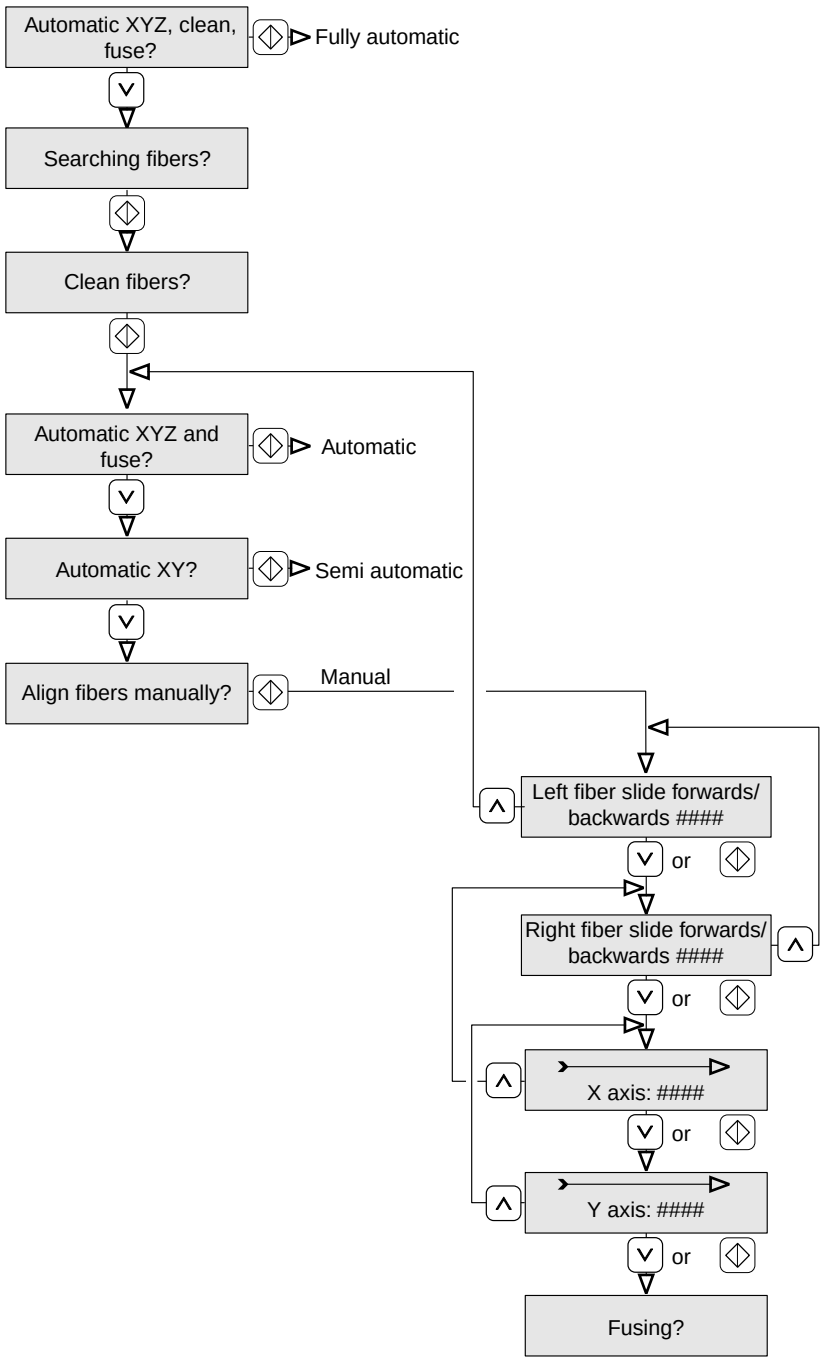
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Fixed Parameters (LID) / Semi-Automatic
Variable Fusion Curve / Semi-Automatic



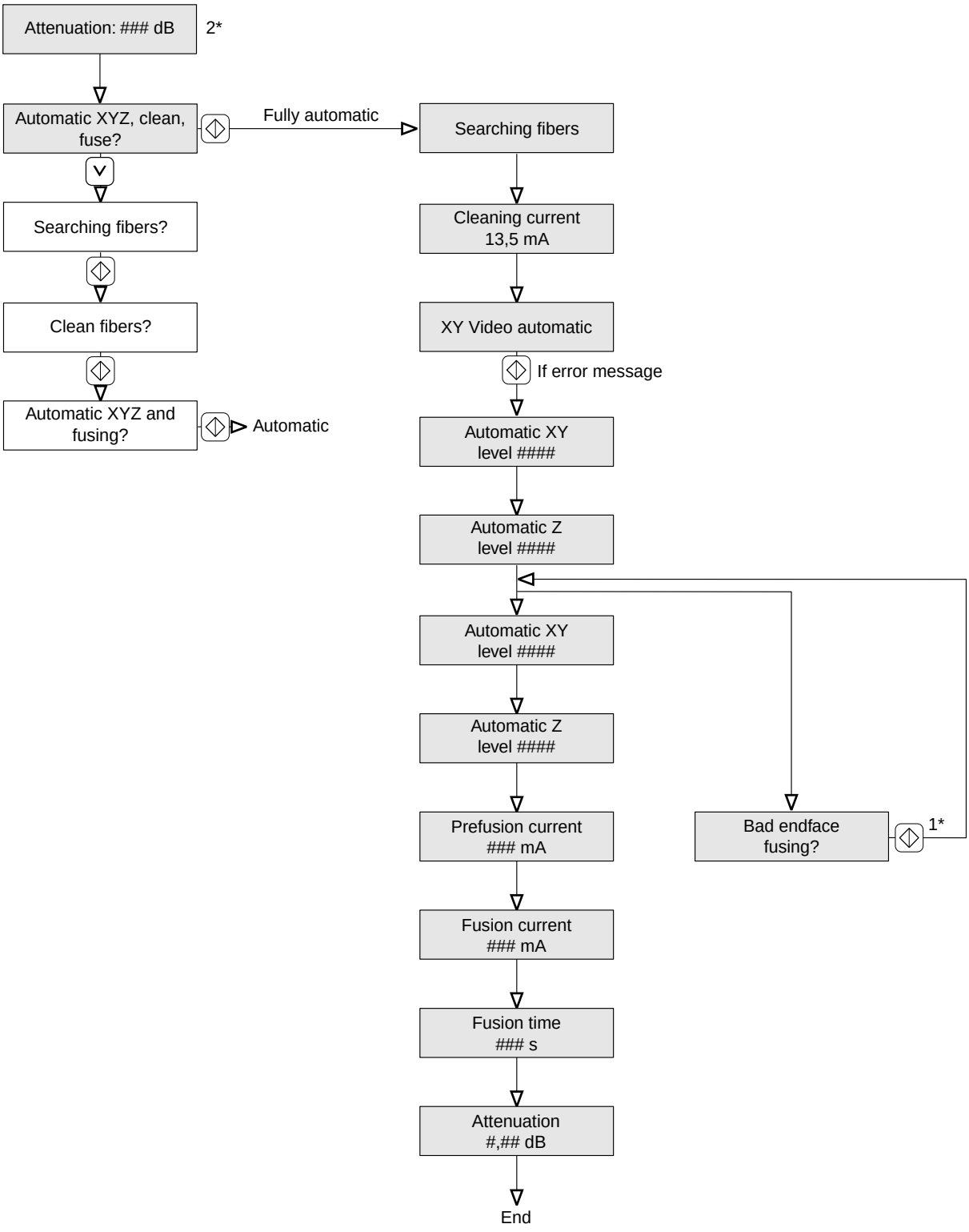
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Fixed Parameters (LID) / Manual
Variable Fusion Curve / Manual



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Attenuation Splice / Fully Automatic

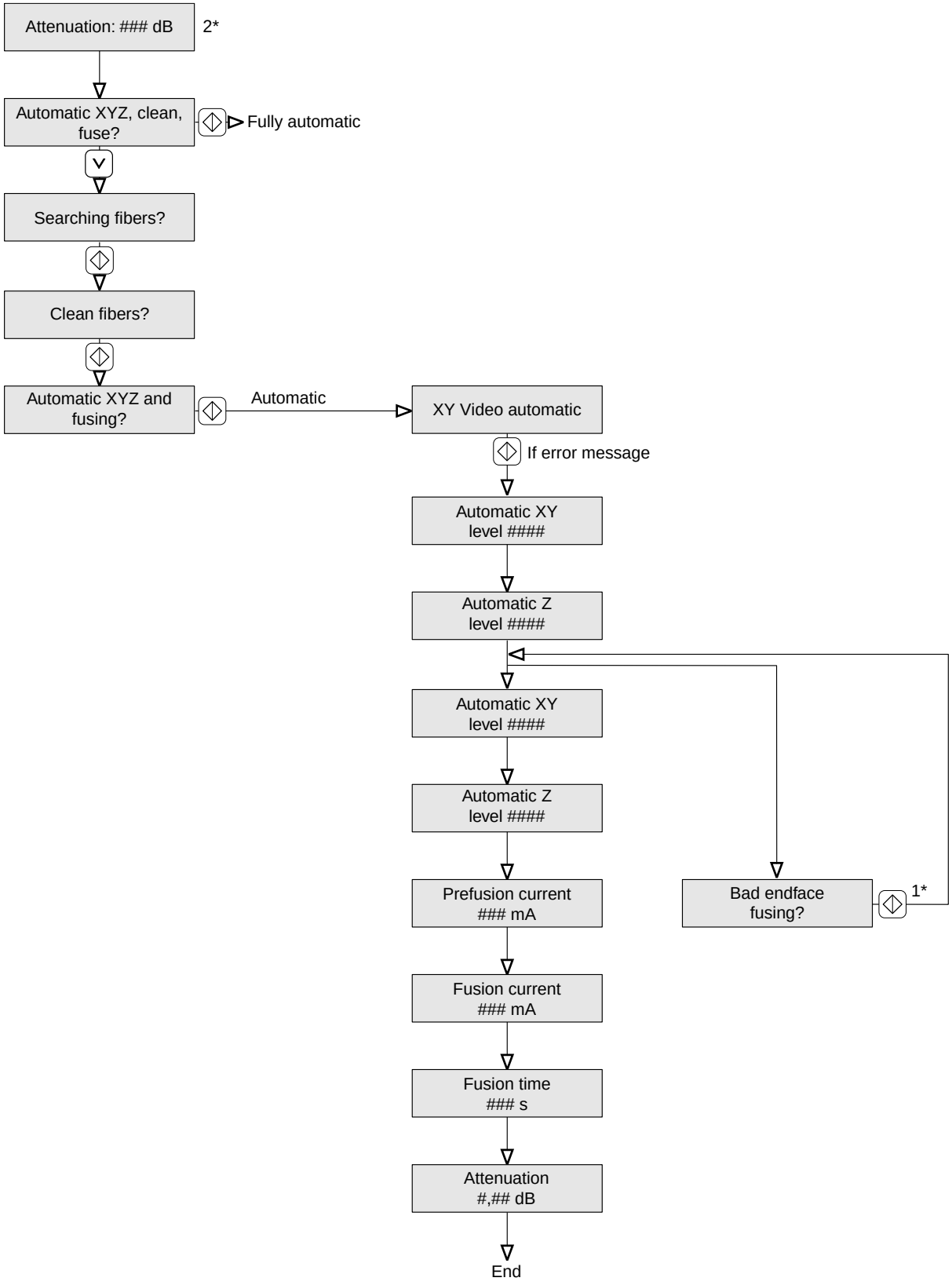


1* The attenuation indicator flashes if fusion is performed after the "Bad endface, fusing?" display.

2* Change required attenuation with button ⊞ or ⊟ and confirm with button ◈.

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Attenuation Splice / Automatic



1* The attenuation indicator flashes if fusion is performed after the "Bad endface, fusing?" display.

2* Change required attenuation with button ⊞ or ⊟ and confirm with button ◈.

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Positioning

The following measurements are performed during the positioning process:

- Detection of interfering light
- Assessment of end face quality
- Detection of end angle

Detecting interfering light

Interfering light will cause positioning and measuring errors in the LID programs. It is produced by interference between the LID transmit signal and signals from external devices (e.g. active OTDR)

If interfering light is detected, "Attention interfering light!" is displayed on the monitor and the current operation is stopped. Switch off the source of the interfering light.

Reselect the sequence that has been halted by pressing button ⌒.

Start the selected sequence by pressing button ◇.

Assessing the end face quality

This measurement is performed in all programs if the fibers are fused in fully automatic, automatic or semi-automatic modes.

If the video system detects dirt or end angle errors totalling in excess of 2.3°, the message "fiber dirty or bad end faces" appears.

Fiber end faces which are poorly prepared will yield high splice losses and incorrect splice loss evaluation.

Detecting the end angle

In the case of single-mode fibers in LID programs, the splicer detects fiber end angle errors that are overall > 2°. The monitor then displays "Bad endfaces".

If one of these fault messages appears, you should then prepare the faulty end face again.

If you press button ◇ instead, you will instruct splicing to continue. This is indicated by the attenuation indicator flashing. The displayed splice loss may be incorrect.

Fusion using End Face Preparation with low-cost Cleavers

Generally, it is also possible to operate the splicer using low-cost cleavers to prepare the end faces.

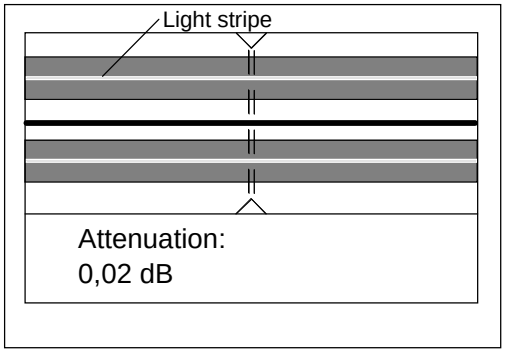
All programs can be employed. The inaccuracy in the attenuation display can generally be expected to be greater in such cases. In the case of the "Attenuation-splice" program, this may be **additionally** accompanied by increased inaccuracy in the attenuation actually attained. If "Bad endfaces" is displayed on the monitor, press button ◇ to continue the fusion process. The splice loss displayed after fusion may have a much greater error. This is indicated by the display flashing. In such cases, measure the splice point with an external test set to determine the exact splice loss.

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Assessing the Splice and Repeating Fusion

Visual assessment

The cladding glass has a smooth surface if the splice is good. The cores are not visible on the monitor, however. The bright stripe in the middle of the fiber is the result of the lens effect of the fiber.



Good Splice

Splice loss indication with LID

Splicing programs with activated LID system display the splice loss in dB in the automatic and fully automatic modes (in the case of single-mode fibers). The accuracy is +/- 0.05 dB for standard single-mode fibers.

Multimode fibers

Accurate measurement of the splice loss is not possible due to the undefined mode distribution in multimode fibers. Consequently, the display merely indicates whether the splice loss is ≤0.10 dB or > 0.10 dB.

Splice assessment with video programs

In the automatic and fully automatic mode the finished splice is analyzed following the fusion process. The splice point is examined first for enlargements or constrictions as well as homogeneity. In the event of a fault, the monitor displays "Bad splice, fuse again?" and the opportunity will be given to repeat the fusion process.

You can repeat fusion by pressing button ◇.

If the splice appears in order, the splice loss is calculated and displayed in dB. The splice loss calculation provides accurate results if the following conditions are satisfied:

- The fusion parameters must be correct.
- The fibers used must be of good quality in terms of the eccentricity of the core relative to the outer contour.

Troubleshooting

Section 7 provides examples of poor splices, their possible causes and the relevant remedies.

Fuse again

"Fuse again" is an aid to parameter optimization and to enhancing the splicing results if the set fusion time was too short or the fusion current too low.

When button ⌒ is pressed, the question "Fuse?" or " Fuse again?" appears on the display. This allows you to perform repeat fusion, i.e. to re-ignite the arc. The splice loss achieved is displayed after that.

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Tensile Test

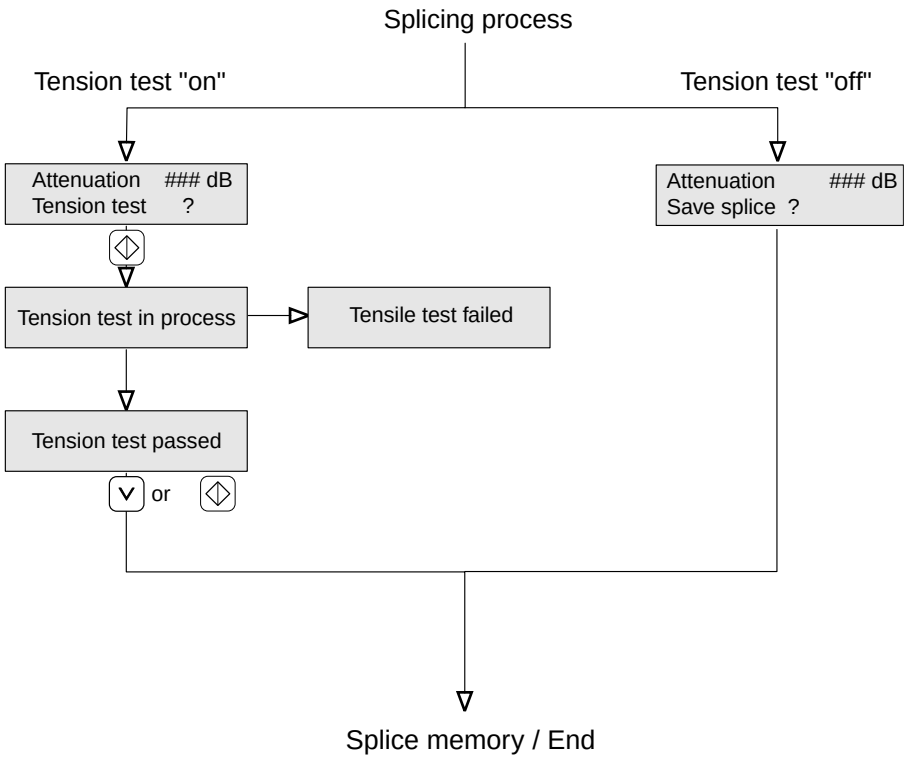
Tensile force

The splicer allows the user to check the splice for tensile strength.

Activating the tension test

The tensile test can be switched on and off in each program group except "Attenuation splice" (see section 3).

The program sequences with the tensile test switched on and switched off are shown below.



Test results with tension test activated

- "Test passed" if test result positive
- "Tension test passed" if test result negative
- "Test ended" if fibers not LID-compatible

> Note
>
> For the tensile test, it is essential, even in the video programs, for the fiber to be inserted into the LID system straight through (without looping between the LID flap and holder flap) and for all flaps to be closed.
>
> If you have left a loop between the LID and holder flaps (in the case of depressed inner cladding fibers), insert the fibers into the LID system without loop before performing the tension test.

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Splice Memory

Activating the splice memory

The splice memory can be activated under "Options" in the Parameter menu (see page 3-9). Up to 1023 results can be stored. They can be printed out via the RS 232c serial interface or transferred to a computer with a standard terminal program for further processing.

> Note
> If the splice is removed before the tensile test, the result cannot be stored in spite of the splice memory being activated.

Displaying the splice memory on the monitor

If you "page" right through the splicing sequence by repeatedly depressing the button; the contents of the splice memory will be displayed on the monitor.

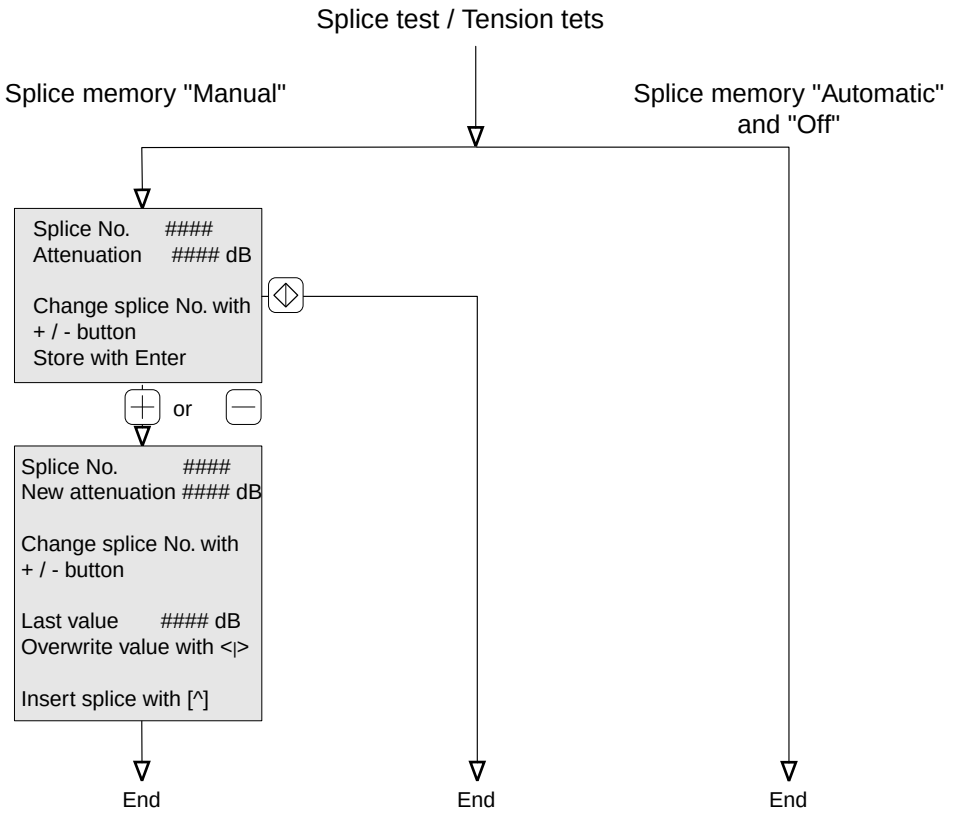
```
No.   Program   No.  dB
####  sm LID     1    ###
####  sm LID     1    ###
####  sm LID     1    ###
####  sm LID     1    ###
####  sm LID     1    ###
####  sm LID     1    ###
[+] Page forwards
[-] Page back
```

If the attenuation value flashes, this means that the splice has been made despite an end face error. This tells you that the deviation from the actual attenuation value can exceed 0.05 dB.

Updating the splice memory by hand

If you have set "Manual save" in the parameter menu, you can decide yourself after splicing whether and where the given splice is stored.

If you subsequently repeat a poor splice, you thus have the opportunity to store the new attenuation value either instead of or in addition to the old value.



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The ⊞ or ⊟ button can be used to select any desired splice number. The last attenuation value is displayed for the selected splice number.

- The ◇ button overwrites this value with the new attenuation value.
- The ◇ button also saves the new attenuation value under the **same** splice number.

Printing out the splice values

The printer and splicer used must be set to the same data transmission speed (see section 3). The splicer's serial interface employs the XON/XOFF protocol. Data transmission is asynchronous with one start bit, eight data bits and one stop bit. The parity bit is not used. The baud rate can be set to the following values:

9600, 4800, 2400, 1200, 600, 300 and 150 Bd.

The settings are changed by means of the ⊞ and ⊟ buttons.
The value is confirmed with the ◇ button.

Printer cable

RS 232c cables can be obtained from trade outlets as "computer - computer"-connections.

The cable used must have the following connections:

Wiring of the printer cable

Fusion Splicer (9-pin cable plug)	**Printer or Computer** (9-pin cable socket)	**Fusion Splicer** (9-pin cable plug]	**Printer or Computer** (25-pin cable socket)
RxD 2 — 2 RxD TxD 3 — 3 TxD GND 5 — 5 GND		RxD 2 — 2 TxD TxD 3 — 3 RxD GND 5 — 7 GND	
Pin Assignment 9 - 9-Pin		*Pin Assignment 9 - 25-Pin*	

Removing the Splice

Note

Observe the sequence!

1. Open flaps of LID system.
2. Open electrode flap.
3. Open fiber holder flaps.

Approx. 5 seconds after the flaps are opened, the splicer outputs the message "Insert fiber, end faces o.k.?" to report that it is once again ready to commence splicing.

All flaps must be opened **and the fibers removed straightway,** since the slide returns to its home position 5 seconds after the electrode and LID flaps are opened.

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Attenuation Splice

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Attenuation Splice with Standard Single-Mode Fibers

If you want to make attenuation splices **with standard single-mode fibers**, you merely need to read the section "Making an Attenuation Splice" from the next page onwards. There, you will also find references to further information if you do **not** obtain the required results.

Description of the Attenuation Splice Program

The attenuation splice program allows you to set the required attenuation over the range 0 to 10 dB in 0.1 dB steps. This attenuation is then implemented and displayed fully automatically by a special fusion sequence.

In the case of attenuation splices, **no tension testing** of the finished splice is performed.

Fiber Types that can be Used

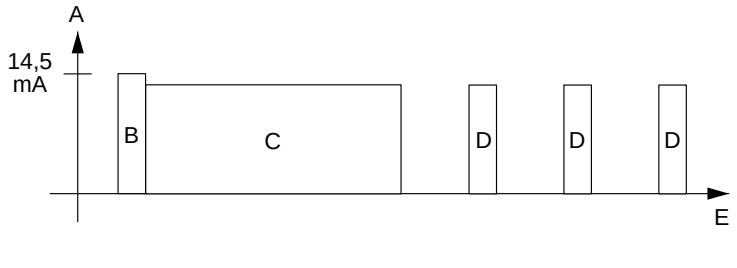
Since the attenuation obtained is checked by means of the LID system, certain restrictions apply with regard to the fibers used:

- The attenuation splices can only be made between ***single-mode fibers.*** The process is not suitable for making attenuation splices between multimode fibers.
- The fibers used must be ***LID-compatible,*** i.e. the nominal coating diameter must be 250 µm and the coating must be transparent at a wavelength of 1300 nm.
- The best results are achieved with ***standard single-mode fibers***. The parameters may need to be modified if other fiber types are used.
- With the "***depressed inner cladding***" type of fiber an excess fiber length must be left between the fiber holders and the LID flaps for correct attenuation measurement as well as for normal splicing (see section 2). It is then possible to make attenuation splices with this fiber type also. For these fibers, refer to the notes in section *Parameter Recommendations*.
- Attenuation splices are also possible between ***dispersion-shifted single-mode fibers*** if appropriate *parameter settings* are used and provided the LID level is not too low. It has to be noted that the attenuation measurement in the fusion splicer is performed at 1300 nm, i.e. beyond the single-mode operating wavelength of dispersion-shifted fibers. The actual attenuation of the attenuation splices at both 1300 nm and 1550 nm may thus deviate from the display value by more than the error limits set out in the *Technical Specifications*. If you wish to form attenuation splices between dispersion-shifted fibers, it is therefore advisable to carry out tests first, measuring the attenuation actually obtained for the wavelength of interest. The inaccuracy can be compensated in part by entering a suitably corrected required value so that the actual splice attenuation then corresponds to the required value.

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Operation of the Attenuation Splice Program

The fibers are positioned in the same way as with all LID programs. Immediately before it commences fusion, the fusion splicer automatically sets a radial offset of the fiber axes. The fusion process consists of an initial fusion phase followed by one or more fusion pulses and runs fully automatically until the required attenuation is reached (see drawing).



A Fusion current
B Prefusion
C First fusion phase
D Fusion pulse
E Time

Fusion Process

Making an Attenuation Splice

Setting the default parameters

The default parameters stored in the fusion splicer provide the basis for all parameter settings. You can set these parameters (for all programs jointly) by keeping button ◇◇ depressed when you switch on the splicer. Please note, however, that you will then lose the set parameters of all programs.

Program selection and adapting the parameters

Use the Parameter menu to select the attenuation splice program and set the "Attenuation" parameter to the required value. If you have set the default parameters and are using standard fibers, you do not need to perform any further parameter settings at this point. If you do not wish to set the default parameters or are using special fiber types, refer to the Parameter Recommendations section.
Conclude parameter setting with button P.

Preparing fibers

If you use a heat-shrink splice protector, slide this over one of the two fibers. The fibers are stripped, cleaved and inserted in the same way as with all other LID programs.

Setting the required attenuation

Start the program by pressing button ◇◇. The set attenuation will be displayed. To change the value, use buttons ⊞ and ⊟. This change then applies for the next splice only. (You can change the default value in the Parameter menu.)

Starting the splicing procedure

Start the splicing procedure in the usual way. You can only select fully automatic / automatic operation.

Fault message "Bad endfaces"

If the fault message **"Bad endfaces"** is displayed during positioning, you can still continue the splicing process. In this case, however, you must expect an additional inaccuracy of approx. 0.1 to 0.2 dB in the attenuation displayed rsp. in the attenuation value obtained. Press button ◇◇ if you want to continue the splicing process or abort the procedure with button △.

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Fusion sequence

The first fusion phase takes the same form as in the other programs. Up to 20 fusion pulses are then generated at intervals of approx. 1 s until the required attenuation is reached.

Level display

After the first fusion phase and after each fusion pulse, the current LID level and the target value are displayed as relative level values. This display serves solely as an aid to parameter optimization. Further information can be found in section "Possible Problems". The displayed levels are unimportant for normal operation.

Attenuation display

After fusion has been completed, the attenuation obtained is measured and displayed. If this value deviates from the required value by more than the amount given in the "Technical Specifications", refer to the notes lower down in this section.

Splice protection

Remove the fibers and fit the splice protection. Refer to the section "Splice Protection".

Attenuation too low

If the attenuation is already below the required value after the first fusion phase, no fusion pulses will be generated and the value reached is displayed. Correct the parameters as described in section "Possible Problems". The same applies if the fusion pulses are generated but the attenuation reached is still too low.

Attenuation too high, repeat fusion

If the attenuation is still significantly over the required value after 20 fusion pulses, the procedure is terminated and a question mark appears after the displayed levels. The displayed attenuation is higher than the required value. You can then attempt to improve the result by fuse again. This is particularly likely to be successful if the displayed actual value has risen significantly after each fusion pulse and the attenuation differs only slightly from the required value.
To perform fuse again, press buttons ⌓ and ⌔ in succession.
Up to 20 new fusion pulses are then generated. If you are still unable to obtain the required attenuation or if you have to perform repeat fusion frequently, this is a sign that the parameters need to be corrected as described in section "Possible Problems".

Splice Protection

Standard crimping and heat-shrink splice protectors are of only limited suitability for protecting attenuation splices since they can impair the temperature stability of the attenuation splice. Depending on the requirements on the attenuation temperature stability, heat-shrink splice protectors must be used which employ a stabilizing support made of glass.

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Parameter Setting

The parameter record for the attenuation splice program contains the same parameters as in program group "Automatic fusion time". Parameters *attenuation, additional time* and *lead* have been added.

Procedure for determining the optimum parameters

- For initial attempts, use the **default parameters** or the values set out in the "Parameter Recommendations" section.
- If this does not yield good results, follow the procedure set out in section "Possible Problems".
- If you still fail to get good results, the following section shows you the effect of changing the individual parameters.

Significance of the additional parameters

Attenuation

Setting range 0 to 10 dB: This is the default setting for the required attenuation and is displayed as the first menu item prior to each splice.

Additional time

Setting range 0 to 0.5 s: This value affects the length of the fusion pulses. The default value is 0.15 s. The value must be increased if the 20 fusion pulses are not sufficient to attain the required attenuation even though the lead has been set correctly. The value must be reduced if the attenuation is well below the required value after one or more fusion pulses. If the additional time is set appropriately, the required attenuation is attained to within an accuracy of approx. 0.1 dB (display value).

Lead

Setting range 0 to 100 %: This value determines the attenuation at which the first fusion phase is terminated. The default value is 30 %. This means that, for example, for a 5-dB splice the target for the first fusion phase is 6.5 dB.
The *value must be increased* if the actual attenuation falls below the required value after the first fusion phase.
The *value must be reduced* if the number of fusion pulses required becomes too high or 20 fusion pulses are insufficient to attain the required attenuation.

Other parameters

The other parameters - with the exception of the fusion current - are to be set to the values determined for a standard splice:

Fusion current

The fusion current applies for the first fusion phase and for the fusion pulses. It is generally set 0.5 mA lower than for a standard splice. The default value is 14.5 mA. If fusion times below 1 s or over 6 s are regularly obtained for the first fusion phase, the fusion current must be reduced/increased slightly. The **prefusion current** is selected in exactly the same way as for a standard splice (default value 14.5 mA).

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Parameter recommendations for different fiber types

The parameter settings suggested here have been tried and tested with fibers from different manufacturers. If you are unable to obtain satisfactory results, proceed as described in section "Possible Problems".
The default parameters stored in the fusion splicer provide the basis for all parameter settings. These correspond to the values in the "Standard Single-Mode Fiber" column in the following table. You can set all default parameters simultaneously by holding button ⏀ depressed while you switch on the splicer. Note, however, that this will overwrite the parameters you have also set for the other fusion programs.

Fiber Type Parameter	Standard Single-Mode Fiber	Depressed Inner Cladding	Dispersion-Shifted Single-Mode Fiber
Cleaning current	14.5 mA	14.5 mA	14.5 mA
Cleaning time	0.1 s	0.1 s	0.1 s
Attenuation value	0 to 10 dB	0 to 10 dB	0 to 10 dB
Z-gap	7.0 µm	7.0 µm	7.0 µm
Autofeed	5.0 µm	5.0 µm	5.0 µm
Prefusion current	15 mA	15 mA	15 mA
Prefusion time	0.25 s	0.25 s	0.25 s
Fusion current	14.5 mA	14.5 mA	14.5 mA
Min. fusion time	1.0 s	1.0 s	1.0 s
Max. fusion time	10.0 s	10.0 s	10.0 s
Additional time	0.15 s	0.15 s	0.15 to 0.18 s
Lead	30 %	45 %	65 %

Parameter setting for special fiber types

If the fiber type you are using needs parameters which deviate substantially from the default parameters (even for normal splicing), determine suitable parameters as follows:

- Use the **Automatic Fusion Time** program to determine the parameters for obtaining good splice losses. The fusion current should be selected so that the displayed fusion time lies between 2 s and 4 s.
- Set the same parameters in the **Attenuation Splice** program.
- Set the required value for the attenuation.
- Reduce the fusion current by 1 mA.
- Set the lead to 30 % and the additional time to 0.15 s.
- Make an attenuation splice with these parameters.
- If you do not get satisfactory results, proceed by using the check list set out in section "Possible Problems".

Dependency of the parameters on the required attenuation

If the parameters have been correctly set for the given fiber type, you should always get good results irrespective of the attenuation value selected. Only in a few particularly unfavorable cases may it be necessary to correct the lead to suit the selected attenuation.

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Possible problems

If the set attenuation is not obtained or the result is not sufficiently accurate, ensure first that all parameters except the fusion current are set to provide good splice attenuation results in the **Automatic Fusion Time** program. If this is the case, proceed as set out in the following check list. Keep to the specified sequence and check the effect of each change before proceeding with other changes.

Fault	Symptom/*Possible Cause*	Remedy
Attenuation too low. The fusion pulses are **not** generated.	*The electrodes are not inserted as far as they can go into the electrode holder or they are very dirty.*	Check and correct if necessary. The electrodes must be clean and inserted as far as they can go.
	The fusion current is set too high.	Ensure that the fusion parameters recommended for the given fiber type have been set. The fusion current is to be set 0.5 mA lower than for normal splices. Check the duration of the first fusion phase. The fusion current must be set so that it is applied for between 2 and 5 s.
	The lead is too low.	If the lead recommended for the given fiber type is set, increase this value in steps of 5 %.
Attenuation too low. The fusion pulses are generated.	The actual value displayed changes with each fusion pulse by a high percentage. *The fusion pulses are too long.*	Reduce additional time in steps of 0.02 s.
Attenuation value too high. The process is aborted after 20 fusion pulses.	The actual value displayed changes only slightly from one fusion pulse to the next. *The fusion current is set too low.*	Check the duration of the first fusion phase. The fusion current must be set so that it is applied for between 2 and 5 s. If this is already the case, the cause may lie in the additional time being too low (see below).
	After the first fusion phase, the actual value is very much smaller than the required value. The actual value rises markedly from one fusion pulse to the next but does not reach the required value. *The lead is too large.*	Reduce the lead in steps of 5 %. If the attenuation is then too low and no more fusion pulses are generated, set the old lead value again and increase the additional time in steps of 0.02 s.
	The displayed actual value changes only slightly from one fusion pulse to the next or falls. *The additional time is too short.*	Increase the additional time in steps of 0.02 s. If the attenuation falls below the required value by an excessive amount, the additional time was probably not too short but rather the lead was too large.

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Accuracy of the Attenuation Display

The displayed attenuation is referred to a wavelength of 1300 nm and can deviate for instrumentational reasons from the actual value, as is shown in the *Technical Specifications.* When using external test instruments to check the attenuation values obtained, e.g. ***OTDR,*** it should be noted that at relatively high attenuation values extreme measuring inaccuracies may occur. To ensure accurate measurements, the measuring instrument must be calibrated first over the range of the attenuation being measured.

Technical Specifications

This section relates only to the **Attenuation Splices** program. All measured values are based on a wavelength of 1300 nm and apply to **identical standard single-mode fibers.** For **dispersion-shifted single-mode fibers** refer to the notes in section "Fiber Types that can be Used" in this section. These also apply for other **special fiber types**.

The values in the table shown in *italics* are examples for a required value of 3 dB.

	Min.	Type	Max.
Attenuation selectable in 0.1-dB steps	0 dB	-	10 dB
Deviation actual value - required value *e.g. for required attenuation=3 dB*	- 1 % - 0.1 dB *- 0.13 dB*	+ 3 % *+ 0.09 dB*	+ 7 % + 0.1 dB *+ 0.31 dB*
Deviation actual value-display value (measuring accuracy) *e.g. for required attenuation=3 dB*	- 0.05 dB *- 0.05 dB*	+ 3 % *+ 0.09 dB*	+ 6% + 0.05 dB *+ 0.23 dB*
Temperature stability of attenuation in range -40°C to +85°C (with suitable splice protection) *e.g. for required attenuation=3 dB*	- 2 % *- 0.06 dB*	0 % *0 dB*	+ 2 % *+ 0.06 dB*
Return loss	60 dB	> 65 dB	-

All percentages in the table are based on the required value in dB.

It follows from the table that the actual attenuations obtained are, on average, 3 % above the required value and the display value. This deviation results from the measuring method used and depends on the fiber type employed. You can reduce the difference between the actual value and required value if necessary by entering a lower required value.

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Taking Out of Service

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Switching Off the Splicer

The splicer can be switched off from either the control panel or the mains switch.

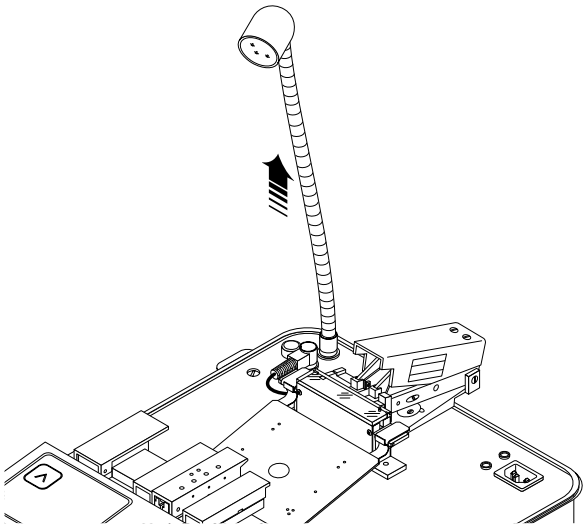
The splicer should be switched off at the control panel so that the fiber slides travel to the transport position. Do this by pressing buttons ⌃ and ⌄ simultaneously.

> Caution
>
> For transport purposes, the splicer must be switched off by pressing buttons ⌃ and ⌄ simultaneously.

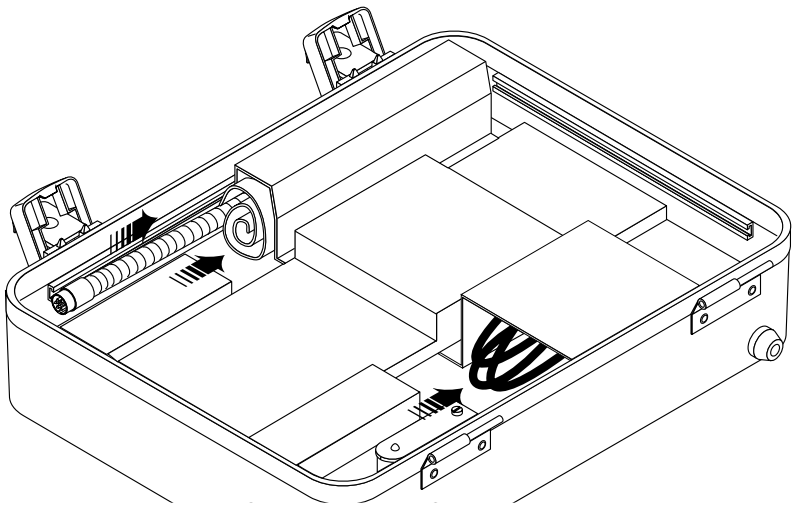
Working Light

Switch off the working light and pull it out of the socket.

Stow away the light in the case lid.



Pull the Working Light out of the Socket.



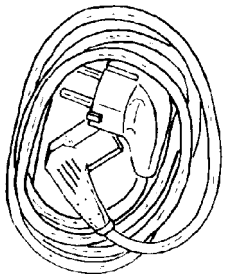
Stow the Working Light, AC Power Cord and Tool Set in the Case Lid

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AC Power Cord

Pull the AC power cord out of the splicer, coil it up and stow it away in the case lid.

Caution
The AC power cord must not project out of the holder.



Coil the AC Power Cord to a Diameter of Approx. 10 cm

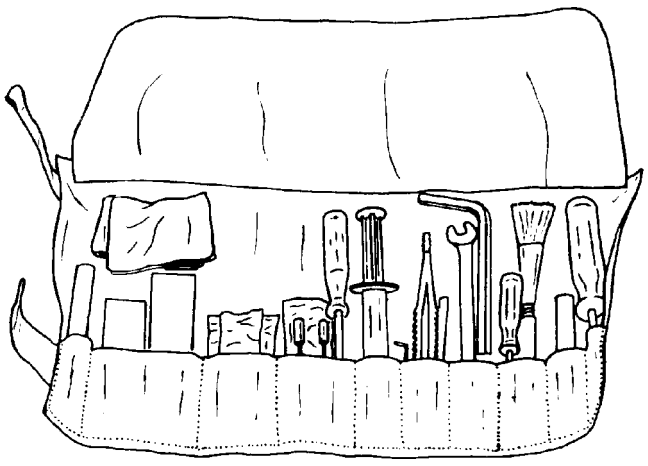
Cleaning the Splicer

Remove dirt and the remains of fibers. Clean the LID system (section 7).

Tools

Place the tools in the tool bag and stow this in the case lid (see figure on opposite page).

Caution
The tool bag must not project out of the holder.

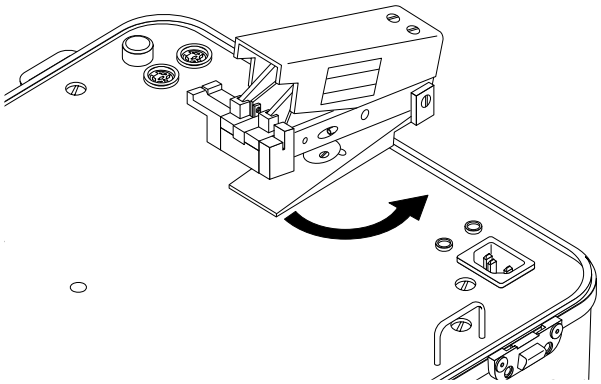


Place Tools in the Tool Bag

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Cleaver

- Turn the cleaver through 90° in counter-clockwise direction.
- Press the sprung flap inwards and, in doing so, let the cleaver fold down.

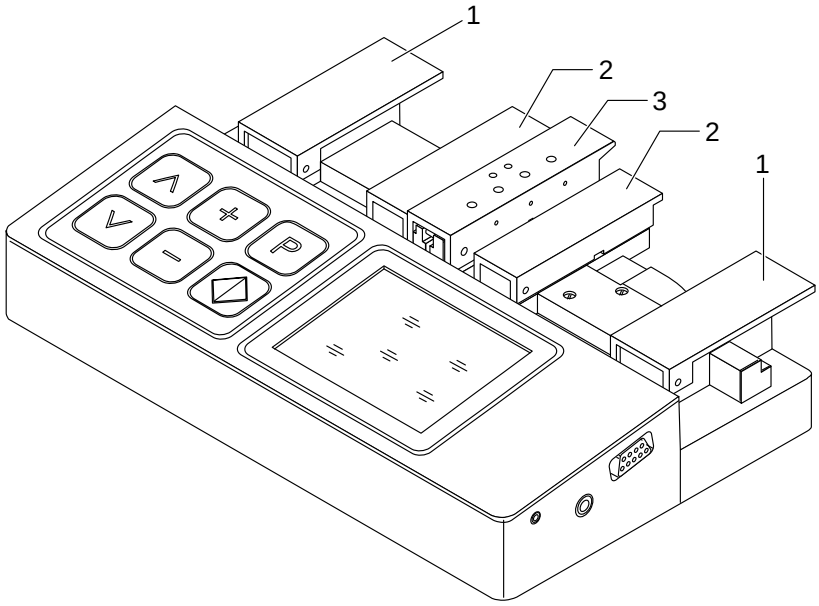


Move Cleaver to Transport Position

Are the Flaps Closed?

Close all the flaps of the fusion unit in the correct sequence:

1. Flaps of the LID system
2. Holder flaps
3. Electrode flap



Close the Flaps of the Fusion Unit

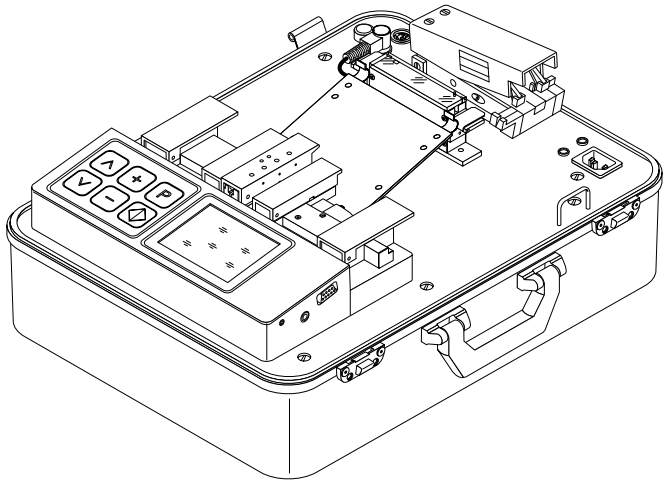
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Case Lid

- Before you close the case, check the following points:
  1. Has the cleaver been rotated through 90° and folded down (transport position)?
  2. Has the splicer been switched off (with buttons ⌃ and ⌄)?
  3. Have all flaps been closed?

- Hook the case lid into the hinges and close the case carefully.

Warning
Never use force to close the case. Ensure that all parts of the splicer are in transport position.



Transport Position without Lid

Note
For transport purposes, please use the light-metal transport container which is available as a special accessory.

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Troubleshooting

Basic procedure for troubleshooting and fault elimination

Proceed in the following sequence for faults or fault messages relating to the splicer:

- In the case of fault messages which occur once only, repeat the action in question. With the fault message "Bad endfaces", for example, restrip the fibers and recleave.
- If the problem is repeated, ensure that you are handling the fibers and operating the splicer as set out in the Operating Instructions.
- If you are unable to detect the cause of the fault or if the fault is repeated, the following subsection provides you with the possible causes of numerous problems and the measures you should adopt to remedy them.
- A number of the remedies set out below require extreme care and should only be performed by qualified personnel in a clean working environment. Perform this work yourself only if you are unable to make use of the service center, e.g. because of shortage of time, and if you are sure that the work can be performed correctly.
- Under no circumstances should you attempt to perform repair work which, according to the table, may only be carried out at the service center.

> Note
>
> You should take due care when troubleshooting.
>
> The manufacturer assumes no liability for damage as a result of the following work being performed incorrectly.

Parameter optimization for single-mode fibers

> Note
>
> Parameter optimization requires the electrodes to be in sound condition. Accordingly, first check the electrodes.

The procedure for parameter optimization described in the following sections is suitable for all commonly used single-mode fibers.

Accessories required

The M90 measures the splice loss using the LID system and the power through method. As a result the attenuation displayed is independent of the set parameters. The parameters can thus be optimized without additional test equipment.

If the LID is not usable, an external attenuation test set is required (e.g. an **OTDR** - **O**ptical **T**ime **D**omain **R**eflectometer).

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General rules

The following rules apply to practically all single-mode fibers. Deviations from these rules are required only for very few special fibers in the event, for instance, of blistering.

If seeding occurs in splices, follow the notes on fusing multimode fibers further on in this section. The remedial measures described there are also suitable for single-mode fibers.

- For separation, fiber feed and prefusion time always use the default parameters.
- Prefusion current and fusion current are always set at the same level.

This leaves only the current (for prefusion and fusion) as the parameters to be optimized.

Fusion current and fusion time

Fusion current and fusion time have, over a certain range, the same effect on the resulting fusion. Increasing the current has about the same effect as extending the time, i.e. different current/time combinations produce the same results.

"Automatic fusion time control"

For the first trial, set the default parameters for fusion current and minimum and maximum fusion time and make several splices.

The fusion current is correctly set when the resultant fusion time is on average between 1.5 and 5 s. A shorter fusion time indicates that the fusion current is set too high, while longer times indicate that the current is too low.

Correct the current (fusion current and prefusion current) in steps of 0.5 mA until the fusion time is in the stated range.

> Note
>
> When automatic fusion time control is used and the fusion time obtained is frequently only slightly longer than the set minimum fusion time despite reducing the fusion current, this may be due to incorrect prefusion parameters or too short a minimum fusion time.

For fine optimization, measure the attenuation if possible with an external attenuation test set. With suitable splice parameters and identical single-mode fibers of good quality, the attenuation obtained must be on average significantly below 0.1 dB. If this value is not reached, although the fusion time is in the stated range, it may then be necessary to adjust the prefusion parameters slightly.

"Fixed parameters (LID)"

Carry out the parameter optimization in the program "Automatic fusion time control" as described in the previous section. Then set the same currents in the program with fixed parameters. As fusion time use the average of the fusion times resulting from 10 splices.

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"Fixed parameters (video)"

Optimize if possible the parameters using the LID system as described above. You can then use the optimized parameters in the video program.

If the LID cannot be used, employ the method described below. This method requires an external attenuation test set because in the video programs the attenuation display provides correct results only if the parameters have already been correctly set.

- First make splices with the default values for fusion current and time. Leave the LID flaps open for the purpose. Do **not** remove the splice from the splicer and do **not** start the tension test.
- Measure the attenuation with the attenuation test set.
- Press button ⌓ and initiate "Fuse again" with ◈.
- Measure the attenuation again.

The parameters are correctly set when the attenuation is slightly worse than the first measurement (by 0.01 to 0.03 dB). If the attenuation stays the same, the fusion current or the time has been selected too low. If the attenuation increases sharply, the current or the time is too high. Change either the current (prefusion current and fusion current) in steps of 0.5 mA or the time in steps of 0.5 s.

You should select the current so that the fusion time is in the range 3 to 5 s.

Fibers with high core eccentricity

For fibers with high core eccentricity you should use if possible the program "Automatic fusion time control". If the splice loss is too high and the fusion time tends to be very close to the minimum fusion time, you should reduce the prefusion and the fusion current by 0.5 to 1 mA. For initial trials use the following parameters:

Parameter	Value
Prefusion current:	15 mA
Prefusion time:	0.25 s
Fusion current	15 mA
Fusion time:	min. 1.0 s max. 5.0 s
Z-gap:	7 µm
Autofeed:	4.5 µm

Parameter optimization for multimode fibers

With multimode fibers the parameter optimization is largely uncritical as regards the attenuation. Unlike single-mode fibers it can be assumed that the splice loss is good whenever the splice is visually ok. It is not therefore necessary to have an attenuation test set for the optimization.

With multimode fibers the prefusion current is generally lower than the fusion current. In addition the prefusion time is longer than for single-mode fibers.

During fusion the following problems may occur:

Blistering	The splice is much thickened and uneven. The splice breaks extremely easily. This problem occurs mainly on fiber with high core refractive index (e.g. 62.5 or 63-µm fiber).	Extend the prefusion time in steps of 0.1 s. At the same time reduce the prefusion current in steps of 0.5 mA. If this is not adequate, reduce also the fusion current in steps of 0.5 mA.
Joints not fused through	The bright line in the center of the fiber is interrupted at the fused joint.	If "fuse again" produces an improvement in each case, increase the fusion time, otherwise the fusion current.
Constriction	The fiber appears thinner in the center of the monitor than at the sides.	Reduce the prefusion current in steps of 0.5 mA.

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Service support

The splicer provides what is referred to as "Service support". With the service support it is possible to detect various problems including loss of alignment and contamination of the optical components.

To use the service support, this function must be activated. It then remains active until either the splicer is switched off or, as described below, the "splicer software" (normal splicer function) is selected.

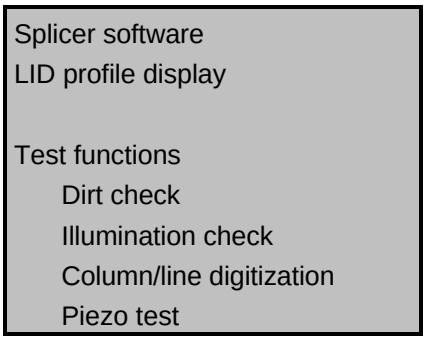
Activating the service support

- The splicer must be switched on.
- Ensure that the electrode flap is closed.
- Press button [P] to switch into the parameter menu.
- Repeatedly press button [▽] to select the menu section "Additional functions" - "Service data".
- Press button [◇] to confirm the menu section.
- Press button [▽] 4 times.

The 2nd monitor page of the service data is now visible with the software section "Service support". The two functions

- LID profile display and
- Optical test functions (with sub-functions)

are selectable for service support.



Service Test

Deactivating the service support

The service support is deactivated when the menu item "Splicer software" is confirmed with button [◇] . Alternatively the splicer can be switched off.

Menu "LID profile display"

Meaning / Function

The menu item "LID profile display" is used when the timing of the splicing process needs to be checked e.g. for determining optimum splice parameters. It can also be used for checking the quality of the fiber ends.

Since this functions only active during the positioning and splicing process itself, the splicer must be ready for splicing, i.e. *two correctly prepared fibers must have been inserted in the fiber guides and all flaps must have been closed*. When the splicing process is started after selecting the "LID profile display" menu, the optical power transmitted across the splice point during the splicing process is measured in relation to time and, at the end of the splicing process (or after termination of the positioning process due to a cleave angle error), it is displayed on the monitor. The curve indicates whether the splice parameters are correctly set and whether the cleave angle quality is adequate.

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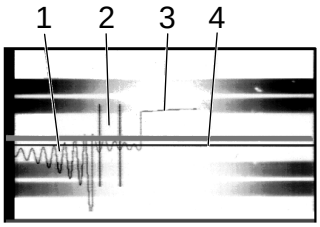
Activating the LID profile display

- Select "LID profile display" with button ▽ .
- Activate "LID profile display" with button ◇ .

Examples for assessing the splice parameters

> Note
> For optimization trials on application-specific parameter sets use only the parameter sets 2 to 5. Do not change the first parameter set if you can avoid it! If you cannot obtain optimum parameters, you can then at least continue with the first parameter set (default / standard set).

If the splicing proceeds normally, the following curve is typically displayed on the monitor:

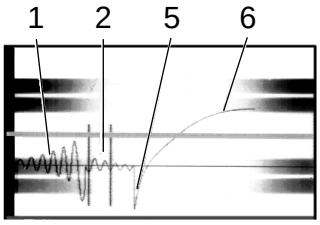


1 Z positioning
2 Reference value recording
3 Splice
4 Reference value

Normal Splice Sequence

During the Z positioning the level rises in an oscillatory manner with increasing amplitude. Then the reference value is determined. During the subsequent fusion process the level rises continuously and then quickly reaches a maximum.

If the splice does not proceed optimally, the following curve, for example, may appear on the monitor.



1 Z positioning
2 Reference value recording
3 Splice
4 Attenuation optimization

Non-Optimum Splice Sequence

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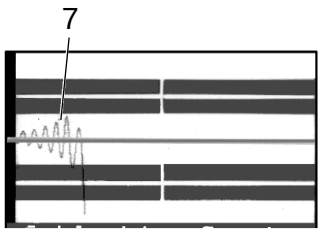
This level curve is typically the result of non-optimally set splice parameters. The level falls sharply just before the start of the main fusion. The reason for this is inadequate heating of the fiber during prefusion, i.e. the prefusion time is too short, the prefusion current too low or the fiber feed is too great. Since the transmitted level during the main fusion continuously rises and reaches its saturation within the usual time, i.e. still displayed on the monitor, the main fusion current is correctly set.

The parameters prefusion current, prefusion time and fiber feed must be checked and, if necessary, corrected in terms of higher current, longer time and smaller feed. In order to follow the effect of the parameter change, it is advisable to change only one parameter per trial. The aim of the parameter setting must be to achieve a sequence corresponding to the figure "Normal Splice Sequence".

Assessing the cleave quality

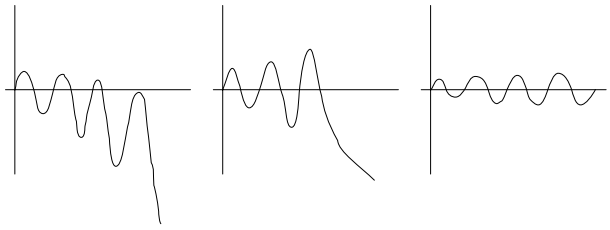
Assessing the cleave quality is likewise performed using the menu "LID profile display". The splicer must be ready for splicing, i.e. *two correctly prepared fibers must have been inserted in the fiber guides and all flaps must have been closed*. After the splicing process has been started, the menu is then activated.

The figure "Splice Sequence for Cleave Angle Error" shows a level curve resulting from poor quality of the fiber ends. Unlike the case with correct fiber ends (figure "Normal Splice Sequence") the level falls sharply during the Z positioning, the splicer interrupts the splicing process and produces a fault message. Level curves declining in this way or oscillating only with low amplitude (see figure "Splice Sequences for Poor Fiber Ends") occur typically with poor end faces.



7 Z positioning with cleave angle error

Splice Sequence for "Cleave Angle Error"



Splice Sequences for Poor Fiber Ends

In this case the cleaver must be cleaned in accordance with the Operating Instructions. If, despite careful cleaning, the results are still poor, the diamond is probably defective. It must be exchanged, an operation that may only be performed under clean environmental conditions. It is advisable to have the cleaver serviced at the service center.

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Menu "Test functions"

In the menu "Test functions" the following submenus can be selected:

- Dirt check
- Illumination check
- Column/line digitization
- Piezo test

The submenu "Column/line digitization" should only be used by the service center. This section is not relevant for the craftsperson in the field. The other two sections can be used to perform selective troubleshooting on the splicer.

On completing a submenu it is possible to return to the monitor page "Service support" (see figure "Service support") by pressing button ◈ .

Submenu "Dirt check"

This menu is used to carry out a menu-driven check of the optical section, including the lens systems and the camera. The test should be performed when poor splice results are thought to be due to contamination of the optical system. The submenu is activated with the following actions:

- **Ensure that no fiber is inserted in the splicer.**
- Select submenu "Dirt check" with button ▽ .
- Confirm submenu with button ◈ .
- Activate submenu with button ◈ .

If contamination is detected, a fault message appears on the monitor, e.g. "Illumination in Y axis poor". In this case the optical system should be cleaned in accordance with the operating instructions. Another check should then be made with the submenu "Dirt check". If, even after several careful cleanings, a fault message continues to appear, it must be assumed that there is a fault that cannot be repaired by the craftsperson in the field. The splicer must then be serviced in the service center which should be advised of the test performed.

Submenu "Illumination check"

This menu is used to carry out a menu-driven check of the illlumination system, including the contrast between background and fiber as well as the focus setting.

The test should be performed when poor splice results occur after the splicer has been exposed to extreme mechanical stress. The submenu is activated with the following actions:

- Remove coating to a length of about 40 mm on the fiber.
- Clean this section of the fiber carefully and insert it in the splicer fiber guide in the splicing area.
- Prevent fiber slipping out by inserting it in the relevant LID coupler.
- Select submenu "Illumination check" with button ▽ .
- Confirm submenu with button ◈ .
- Activate submenu with button ◈ .

If a malfunction is detected, a fault message appears on the monitor, e.g "Focus in XY axis poor". In this case the splicer must be serviced in the service center particularly if splice loss performance is continually poor. The service center should be advised of the test performed.

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Submenu "Piezo test"

This menu is used to check the three positioners.

- Insert fibers as for a normal splicing operation.
- Change to submenu "Piezo test"
- Start the test by pressing button  .

Any positioner defect detected is displayed on the monitor.

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Splicing single-mode fibers of type "Depressed Inner Cladding"

Problem

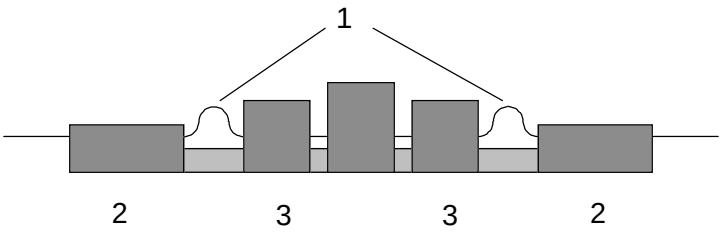
When splicing single-mode fibers of type "Depressed Inner Cladding", difficulties may be encountered if using LID programs. In such instances, the fault message "Bad end-faces" often appears during Z-positioning even though the cleave appears perfect on the monitor. In addition, the splice loss may be displayed incorrectly for splices for which no fault message is produced.

Cause

These problems are not related to the cleaver but to the fact that the index profile of this special fiber type is disadvantageous for LID input.

Possible solutions

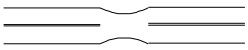
The problems can be easily avoided by inserting the fibers with an excess length between the LID flaps and the fiber holder flaps so that it forms an arc with a diameter of around 2 cm. The following figure gives an impression of what this should look like. There is no need to use this precise diameter or to measure it out. The arc must not be too weak though. This measure reliably prevents the problem occurring. When standard single-mode fibers are to be fused, the fibers can be inserted is the usual way. An alternative remedy would be to use video programs.



1 Fibers with excess length
2 LID
3 Fiber holder

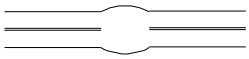
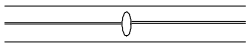
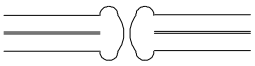
Inserting Fibers of Type "Depressed Inner Cladding"

Splice appearance

Fault Appearance	Cause	Remedy
Constriction 	Dirty electrodes, arc burning irregularly	Clean electrodes (page 7-29)
	Fusion current too high	Reduce in steps of 0.2 to 0.3 mA
	Feed too small	Increase in steps of 1 µm
	Prefusion time too long	Standard value: 0.20 s, change only in exceptional cases. Reduce in steps of 0.05 s.
	Prefusion current too high	Standard value: 14.5 mA, change only in exceptional cases. Reduce in steps of 0.1 mA.
	Separation too great	Reduce separation in steps of 0.5µm

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Splice appearance

Fault Appearance	Cause	Remedy
Enlargement 	Feed too large	Reduce in steps of 1 µm
Not fused through 	Fusion current too small	Increase in steps of 0.2 to 0.3 mA
	Prefusion time too short	Standard value: 0.25 s, change only in exceptional cases. Increase in steps of 0.05 s
Seeds or inclusions 	Dirty end faces before splicing	Clean end faces before fusion! If necessary, increase cleaning current by 0.2 - 0.3 mA or increase cleaning time by 0.1 s
	Bad cleavage	Check cleavage quality before fusion
	Fusion current too high	Reduce prefusion and main fusion currents
	Prefusion time/current too low	Increase prefusion time in steps of 0.1 s
Match-stick heads 	Electrodes dirty, arc burns irregularly	Clean electrodes
	Fusion current is much too high	Reduce in steps of 0.5 to 1.0 mA
	Prefusion time is much too long	Set guide value of 0.25
	Prefusion current is much too high	Set guide value of 14.5 mA
	Feed is too small	Increase feed in steps of 1 µm
	Separation too large	Reduce separation in steps of 1 µm

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Fault messages on the monitor

The following pages contain explanations to the **fault messages** displayed on the monitor, together with notes on remedying the faults. The fault messages are arranged according to the operations in which they occur.

Note that a number of fault messages can have different causes and symptoms and may therefore be listed more than once on the following pages.

Fault messages at switch-on

Fault Message ***Fault Symptom***	**Possible Cause**	**Fault Locating**	**Remedy**
Self-test faults 1 to **4**	These messages are displayed if the splicer has detected an internal fault or error.		Switch off the splicer and then switch it back on again. If the fault is repeated, the splicer must be sent to the service center for repair. Notify the service center of the fault number displayed.
Battery monitoring, remaining capacity 0 %. The splicer switches off automatically *The battery cannot be charged.*	The AC line adapter is not working. The battery is not being charged.	The display appears even though the splicer is being powered from the AC supply.	Check whether the green charging indicator is lit. If not, check the AC supply and the primary fuse.
	The battery is faulty.	AC power operation is possible.	Change the battery.
Reference switch left/ right fault	The slides do not reach the final position.	Check whether a fiber is still inserted at switch-on.	If no fiber is inserted, push both slides outwards by hand at switch-on. Then switch the splicer off and on again to check whether the fault has been corrected. If the fault occurs again, the splicer must be repaired at the service center.

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	Fault Message *Fault Symptom*	Possible Cause	Fault Locating	Remedy
General fault messages during operation	**Program status [X]=.....**	Processor crash or software error		Switch off the splicer, then switch it back on again. If the fault still occurs, the splicer must be repaired at a service center. Notify the service center of the fault numbers displayed.
Fault messages before positioning	**Clean electrodes**	The set electrode cleaning interval has been exceeded.		Clean the electrodes at the next opportunity and then reset the counter in the Parameter menu.
	Replace electrodes	The set electrode change interval has been exceeded.		Change the electrodes at the next opportunity and then reset the counter in the Parameter menu.
Fault messages during fiber location and positioning	**distance too wide or fiber missing** **or fiber left/ right missing**	Fibers wrongly inserted or wrong cleave length	The fiber ends must project 5 to 6 mm out of the guides with the fiber holder flaps closed.	The cleave lengths and insertion positions described in section 2 should be adhered to exactly.
		No fibers present		Insert fibers
	Fiber input error	The fiber end could not be found at fiber search	The fibers overlap considerably or are too long or have been cleaved to very different lengths.	The cleave lengths and insertion positions described in section 2 should be adhered to exactly.

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Fault messages during fiber search and positioning

Fault Message *Fault Symptom*	Possible Cause	Fault Locating	Remedy
Fiber not detected or fiber end not detected	Dirty optical system.		Clean the flat mirror, the two lenses and the illumination system using alcohol and optics leather. Wrap the leather around plastic tweezers.
	Flat mirror scratched or damaged.		Change the flat mirror. To do this, remove the rear electrode, remove the old mirror upwards and carefully fit the new mirror. Use tweezers to hold the sprung holding clamps to one side while doing so.
	Condensation on optical system.	The fiber image displayed is unclear in one or two axes.	Prevent condensation by placing the splicer prior to use in a room which is not too cold and leave the electrode flap open for as short a time as possible during fusion.
	Fiber end no longer detected as such by the video system.	Fiber is extremely dirty or cleaved extremely poorly.	Clean fiber or prepare fiber again.
Auto Z Fiber o.k.?	The fibers cannot be positioned in Z direction.	Check that the fibers have been inserted correctly and that the slides can move unhindered. Put through the piezo test (see page 7-9).	If the fault occurs again despite the fibers being inserted correctly, the cause is a fault in the electronics or mechanical system which will need to be corrected by the service center.

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	Fault Message *Fault Symptom*	Possible Cause	Fault Locating	Remedy
Fault messages during fiber search and positioning	**Fiber offset excessive** (LID or video system) *The fiber offset before positioning is larger than half the fiber diameter*	Coating stripping edge wrongly positioned or fiber not located correctly in guide.	Check whether the fiber is clean and positioned correctly in the guide.	Only 250/900 µm fiber guide: The coating stripping edge must lie inside the mark at the end of the fiber guide as described in section "Preparing the splice". In the case of doubt, it is better that the coating projects out of the guide rather than the stripping edge lies inside the guide.
		Fiber guides dirty or damaged.		Clean the guides. Use alcohol as solvent if necessary. Exchange damaged guides.
		Wrong fiber guide or wrong cleave length.		Use the correct guide for the fiber in question and observe the prescribed cleave length.
		Dirt under the fiber guides.		Remove the fiber guides, clean them from below as well and remove dirt from the receiving channel in the guides.
		Positioning system not aligned properly.	Check the fiber position using clean 900-µm guides. Only if the fault is then repeated must the positioning system be realigned. (Is very seldom the case.)	Perform basic alignment of the X/Y axis as described below. Even if the splicer functions correctly afterwards, you should still send it for examination to the service center at the earliest opportunity.
	Fiber dirty or damaged	The video system has detected that the total end face angle exceeds 2.3° or that the end face is dirty.	Determine on the monitor which fiber end is at fault.	Prepare fibers again.

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Fault messages during fiber search and positioning

Fault Message *Fault Symptom*	Possible Cause	Fault Locating	Remedy
Important Interfering light!	The fiber contains light from a transmission or measuring system or LID flaps are open.		Switch off foreign light source or close LID flaps.
Auto XY Fiber o.k. ? *Fiber offset **not** too large.*	XY positioning cannot be performed.	Put through the piezo test (see page 7-9).	The splicer must be repaired at the service center.
Level too low	LID receives no light.	Check that you have inserted the fiber into the LID. If the fault still occurs select **Manual fiber adjustment** from the menu and check that a minimum level of 0.5 is displayed when a continuous fiber is inserted.	Clean the LID system and ensure there is sufficient index-matching fluid on the input and output areas. If the LID level is still not high enough with a continuous fiber, the fiber is not LID-compatible. In this event, you can either remove the color from the fiber which is inserted in the LID or use one of the video programs.
LID system overdriven	Malfunction of the LID system.		The fault can only be eliminated by the service center. You can continue using the video system, however.
Video analysis faulty	Video system electronics not functioning.		Switch off the splicer and switch it back on again. If the fault occurs again, the splicer must be repaired at the service center. You can fuse using manual fiber positioning (with or without LID).

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Fault messages during fiber search and positioning

Fault Message *Fault Symptom*	Possible Cause	Fault Locating	Remedy
Bad endfaces (LID system)	Wrong cleaver. The total of the fiber end face errors exceeds 2°.		Use cleaver FBC-005. When using other cleavers you must expect poorer splice results and greater inaccuracy in the splice loss display.
	Cleaver dirty or damaged.		Examine the cleaver diamond for damage and/or clean the cleaver as described in the Instructions.
	Fiber end faces dirty.		Restrip the fibers and recleave.
	Guide of left-hand slide dirty or damaged.	Switch off the unit and then switch it back on again. Both slides move outwards at first and then move inwards. When the left slide reaches its outermost position, switch off the splicer with the mains switch (!). Push the slide inwards by hand against the spring pressure and check for any irregularities. The slide must move smoothly without jerking.	The guides can be damaged by improper treatment, e.g. through jolt or impact to the slide, or may become difficult to move as a result of dirt. Repair is only possible at the service center.

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Fault messages during splice analysis

Fault Message *Fault Symptom*	Possible Cause	Fault Locating	Remedy
Fiber not detected	Dirty optical system.		Clean the flat mirror, the two lenses and the illumination system using alcohol and optics leather. Wrap the leather around plastic tweezers.
	Flat mirror scratched or damaged.		Change the flat mirror. To do this, remove the rear electrode, remove the old mirror upwards and carefully fit the new mirror. Use tweezers to hold the sprung holding clamps to one side while doing so.
	Condensation on optical system.	The fiber image displayed is unclear in one or two axes.	Prevent condensation by placing the splicer prior to use in a room which is not too cold and leave the electrode flap open for as short a time as possible during operation.
	Fiber is no longer detected as such by the video system.	The splice is so poor (e.g. fibers burnt or blistering) that the splice point no longer has the appearance of a fiber.	Clean fiber or repeat splice.

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Fault messages during splice analysis

Fault Message *Fault Symptom*	Possible Cause	Fault Locating	Remedy
Measurement inpossible (LID system)	LID system dirty.	Select **Manual fiber adjustment** from the menu. Insert a continuous fiber in the LID transmitter and LID receiver and observe the level displayed. This level must stabilize a few seconds after the flaps are closed, otherwise the LID must be cleaned.	Clean the LID transmitter and LID receiver as described in section "Care and maintenance". Clean the contact face of the mandrel and the mandrel itself over its entire length. Use alcohol as a solvent if necessary.
	Fiber coating is too soft causing fiber axes to deviate from straight.		Use the 900-µm guides. If this is not possible, you can use one of the video programs.
	Fiber guides dirty or damaged.		Clean the guides. Use alcohol as solvent if necessary. Exchange damaged guides. Ensure there is no dirt under the guides.
	Poor cleave quality	The **Bad cleavage** fault message appears relatively frequently.	As for **Bad cleavage**.

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	Fault Message *Fault Symptom*	Possible Cause	Fault Locating	Remedy
Fault messages during splice analysis	**Bad splice - fuse again?** The actual attenuation can still be very good under some circumstances (video system)	Unfavorable splicing parameters.		Reduce the prefusion current or prefusion time. The prefusion time must not be set too low (default setting: 0.25s).
		Unfavorable fiber type or different fiber types on both sides.		Use an LID program if possible.
		Dirt in the optical system.	Check the monitor image without fibers inserted to see if there are any signs of dirt.	Ensure there is no dirt visible on the lenses or mirror in the area of the electrodes or on the illumination LEDs.
Fault messages during the tension test	**Tensile test failed**	Fiber has fractured.	Ascertain whether the fiber has fractured at the splice point or next to it.	With fibers now widely used, fractures at the splice point itself generally only occur if the parameter settings are extremely unfavorable. If the fracture has occurred next to the splice point, the stripping tool is most likely to be faulty.
		Fibers slips in the LID system.	The fiber is not really fractured.	Clean the LID system to remove any excess index-matching fluid. The index-matching fluid should only occur in the area of the mandrel or coupling faces.

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	Fault Message *Fault Symptom*	Possible Cause	Fault Locating	Remedy
Fault messages relating to the splice memory	**No data available**	The splice memory is empty.		Ensure that the splice memory is switched on (automatic or manual) in the parameters.
	Attenuation value flashing	The attenuation value of the splice could not be determined reliably due to a fault (**end face dirty or damaged; bad cleavage**).		See appropriate fault messages.
	Display of **Fault** instead of attenuation value	The attenuation could not be calculated for the splice concerned (**attenuation measurement not possible** or **bad cleavage**).		See appropriate fault messages.
Fault messages during printing	**Printer not ready!**	The printer connected to the serial interface transmits incorrect characters.	Check the baud rate set at the printer and splicer. Ensure that the printer supports the XON/XOFF protocol and the data format (8 data bits, 1 stop bit, no parity).	

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Other faults

The following table sets out explanations for eliminating faults which do not generate fault messages on the monitor.

Fault Symptom	Possible Cause	Fault Locating	Remedy
Battery mode not possible; AC mode functioning.	The battery is missing, is not connected or the battery fuse is faulty.	Check that the battery has been fitted correctly and that the battery fuse is o.k.	Install and correctly connect the battery and/or change the fuse. If the fault is repeated, the splicer must be sent to the service center for examination.
Arc flickers or hisses.	Electrodes dirty or worn.		Clean or exchange electrodes.
The fiber does not melt during fusion but buckles instead.	Fusion current too low.	The splice point barely lights up during splicing.	Set correct fusion current. Correct altitude information or activate altitude correction.
	Fusion generator is faulty.	The arc is not burning.	Service center.
The fiber buckles at the start of the fusion process. When automatic fusion time control is used, a more or less usable splice is obtained after a long fusion time. If the fusion time is fixed, high attenuation levels are obtained.	The prefusion time is too short or the prefusion current too low.		Correct the prefusion parameter. You can use the default parameter as a basis.
Fusion process is usually aborted after less than 1 s (e.g. 0.6 s) if automatic fusion time control is used, poor splice, high attenuation.	The minimum fusion time is too short. As a result the automatic fusion time control terminates fusion before a homogeneous joint has formed.	The fiber shows irregularities at the fusion point when displayed on the monitor. The splice breaks easily when removed. Good results can be achieved through "Repeat fusion".	In most cases, you can still 'rescue' unsuccessful splices by fuse again (see section 6, Fusion). To prevent the faults occurring in the first place, increase the minimum fusion time to 0.8 s - 1 s.

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Fault Symptom	Possible Cause	Fault Locating	Remedy
Fibers burn off.	Prefusion current or prefusion time too high		Set the parameters as described in section 3.
	Feed too small.		Use the default parameters if necessary.
	Fusion current much too high.		Correct altitude information or activate altitude correction.
	Z-piezo faulty.	Put through the piezo test (see page 7-9).	Service center.
Index-matching fluid not emerging.	Feed container is empty.		Top up with index-matching fluid.
Charging indicator not lit.	AC power fuse faulty.		Change fuse.
	AC line adapter faulty.		Service center.

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Care / Maintenance

General

Note

To maintain the precision of your splicer, it is important to provide it with regular care and maintenance.

Regular cleaning

Keep the splicer clean.

Clean at the end of every working day and more often if required:

- LID system.
- Fiber guides.
- Electrodes.
- Cleaver.

Regularly charge splicers with battery!

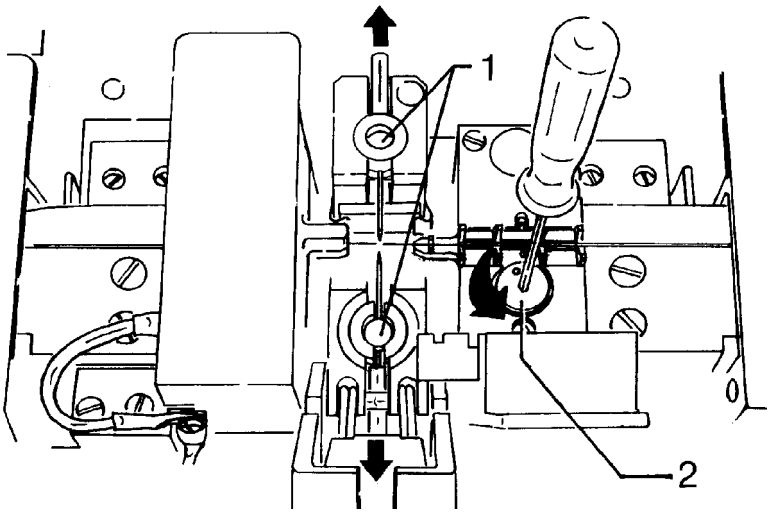
Warning

Do not use chemical solvents!

Cleaning the mirrors and optical lenses

The mirrors and optical lenses in the splicer must be kept clean to ensure the splicer functions properly:

- Switch off the splicer.
- Open the electrode flap and loosen the bolts (1) approx. half a turn using a hexagon socket head wrench, size 2.5. Remove the electrodes.
- Open both holder flaps, rotate the eccentric clamp (2) through 180° using a hexagon socket head wrench, size 1.5, and then remove the fiber guides.
- Carefully clean the mirror and the two lenses using an optics leather cloth.
- Install the fiber guides and electrodes again. Ensure they are clean!



Location of the Electrodes and the Optical Parts to be Cleaned

Caution

Reinstall and tighten the electrode.
Performing fusion without electrodes in place will damage the splicer!

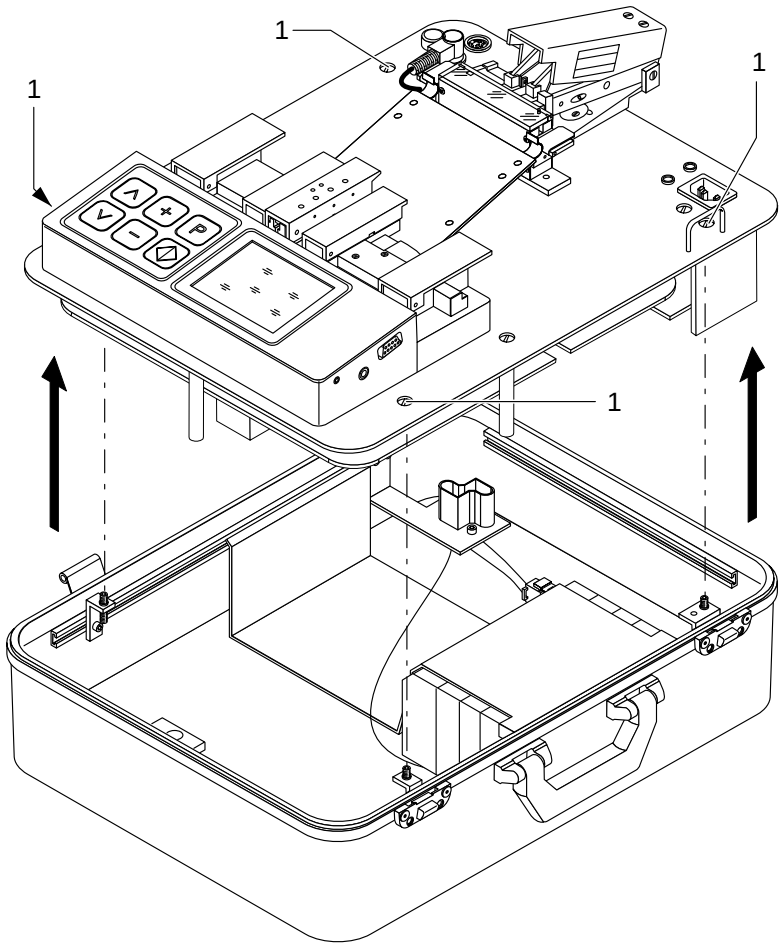
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Opening the top panel

Danger
Before opening the top panel, switch off the splicer and disconnect the power supply.

Caution
Under no circumstances should you touch any of the electrical components on the underside of the top panel. These components could be damaged by electrostatic discharge (ESD).

- Loosen the four bolts (1) using the screwdriver from the toolset.
- Lift off the top panel using the handles.



Lifting Off the Top Panel

The top panel is closed in the reverse sequence of steps.

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Changing the AC power fuse

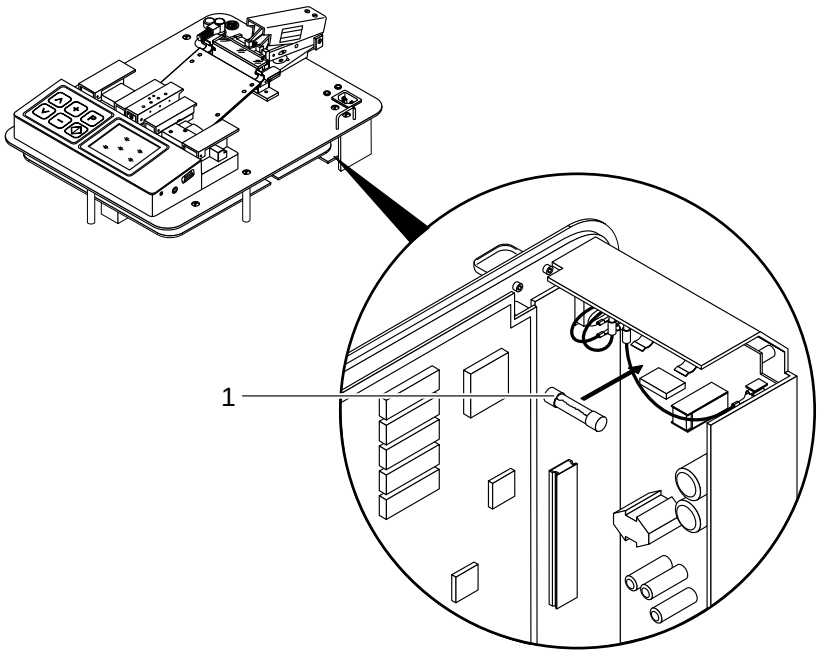
Warning
This work may only be performed by appropriately qualified personnel.

Take a new fuse and the size 3 screwdriver from the tool bag.

Danger
Switch off the splicer! Disconnect the power plug!

- Open the top panel as described in this section.
- Pull out the faulty fuse (see figure below).
- Fit the new fuse (1).

Danger
Only use the original fuses specified.
AC power fuse: medium time-lag 2.5 A.



AC Power Fuse

Close the top panel and tighten the bolts securely.

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LID system

The LID system is a sensitive opto-electronic system.

You should therefore ensure it is always clean.

Cleaning

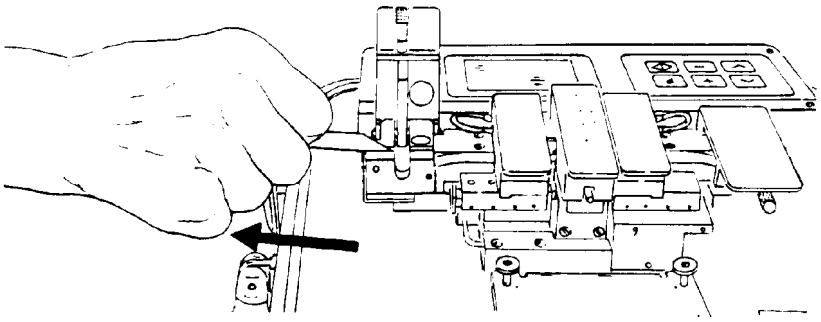
Clean the LID system using the groove cleaners, the cleaning tool and one of the leather swabs included in the tool bag.

Cleaning the groove

Clean the groove in which the fiber is inserted using a groove cleaner (see next figure).

Pull the tip of the groove cleaner through the groove. Always clean from the inside outwards!

You can use the groove cleaner several times.



Cleaning the Groove

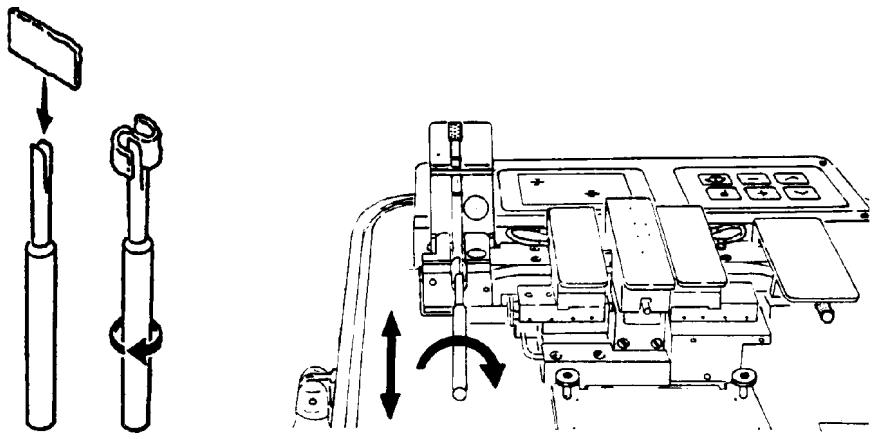
Input and output areas

Use the cleaning tool to remove dirty index-matching fluid from the input and output areas.

Insert a leather swab in the notch in the swab holder.

When performing cleaning, turn the tool so that the leather swab wraps around the tool (see next figure).

You can use each leather swab until it loses its absorbency.



Removing the Index-Matching Fluid

Clean the other parts of the LID system using a non-linting paper cloth.

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Topping up the index-matching fluid

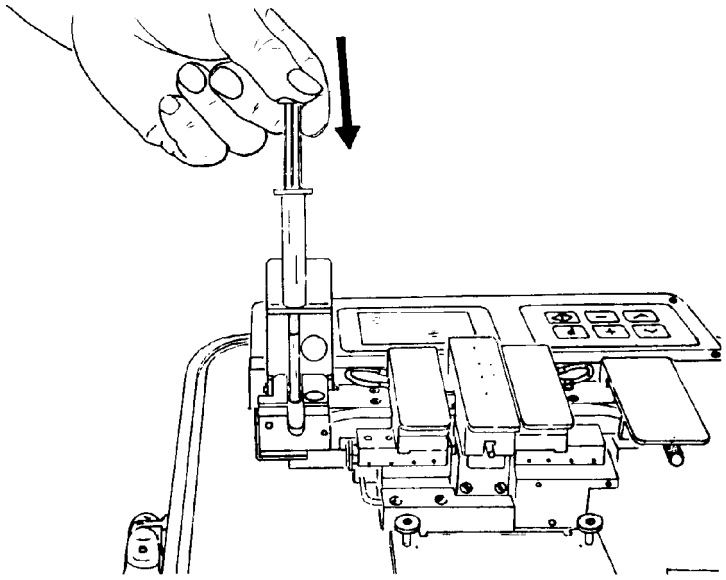
If no more index-matching fluid emerges when turning the metering wheel in clockwise direction, top up with new index-matching fluid.

The tool bag contains a plastic syringe filled with index-matching fluid (see next figure).

Turn the metering wheel in counter-clockwise direction until you can remove it. Located in the lid is a cavity for holding the index-matching fluid.

Use the syringe to fill the cavity with the index-matching fluid (approx. 0.1 ml) (see next figure).

Screw the metering wheel back on.



Topping Up the Index-Matching Fluid

Cleaning the fiber guide

Clean the fiber guides with the brush.

To remove stubborn dirt from the grooves in the fiber guides, use the groove cleaner for the LID system.

> Note
>
> Always clean the fiber guide, when installed, working from the inside out.

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Exchanging / cleaning the electrodes

The electrodes become dirty through the fusion process. If too much dirt accumulates, they are therefore unable to function properly. Your electrodes will work properly if:

- The arc is burning evenly.
- No hissing sounds can be heard during the fusion process.

Try to burn the electrodes clear before cleaning them mechanically.

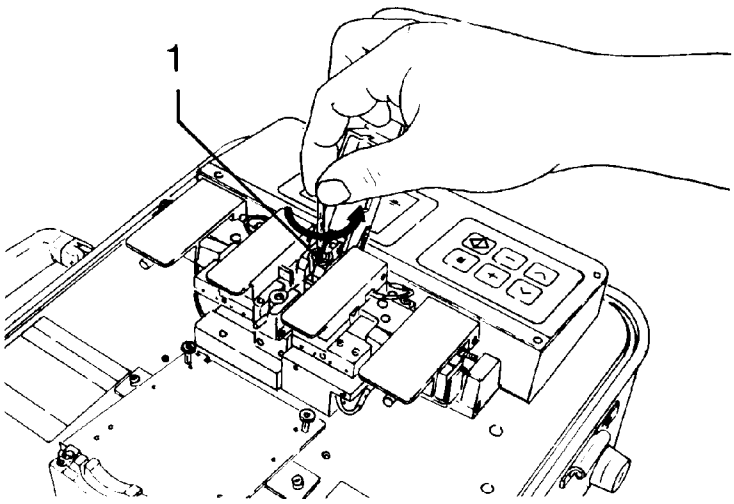
Burning the electrodes clear

- Ensure no optical fiber is inserted.
- Switch the splicer off and on again.
  The splicer will burn the electrodes claer automaticcally.

> Note
>
> The electrode tips are made of a hard, resistive material.
> Avoid the tips becoming soiled.
>
> Be careful not to bend or break off the tips.
>
> The electrodes are identical.

Exchanging the electrodes

- Open the electrode flap.
- Loosen the bolt (1) with the hexagon socket head wrench, size 2.5 (approx. one half turn).



Removing the Electrodes

- Pull out the electrode.
- Push the new electrode into the holder as far as it will go.
- Clamp the electrode using the socket head screw.
- Change the second electrode in the same way.

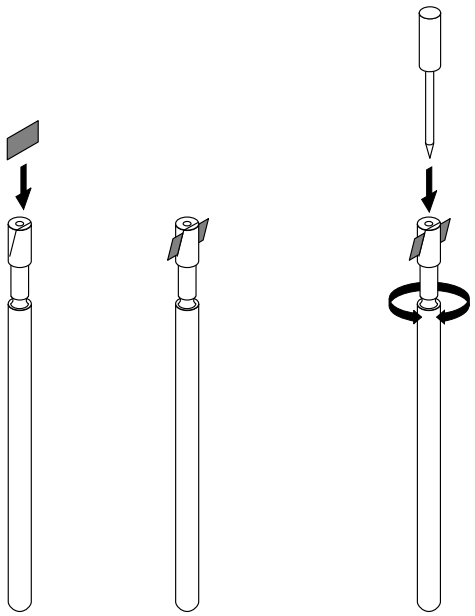
> Caution
>
> Only use the special wrench supplied in the tool bag.

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Mechanical cleaning

If the electrodes still do not function correctly after burn-off, clean them mechanically. When cleaning the electrodes, use only the swab holder and a piece of emery paper provided in the tool bag.

- Place a piece of emery paper (with the **rough** side to the inside) in the notch in the swab holder.
- Dismantle the electrodes.
- Position the swab holder on the electrode.
- Carefully turn the swab holder several times (see next figure).
- Do not touch the tips of the electrodes with your fingers after cleaning.
- Clean the second electrode in the same way.



Cleaning the Electrodes

Ultrasonic cleaning

You can also clean the electrodes in an ultrasonic bath. We recommend you use alcohol for the solvent.

> Danger
>
> Never spray solvents or other cleaning agents into the area of the electrodes or lenses.
>
> The electric arc can ignite the gas mixture.

If the cleaning proves unsuccessful or the electrodes are too heavily worn, they will need to be exchanged. Use only original electrodes.

> Caution
>
> Reinstall and tighten the electrode.
> Performing fusion without electrodes in place will damage the splicer!

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Accessories

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Ordering Numbers

Designation	Ordering Number	Explanation
battery	2108023-01	12 V, 6.5 Ah, rechargeable
fiber cleaver	FBC-005	for cleaving of SM and MM fibers
splice tray holder	2806102-01	Universal splice tray holder
heat shrink oven	FSA-004	heat shrink oven for preseries 3000 (S/N < 3000), 3 pin plug
enhanced heat schrink oven	FSA-004-01	heat schrink oven for series 3000 (S/N > 3000), 6 pin plug
crimp tool	FSA-010	1 x
transport case	M90-001	heavy duty transit case with wheels
tool set	M90-037	as supplied with splicer
fiber guides	2802081-01	2 pcs. 125/250 (for M90 S/N < 4161)
fiber guides	2802082-01	2 pcs. 125/900 (for M90 S/N < 4161)
electrodes	FSA-014	1 set of 2
fuses	2806003-01	contains 2 fuses
set of consumables	FSA-005	replacements for tool set
crimp splice protector	FSA-012	pack of 150 pcs.
heat shrink splice protector	2806031-01	pack of 50 pcs.
external video monitor	FSA-013	approx. 13 inch diagonal
case for video monitor	FSA-013-01	transport case for monitor
printing kit	M90-011	Universal printing adapters for serial or parallel printers
replacement work light	M67-024	same as supplied with unit (for M90 S/N < 3000, 3 pin plug)
replacement bulb	M67-044	for work light
fiber stripping tool	3205004-01	250 µm buffer Miller tool
fiber stripping tool	3205007-01	900 µm buffer No-Nik
splice tray	M67-041	holds 12 fusion splice RTV or Crimp & Go
splice tray	M67-048	holds 12 fusion splice heat shrinks
replacement parts for tool pouch	2806055-01	LID cleaning tool
replacement parts for tool pouch	2802133-01	syringe/index matching gel
replacement parts for tool pouch	2806003-01	power supply fuses
replacement parts for tool pouch	2101015-01	4" x 4" emery cloth

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replacement parts for tool pouch	2806059-01	LID cleaning strips (chamois)
replacement parts for tool pouch	2806060-01	plastic groove cleaner
replacement parts for tool pouch	2806061-01	flat head screwdriver
replacement parts for tool pouch	100312-01	tweezers
replacement parts for tool pouch	2806063-01	1,5 mm allen wrench
replacement parts for tool pouch	2806062-01	6 x 7 mm open-end wrench
replacement parts for tool pouch	2806064-01	5 mm allen wrench
replacement parts for tool pouch	2806065-01	2 mm allen wrench
replacement parts for tool pouch	2806066-01	electrode allen wrench (2.5 mm)
replacement parts for tool pouch	2806067-01	horse hair brush
replacement parts for tool pouch	FSA-014	spare electrodes
replacement parts for tool pouch	2806042-01	electrode cleaning tool

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Battery

Charging the battery

The optional battery requires no maintenance and has low gas emissions.

> Note
>
> If the splicer is not used for a long time, fully charge the battery at least every three months.

Connect the splicer with the AC power cord to the AC supply. The charging indicator lights up.

> Note
>
> If the charging indicator does not light up, locate the cause of the fault (section 7)!

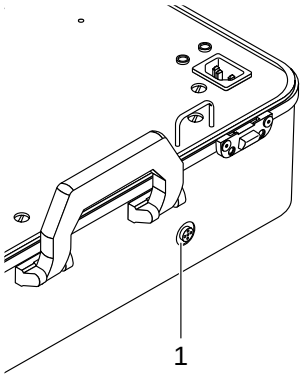
After approx. 3 hours, the empty battery will be fully charged again. The internal charger prevents overcharging.

You can also charge the battery via the external 12-V connection. To do this, apply a DC voltage of 14.0 V to 14.5 V. The charging time depends on the voltage applied.

> Caution
>
> If you charge the battery using the external 12-V connection, the charging voltage must not exceed 14.5 V.

The splicer can be used during the charging process.

> Danger
>
> During (trickle) charging, hydrogen can escape from the battery which, if ventilation is inadequate, can result in an explosive mixture of gases being concentrated in the battery. For this reason, the venting hole (1) in the splicer must always be kept free.



Venting Hole

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Installing / exchanging the battery

Warning

This work may only be performed by appropriately qualified personnel.

Only the maintenance-free safety battery available as an optional extra may be installed.

Opening the top panel

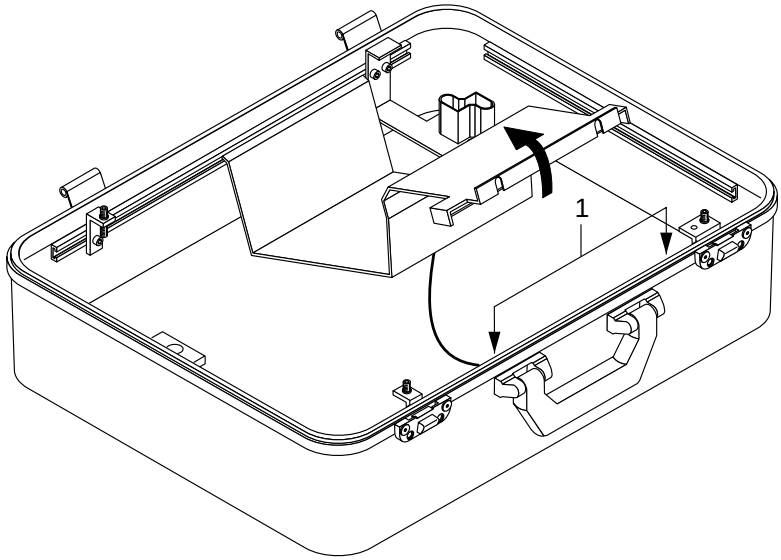
Warning

Switch off the splicer! Disconnect the power plug!

See section 7

Remove the battery retaining angle

Loosen the self-locking nuts (1) and remove the battery retaining angle.



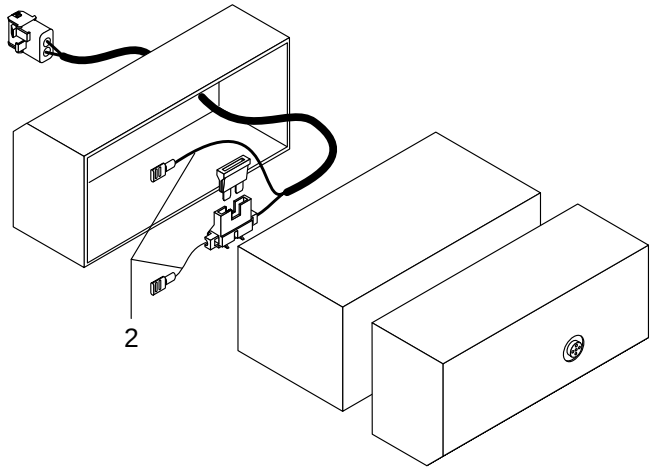
Removing the Battery Retaining Angle

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Removing the old battery, if necessary

- Disconnect and remove the battery.
- Remove the adhesive strip from the battery housing and pull the housing apart.
- Now remove the old battery from the battery housing.
- Disconnect the battery connecting cable (2) (see next figure).
- Connect the battery connecting cable (2) to the new battery and plug it into the battery housing.
- Wrap the adhesive tape around the housing five times to ensure the battery is gas-tight. Each layer of tape should be offset approx. 5 mm.

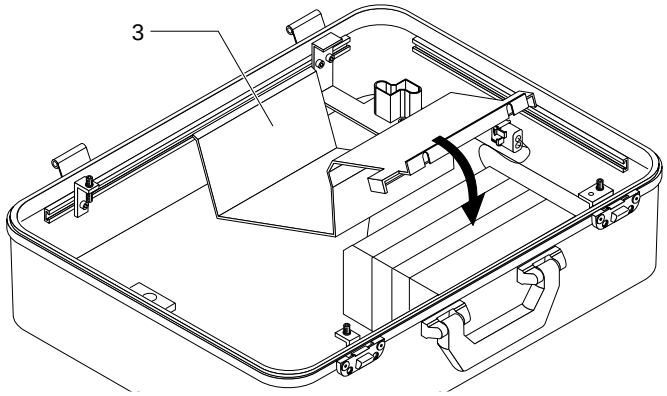
Note
Note battery polarity. Positive terminal: Brown lead Negative terminal: Blue lead



Battery Connecting Cable

Installing the battery

- Install the battery so that the battery's venting nozzle lies in the bore of the case housing.
- Secure the battery with the battery retaining angle (3). Tighten the bolts securely.



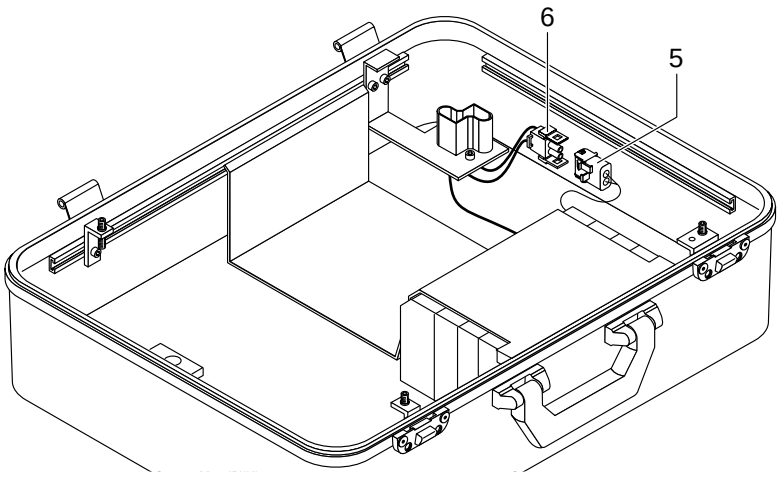
Installing the Battery

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Connecting the battery

Secure the battery cable with the cable clamp.

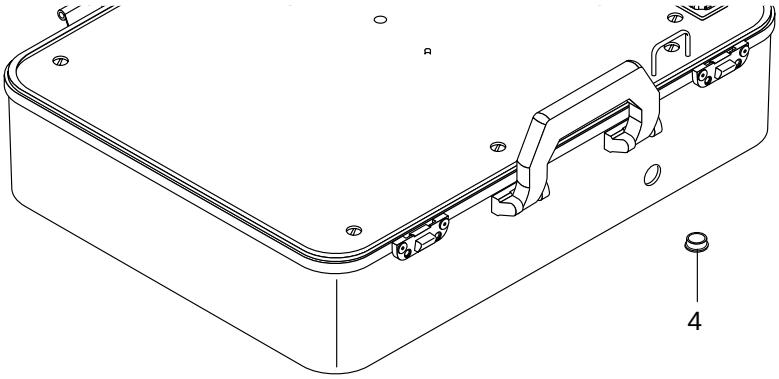
Connect the battery plug (5) into the socket (6).



Connecting the Battery

Dismantling the case closure cap

Remove the closure cap (4) from the case housing.



Closure Cap of Case Housing

Closing the top panel

See section 7.

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Changing the battery fuse

> Warning
>
> This work may only be performed by appropriately qualified personnel.

To exchange the battery fuse, the battery must be removed. The procedure for doing this is the same as that already described in the section "Installing / exchanging the battery".

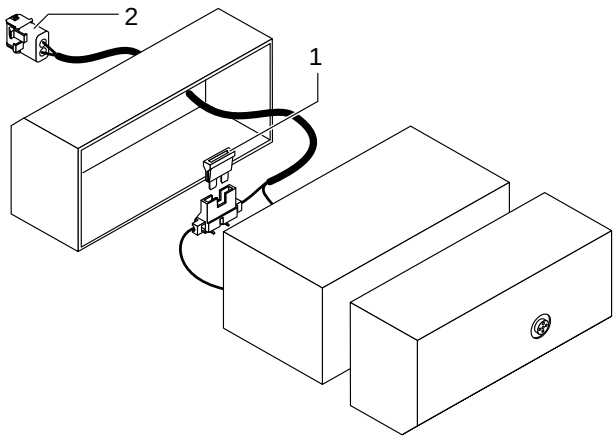
Removing the battery

- First open the top panel (see section 7).
- Now remove the battery retaining angle.
- Disconnect the battery cable (2).
- Remove the battery from the case. Remove the adhesive strip from the battery housing and pull the latter apart.

Exchanging the fuse

- Now pull out the faulty fuse (1). Take a new 10-A fuse from the tool bag and fit it in position.

> Danger
>
> Use only original fuses!



Changing the Battery Fuse

Installing the battery

- Re-assemble the battery housing. Wrap the adhesive tape around the housing five times to ensure the battery is gas-tight. Each layer of tape should be offset approx. 5 mm.
- Place the battery in the case and secure with the retaining angle.
- Plug the battery cable (2) back in.
- Close the top panel (see section 7).

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Heatshrink Oven, Adjustable with Universal Splice Tray Holder

Characteristics

The heatshrink oven is required for protecting the spliced joint with the heat-shrink splice protector.

The adjustable heatshrink oven provides:

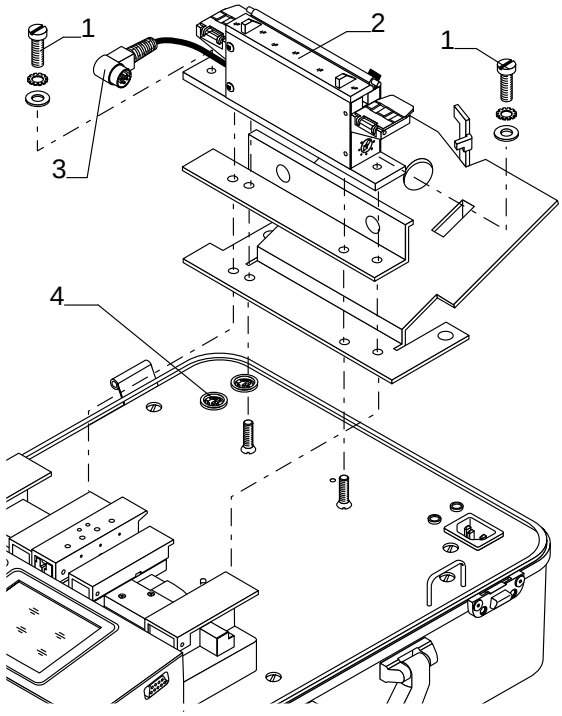
- Fully automatic heat-shrinking.
- Indication of heat-shrinking time by LED.
- Adjustable heating time and temperature.
- The heat-shrink process is indicated by LED.

Installation

-Secure the universal splice tray holder together with heat-shrink oven on the splicer with the two bolts (1).

-Ensure that the cover (2) is closed.

-Insert the plug (3) in the socket (4).



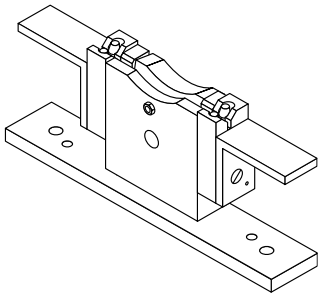
Further information

For further information regarding e.g. operation and technical specifications, please refer to the Operating Instructions for the "Heat-Shrink Oven, Adjustable".

Crimping Device

Characteristics

The crimp splice protector consists of a V-shaped aluminum section with a soft coating on the inside edges. This splice protector is crimped around the splice after splicing using the crimper and restores the mechanical stability of the spliced joint.

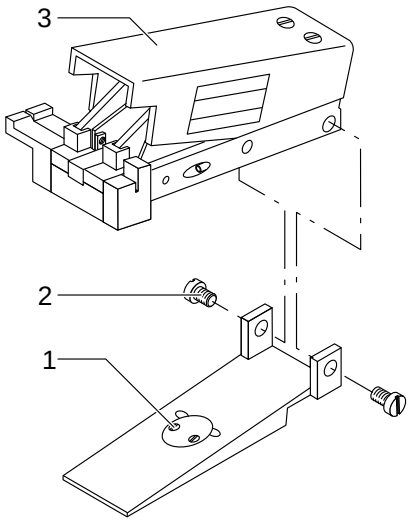


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Cleaver

Installing the cleaver

- Screw the turntable to the top panel (4) using the two bolts (1).
- Then secure the cleaver (3) to the turntable using the two bolts (2).

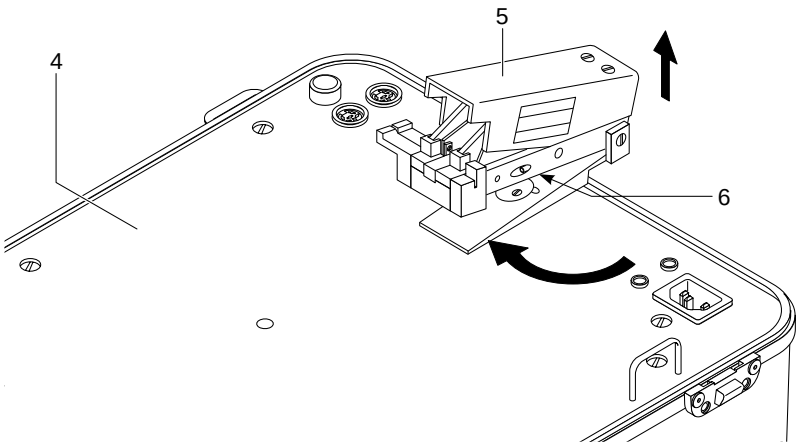


Installing the Cleaver

Operating position

Move the cleaver from the transport position to the operating position:

- Do this by turning the cleaver (5) clockwise through 90°, lifting it slightly at the same time. A sprung flap springs out and functions as a support.



Installing the Cleaver

Transport position

- Turn the cleaver (5) counter-clockwise through 90°.
- Press the sprung flap (6) inwards, letting the cleaver fold down at the same time.

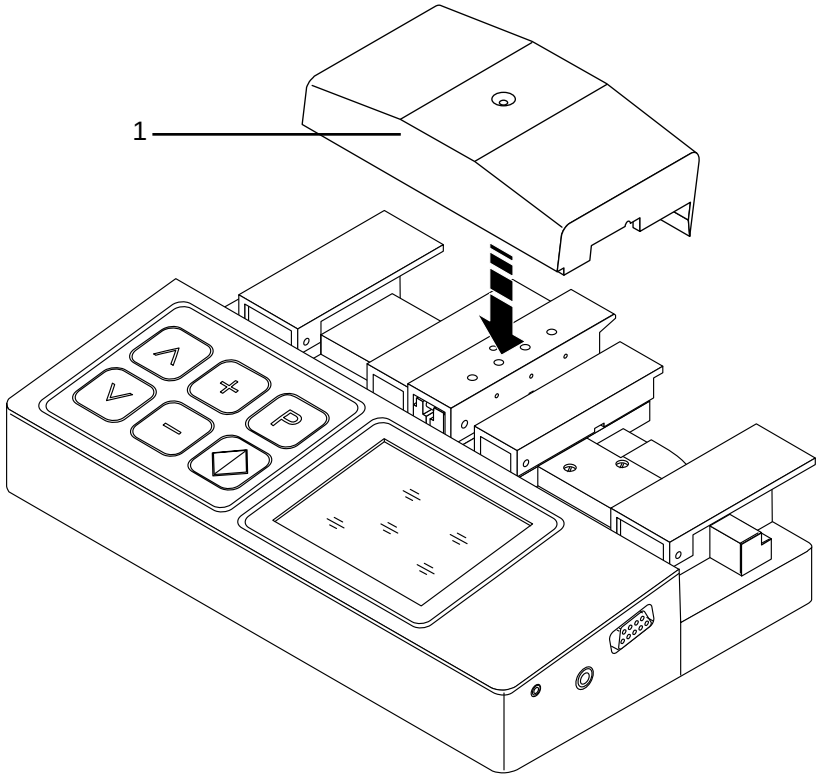
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Wind Protection

The M90 can be equipped with wind protection which assures the usual high quality splicing results even when strong winds prevail. The wind protection device is stored in the cover of the splicer case.

Installing Wind Protection

- Insert the fiber into the splicer and close all flaps.
- Remove the wind protection device from its storage clips in the splicer case cover.
- Push the wind protection device (1) over the splicer flaps (see diagram).



- Remove the wind protection device after the splice has been completed. The flaps can now be opened and the splice removed.

Wind Protection Storage

- Remove the wind protection device from the M90 splicer and press the wind protection device into the storage clips in the splicer case cover.

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