

## 1. Splice Mode

The optimal splice setting for a specific fiber combination consists of the splicing parameters listed below. In other words, the optimal splicing parameters depend on the fiber combinations, and are different from fiber to fiber.

- Parameters for controlling arc discharge / heating.
- Parameters for calculating estimated splice loss.
- Parameters for controlling fiber alignment and splicing procedures.
- Threshold for error messages.

A series of optimal splice parameters for major fiber combinations are already stored in the splicer. These parameters are stored in the database area and can be copied to the user-programmable area. These splice parameters can be edited for a specific fiber combination.

### How to select the “Splice Mode”

- [AUTO SM/NZ/DS/MM]

Use this mode if the fiber type is not identified.

- [SM AUTO] and others

Use this mode if the fiber type is identified.



- [SM FAST] and others

Use this mode if the fiber type is identified and prefer quick splice with high yield to consistent splice loss.

- [SM-SM] and others

Use this mode for splicing special fibers. This mode enables to set specific parameters for each splicing. Execute [Arc Calibration] before using this mode.

Database

Splice Mode	Description
AUTO SM/NZ/DS/MM	<p>This splice mode observes the core profile of the optical fiber, and automatically identifies the fiber type being SM, MM or NZDS. A set of splicing parameters is selected for the identified fiber type and the fibers are automatically spliced. This is beneficial if the fiber type is uncertain. The identified fiber type is displayed in the lower left hand corner of the monitor.</p> <p>The heat amount applied to the fiber is calibrated in real time by analyzing the cladding illumination during arc discharge then adjusting the arc current accordingly. This splice mode does not require operator to perform an arc calibration.</p> <div style="border: 1px solid black; border-radius: 15px; padding: 10px; margin-top: 10px;"> <p style="text-align: center;"> Points to note of AUTO mode</p> <ol style="list-style-type: none"> <li>(1) Fiber types that can be identified are standard SM, MM and NZDS. However, some fibers with unique core profile may not be correctly identified. If this is the case, the recommendation is to use the other splice modes.</li> <li>(2) NZDS fiber is spliced using the splicing mode for standard NZDS. However, for best results, it is recommended that the optimum splice mode be selected for a specific type of NZDS fiber. This is due to the variation in the NZDS fiber properties and optimum splicing parameters are different from one type of NZDS fiber to the next.</li> <li>(3) The FSM-60S identifies each fiber independently. If the fibers are identified as different, this unit still continues to splice. Set [PAUSE] "ON" to confirm the fiber types</li> </ol> </div>

## Splice Menu

Splice Mode	Description
SM-FAST	For splicing standard Single-mode fiber (ITU-T G652). The MFD is 9 to 10 um at wavelength of 1310 nm. Automatic arc calibration doesn't work in this splice mode. Execute [Arc Calibration] before splicing.
NZ- FAST	For splicing Non-zero dispersion-shifted fiber (ITU-T G655). The MFD is 8 to 10 um at wavelength of 1550 nm. Automatic arc calibration doesn't work in this splice mode. Execute [Arc Calibration] before splicing.
DS- FAST	For splicing Dispersion-shifted fiber (ITU-T G653). The MFD is 7 to 9 um at wavelength near 1550 nm. Automatic arc calibration doesn't work in this splice mode. Execute [Arc Calibration] before splicing.
MM- FAST	For splicing Multi-mode fiber (ITU-T G651). Core diameter : 50.0 to 62.5 um Automatic arc calibration does not work in this mode. Execute [Arc Calibration] before splicing.
SM AUTO	For splicing standard Single-mode fiber (ITU-T G652). The MFD is 9 to 10 um at wavelength of 1310 nm. Automatic arc calibration works in this splice mode.
NZ AUTO	For splicing Non-zero dispersion-shifted fiber (ITU-T G655). The MFD is 9 to 10 um at wavelength of 1550 nm. Automatic arc calibration works in this splice mode.
MM AUTO	For splicing Multi-mode fiber (ITU-T G651). Core diameter : 50.0 to 62.5 um Automatic arc calibration works in this splice mode.
DS AUTO	For splicing Dispersion-shifted fiber (ITU-T G653). The MFD is 7 to 9 um at wavelength of 1550 nm. Automatic arc calibration works in this splice mode.
Other splice modes	There are many types of splice modes in this splicer, other than the ones stated above, stored in the splicer database. Select a "BLANK" splice mode, and press <b>[Menu]</b> key. Then press <b>[Enter]</b> key. Typical splice modes stored in the database are displayed. Select one splice mode to be used.

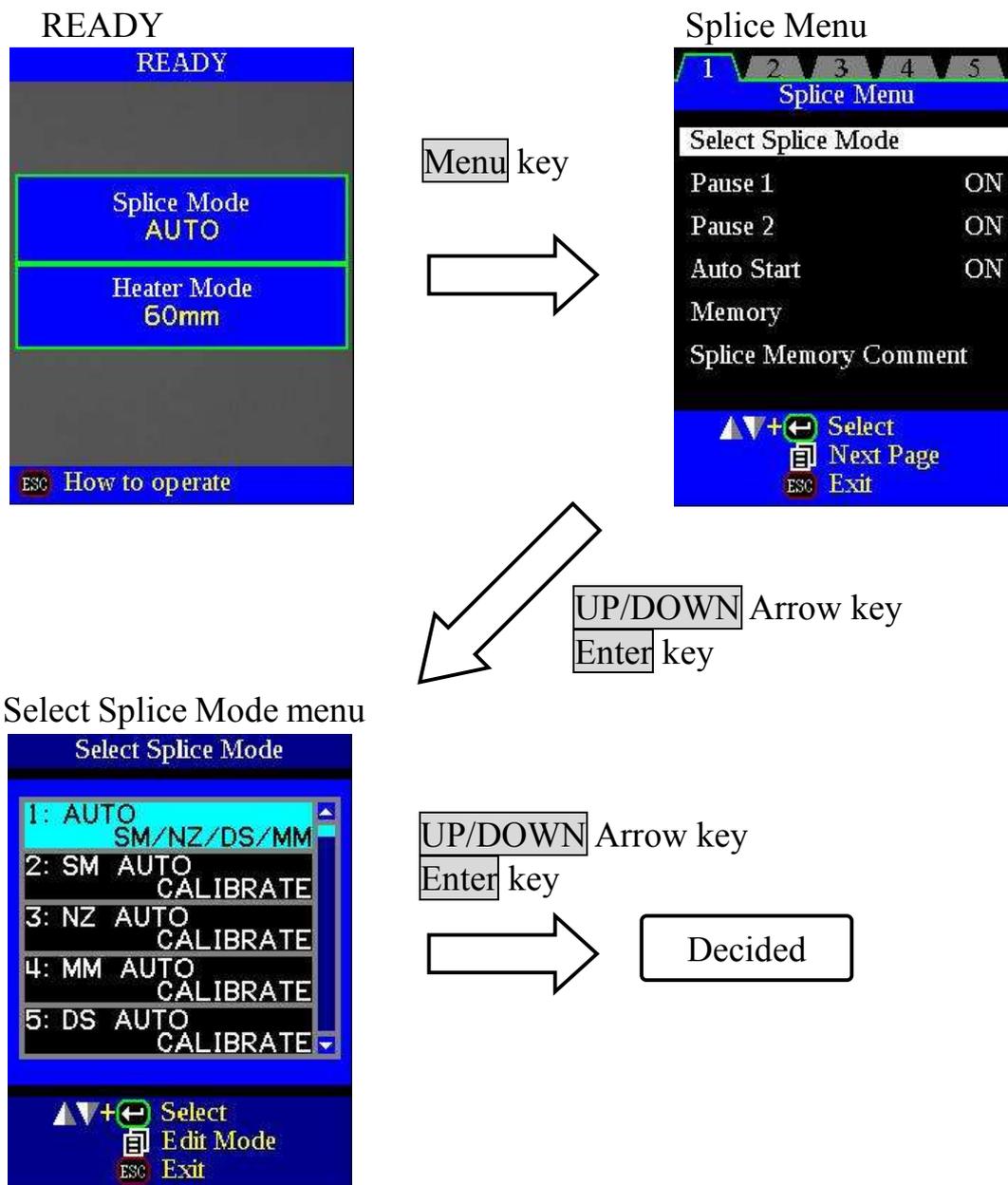
## 1-1. Splice mode selection

Select an appropriate splice mode for type of fiber to be spliced.

- (1) Press **Menu** key at [READY], [PAUSE1], [PAUSE2] or [FINISH] state to open [Splice Menu]. Select [Select Splice Mode] and the [Select Splice Mode] menu is displayed.
- (2) Move cursor by pressing **Up/Down** Arrow key and press **Enter** key to select [Splice mode].



- Pressing **ENTER** key at [READY] screen takes shortcut to [Select Splice Mode].



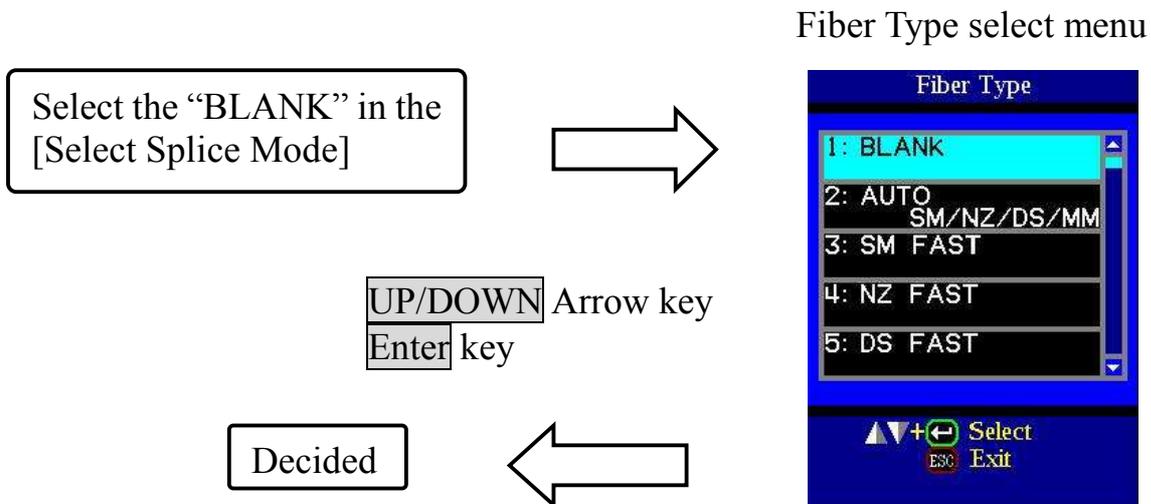
# Splice Menu

## 1-2. Creating or erasing splice mode

### How to create splice mode

There are necessary splice modes stored when the splicer is first delivered, and all the other modes are displayed [BLANK]. Follow the below steps to add splice mode.

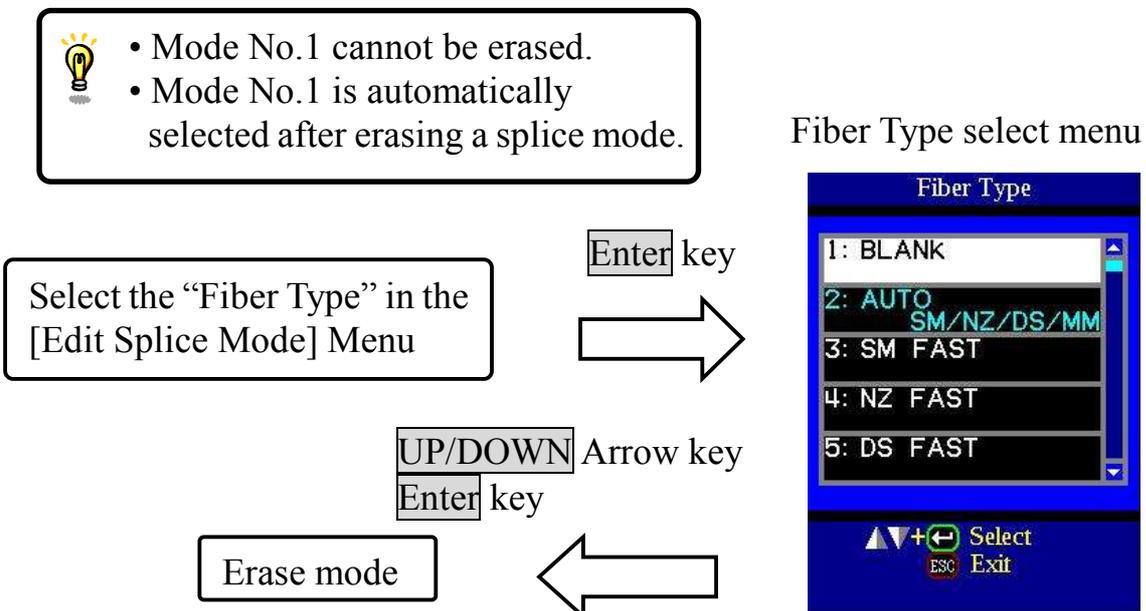
Select a “BLANK” splice mode and press **Menu** key. Typical splice modes stored in the splicer database are displayed. Select one splice mode to be copied. Press **Enter** key to execute. Press **Escape** key to verify the fiber type is named in the specific splice mode.



### How to erase splice mode

Splice mode can be erased. Follow the below steps to erase splice mode.

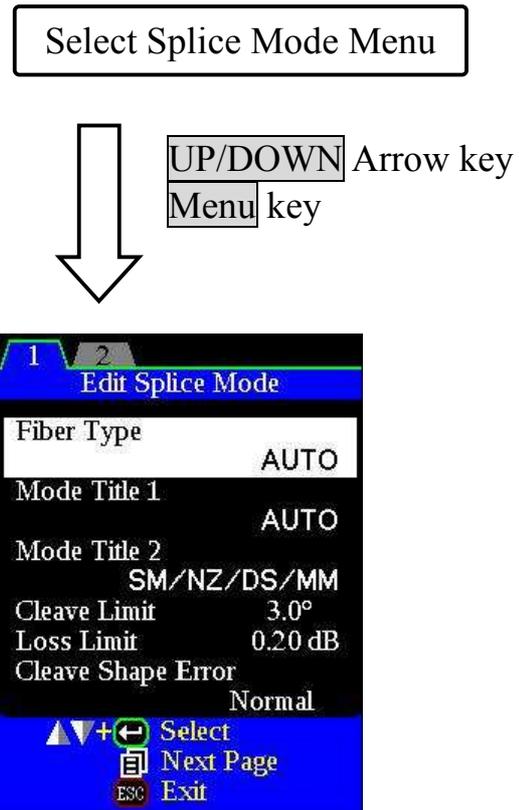
- (1) Select the specific splice mode and press **Menu** key to go to [Edit Splice Mode] menu. Select [Fiber Type] by pressing **Enter** key.
- (2) Select the “BLANK” and press **Enter** key to execute.



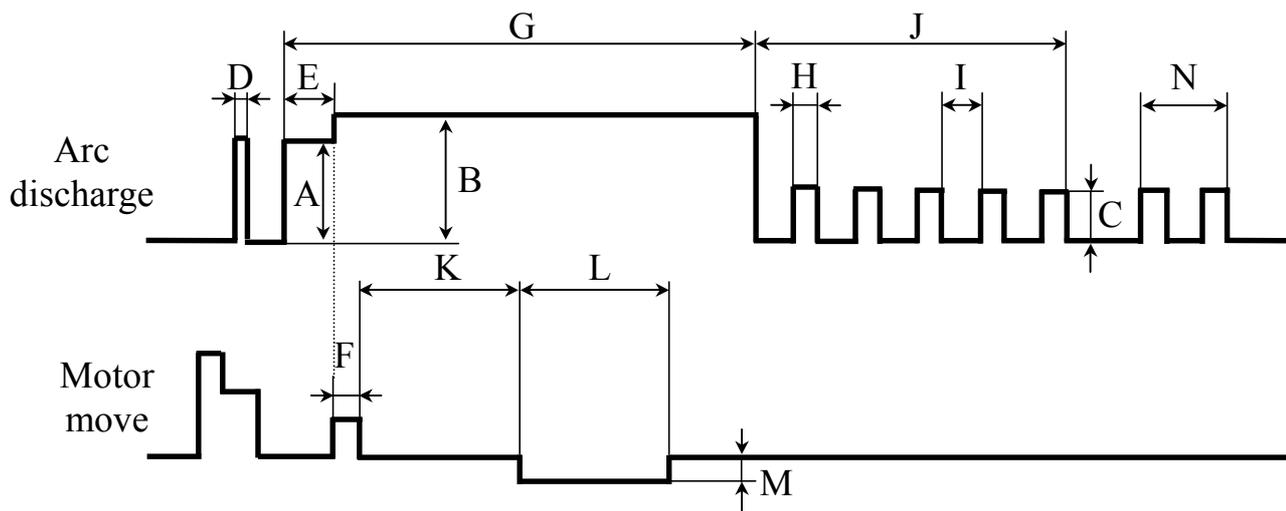
## 1-3. Referring or editing splice mode

Splicing parameters in each splice mode can be modified. Arc power and Arc time are considered the two most vital parameters. To edit parameters follow below steps:

- (1) In [Select Splice Mode] menu, move cursor to a splice mode to be modified. Press **Menu** key to display [Edit Splice Mode] menu.
- (2) Move cursor by pressing **Up/Down** Arrow key to a parameter to be changed.
- (3) Press **Enter** key to select parameter. Press **Up/Down** Arrow key to change its values. Press **Enter** key to accept changed values.



Below is a figure showing the Arc discharge conditions (relationship between "Arc power" and "Motor motion"). The conditions can be edited by changing the splicing parameters listed below. Depending on splice mode, certain parameters cannot be changed.



- |                                     |  |                |
|-------------------------------------|--|----------------|
| A: Prefuse Power,                   | B: Arc1 Power,                         | C: Arc2 Power, |
| D: Cleaning Arc,                    | E: Prefuse Time,                       |                |
| F: Forward Time related to Overlap, | G: Arc1 Time,                          |                |
| H: Arc2 ON Time,                    | I: Arc2 OFF Time,                      | J: Arc2 Time,  |
| K: Taper Wait Time,                 | L: Taper Time related to Taper Length, |                |
| M: Taper Speed,                     | N: Rearc Time                          |                |

## Splice Menu

Below is a list of Splicing parameters for AUTO modes

AUTO mode : [AUTO], [SM AUTO] ], [MM AUTO] ], [NZ AUTO], [DS AUTO]

Only a limited number of parameters listed below are displayed for AUTO, SM, DS, MM and NZ modes to simplify the operation. Additional hidden parameters are all fixed values set at the factory.

Parameter	Description
Fiber Type	List of splice modes stored in database is displayed. A selected splice mode stored in the database area is copied to a selected splice mode in the user-programmable area.
Mode Title1	Title for a splice mode expressed in up to nine characters.
Mode Title2	Detail explanation for a splice mode expressed in up to 15 characters. Title2 is displayed at the [Splice Mode Select] menu.
Cleave Limit	An error message is displayed if the cleave angle of either the left or right fiber ends exceeds the selected threshold (cleave limit).
Loss Limit	An error message is displayed if the estimated splice loss exceeds selected threshold (loss limit).
Cleave Shape Error	Error message is displayed if the cleaved end face of either left or right fiber exceeds the selected threshold (cleave shape).
Arc Power	The Arc Power is fixed. The Arc Power is changed automatically.
Arc Time	Arc Time is fixed. This is automatically set depending on the fiber type when AUTO mode is selected.
Cleaning Arc	A cleaning arc burns out micro dust on the surface of the fiber with an arc discharge for a short period of time. The duration of the cleaning arc can be changed by this parameter.
Rearc Time	Splice loss may be improved by an additional “rearc” discharge in some cases. The duration of this additional arc can be changed by this parameter.



- Menus change when [Fiber Type] is set other splice modes, e.g. SM-SM mode.

Splicing parameters: special modes

Special mode : e.g. [SM-SM]

In other splice modes in the user-selectable database, the user can select one from a series of factory-set splicing modes for various splicing combinations. Below are the descriptions of the various parameters used in these modes.

Parameter	Description
Fiber Type	A list of splice modes stored in the splicer database is displayed. Upon inputting the appropriate mode, the selected splice mode stored in database area is copied to a selected splice mode in user-programmable area.
Mode Title1	Title for a splice mode expressed in up to nine characters.
Mode Title2	Detail explanation for a splice mode expressed in up to 15 characters. Title2 is displayed at the [Splice Mode Select] menu.
Align	Sets the aligning method for the fibers. “Core” : Aligns fibers by core position. “Clad” : Aligns fibers by center position of the cladding of the fiber. “Manual” : Aligns fibers manually.
Focus-L Focus-R	Sets the focal point for fiber observation. The focal point moves closer to the core when [Focus] value is increased. "Auto" focus is strongly recommended, as [Focus] optimization is very difficult. Left and right fibers are focused independently even if they are a different fiber type (dissimilar fiber splicing). If the fiber core cannot be observed (e.g. MM fiber), use the “Edge” parameter. [Align] and [Est. Mode] are automatically fixed to the “Clad” setting. [ECF] and [Auto Power] are automatically fixed to the "OFF" setting.
ECF	Sets the axial offset ratio for ECF. See [ECF Splice] for detail. For a splice mode in which arc time is 5 sec. or longer, setting [ECF] "OFF" is recommended. If [Align] is set to "Edge", “Clad” or "Manual", [ECF] is automatically fixed to "OFF". If [ECF] is set "OFF", [Auto Power] is automatically fixed to "OFF".
Auto Power	Optimizes Arc power according to core concentricity-error. This function is used in combination with ECF. If [ECF] is set to "OFF", [Auto Power] is automatically fixed to "OFF"
Proof Test	If [Proof Test] is set to "ON", a proof-test is performed upon opening the wind protector after splicing or by pressing the <b>SET</b> key.

## *Splice Menu*

Parameter	Description
Cleave Limit	An error message is displayed if the cleave angle of either the left or right fiber ends exceed the selected threshold (cleave limit).
Loss Limit	An error message is displayed if the estimated splice loss exceeds the selected threshold (loss limit).
Fiber Angle Limit	An error message is displayed if the bend angle of the two fibers spliced exceeds the selected threshold (Fiber Angle Limit).
Cleave Shape Error	Error message is displayed if the cleaved end face of either left or right fiber exceeds the selected threshold (cleave shape).
Cleaning Arc	A cleaning arc burns off micro dust on the surface of the fiber with an arc discharge for a short period of time. The duration of the cleaning arc can be changed by this parameter.
Gap	Sets the end-face gap between the left and right fibers at the time of aligning and pre-fusion discharge.
Gapset Position	Sets the relative position of the splicing location to the center of electrodes. Splice loss may be improved in the case of dissimilar fiber splicing by shifting [Gapset Pos] towards a fiber whose MFD is bigger than the other fiber MFD.
Prefuse Power	Sets the power of the prefuse arc, which is an arc discharge occurring from the beginning until the fibers begin stuffing. If [Prefuse Power] is set too low, axial offset may occur if cleaved angles are relatively poor. If [Prefuse Power] is set too high, fiber end faces are fused excessively and splice loss gets worse.
Prefuse Time	Sets the duration of the prefuse arc, which is arc discharge occurring from the beginning until the fibers begin stuffing. Longer [Prefuse Time] is synonymous with higher [Prefuse Power].
Overlap	Sets the overlap amount of fibers at the fiber stuffing stage. Relatively small [Overlap] is recommended if the [Prefuse Power] is low, while relatively large [Overlap] is recommended if the [Prefuse Power] is high.
Arc1 Power	Arc discharge can be separated into two stages. Arc1 Power is the first stage. This sets Arc1 Power.
Arc1 Time	Sets Arc1 time. <b>Caution</b> If Arc1 Time is set 1 sec. or less and Arc2 Power is set to "OFF", the splice may break during proof-test stage.

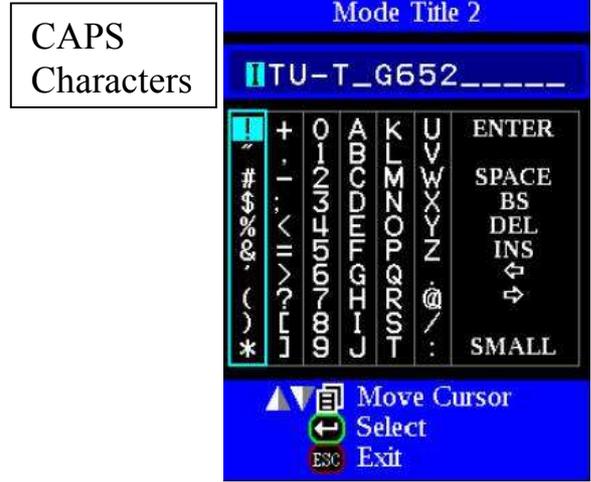
Parameter	Description
Arc2 Power	Arc2 is the second arc discharge stage. This sets Arc2 Power.
Arc2 Time	Sets the total Arc2 time. Usually set this value to "OFF". It is possible to set a very long arc time. However, when the total of the Arc 1 time and Arc2 time exceeds 30 seconds, always adjust the function [Arc2 ON Time] and [Arc2 OFF Time] to weaken the arc power. A continuous arc over 30 seconds, without weakening the arc power, may damage the arc discharge unit.
Arc2 On-Time	During Arc2 discharge, arc power can be pulsed by turning the arc on and off. This sets the amount of time that Arc2 is ON.
Arc2 Off-Time	Sets Arc2 OFF Time during Arc2. When the Arc2 discharge is intermittent, re-arc discharge is also intermittent. When continuous re-arc discharge is necessary, set this parameter to "OFF".
Rearc Time	Sets Rearc Time. In other splice modes, the Re-arc power is automatically fixed to the same arc power of [Arc2 Power]. If Arc2 is set ON and OFF, Re-arc is automatically set ON and OFF.
Taper Splice	Splice loss is sometimes improved when the fiber is tapered (pulled) during arc discharge to make the splice thinner. This sets taper function "ON". The following three parameters determine the taper shape.
Taper Wait	Sets the taper wait time from the end of fiber stuffing until the start of pulling fiber.
Taper Speed	Sets the fiber pulling speed.
Taper Length	Sets the fiber pulling length.
Estimating Mode	Selects splice loss estimation mode to "OFF", "Clad", "Core" or "Core-Fine". When MM fibers are spliced, select "Clad".
MFD-Left	Sets MFD of the left and right fibers. Both MFD-L & R are taken into account for estimating splice loss.
MFD-Right	
Minimum Loss	This amount is added to the estimated splice loss originally calculated. When splicing specialty or dissimilar fibers, a high actual splice loss may occur even with optimized arc conditions. To make the actual splice loss concur with the estimated splice loss, set the minimum value of estimate to the minimum optimized actual splice loss.
Core Step	Determines how Core step, Core curve and MFD mismatch influences splice loss estimate. If Est. Mode is set "OFF" or "CLAD", these Core step, Core curve and MFD mismatch are automatically set "OFF". If the estimated splice on certain fiber combinations needs adjustment, Core step, Core curve and MFD mismatch are used. These are advanced splicer functions and should be discussed with you authorized distributor before changing.
Core Curve	
MFD Mismatch	

# Splice Menu

## 1-4. How to input Mode Title / Comment / Password

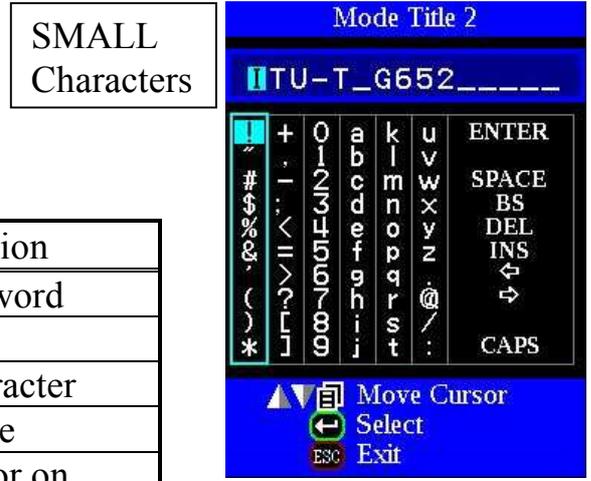
Character list below is displayed by selecting Mode Title / Comments / Password.

(1) Move the cursor by pressing [Up/Down] Arrow key, [Menu] key, and press [Enter] key to input the selected character. If an incorrect character is inputted, move the cursor to [BS] and press [Enter] key to highlight the character, and then input the proper character over it.



(2) Move cursor to [ENTER] on left side and press [Enter] key on completion of inputting characters.

(3) In the case of Password input, the next screen image is displayed if the correct password is inputted. If the input password is incorrect, the previous screen image is displayed.

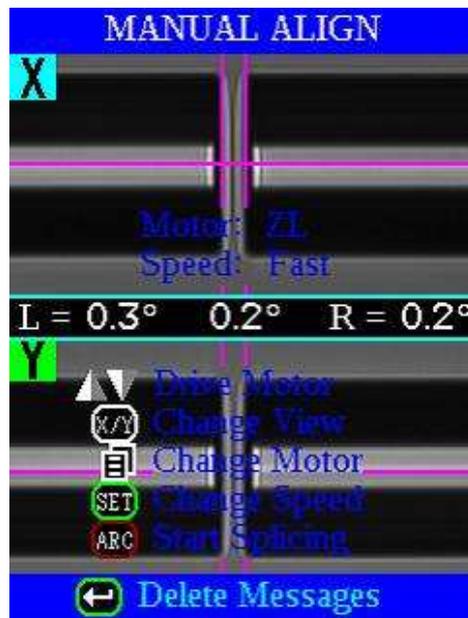


	Description
[ENTER]	Input the Password
[BS]	Back Space
[DEL]	Delete the character
[INS]	Insert the Space
[Left] and [Right] arrow	Move the cursor on inputted character
[SMALL] or [CAPS]	Change the character type

## 1-5. Manual Splice Mode

This mode is to manually align and splice fibers. The following procedure is required, and is different from standard automatic splicing.

- (1) Select a splice mode that allows the splice parameter [Align] in page two of splice mode edit menu to be changed to "manual" (i.e. SM-SM mode).
- (2) Press **SET** key to drive the fibers forward. The fibers stop moving forward at the Gapset position.
- (3) Select a motor to be manually moved by pressing **Menu** key. The name of the motor to be moved is displayed in the monitor. Motor speed can be selected "fast" or "slow" by pressing **SET** key.
- (4) Press **Up/Down** Arrow key to move the selected motor and drive the fibers forward or backward.
- (5) After manual alignment is completed, press **ARC** key to arc and splice the fibers.



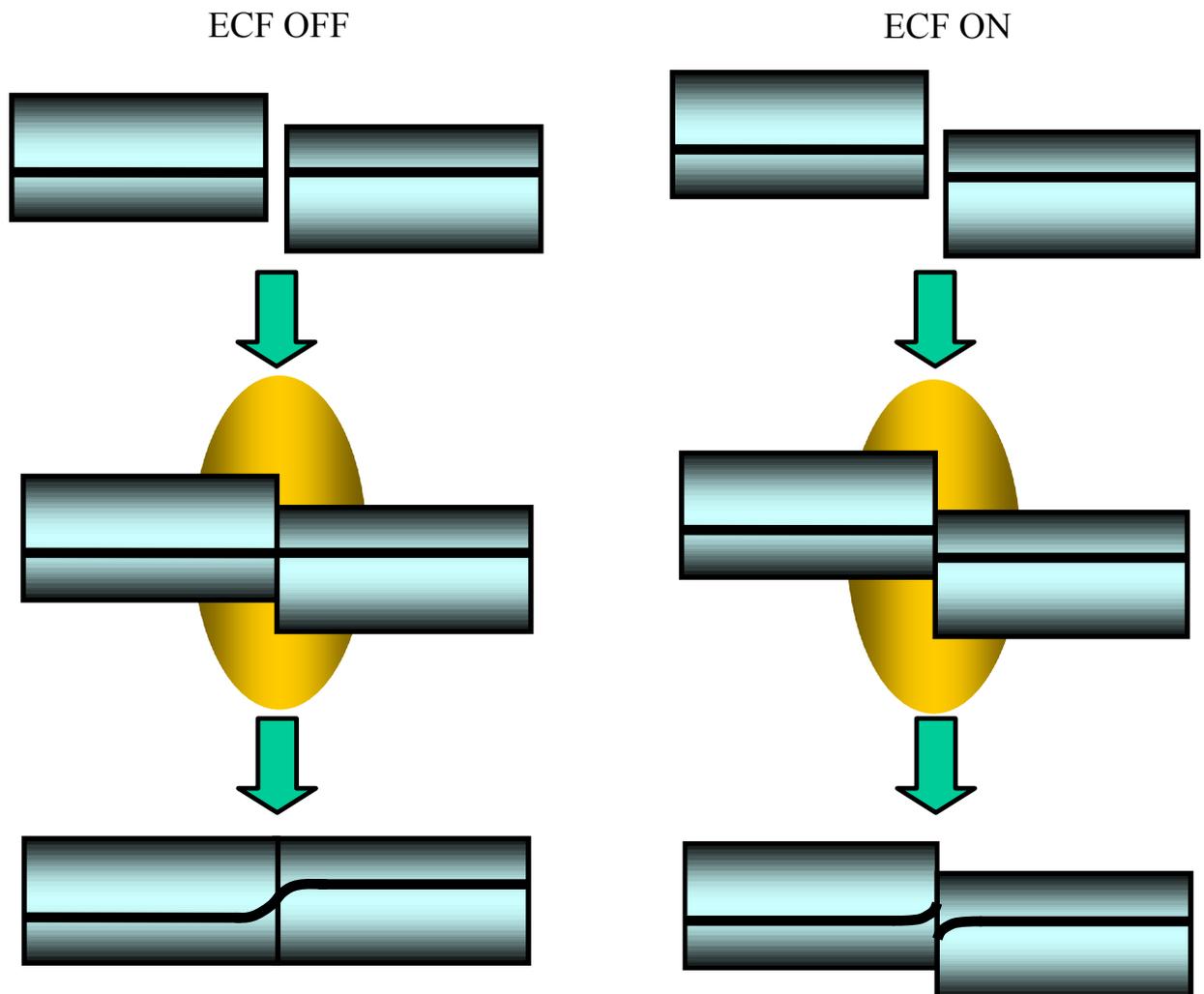
- The splicer beeps if motor reaches its limit and stops. Press the opposite arrow key to move the motor again.
- Display messages can be erased by pressing **ENTER** key. The message can be displayed by pressing **ENTER** key again.

Motor	<b>Up</b> Arrow key	<b>Down</b> Arrow key
ZL/ZR	Forward	Backward
X/Y	Upward	Downward
Focus X Focus Y	Lens moves nearer fiber.	Lens moves away from fiber.

## 1-6. ECF Splice

When fibers having some core concentricity-error are aligned using the core-to-core method, their outer claddings are not aligned in line with each other as shown below. However, surface tension created during arc discharge aligns the fibers cladding-to-cladding due to the viscous self-centering effect. This results in a high splice loss due to the fact that the cores of the fibers are offset during the process.

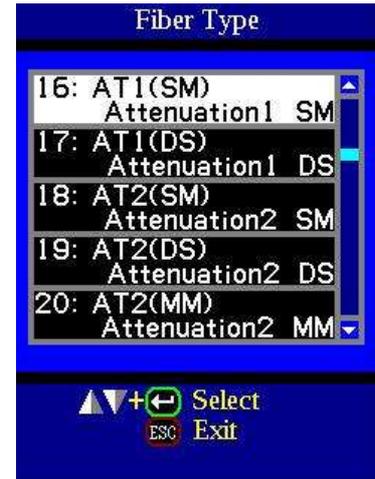
The ECF (Eccentricity Correct Function) function in the splicer prevents this from happening. The amount of offset expected due to this surface tension phenomenon is calculated in advance, and this is taken into account to determine an intentional core axis offset amount that is added after the fiber cores are aligned. With this function, the fibers are core-to-core spliced even with the effect mentioned above. Some "Core step" may remain at splice point but this gives much lower splice loss than core axial offset. A long arc discharge counteracts ECF, because surface tension eventually aligns and splices fibers cladding-to-cladding. Canceling [ECF] by setting this "OFF" reduces core step amount and increases core axial offset.



## 1-7. Attenuation splice mode

Attenuation splice mode makes an intentional core axial offset to create attenuation at the splice point. Two types of attenuation splice modes are included in the splicer as stated below.

Select either "AT1(SM)", "AT1(DS)", "AT2(SM)", "AT2(DS) or AT2(MM) in data base area at [Fiber Type].



### [AT1] mode

[AT1] creates an intentional core axial offset and splices fibers. [AT1] mode provides an estimated splice loss, but this should be regarded as a reference as the estimated splice loss may not be correct in some cases, depending on fiber properties. A power meter is recommended for correct splice loss measurements.

#### Splicing parameters

Parameter	Description
Target Loss	Sets target splice loss.
MFD	Sets MFD of fibers to be spliced.
Coefficient	If actual splice loss measured does not match [Target Loss], the "coefficient" can be used to adjust this. This is often more practical than "Target loss" or "MFD" in terms of accuracy.
Other Parameters	Refer to other splice modes for complete description.

### [AT2] mode

This mode allows the users to set a starting core offset value and a finishing core offset value. Set [Start Offset] manually and then splicing starts. Re-arc is performed continuously / automatically until the axial offset reaches [Stop Offset] value. A splice loss estimate is not performed.

#### Splicing parameters

Parameter	Description
Start Offset	Sets axial offset amount before splicing.
Stop Offset	Re-arc is continuously performed until axial offset reaches specific offset amount [Stop Offset]. Axial offset amount decreases as splicing occurs, so [Stop Offset] must always be smaller than [Start Offset]. The maximum amount of [Stop Offset] is 80% of [Start Offset].
Other Parameters	Refer to other splice modes for complete description.

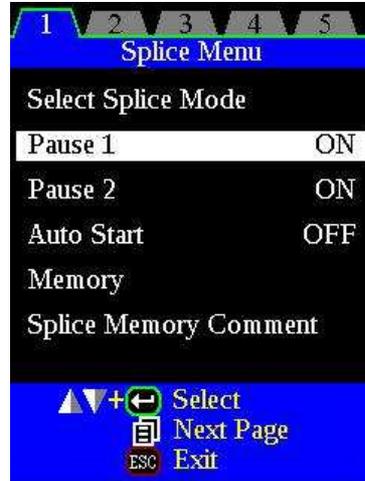


- [AT2] mode provides more stable performance than [AT1] mode, but some variation may inevitably occur. To decrease variation, set the [Cleave Limit] as low as possible.
- Attenuation splices made with [AT1] / [AT2] modes are not as accurate as power meter attenuation feedback splicing.
- [AT2 (MM)] mode is for attenuation splicing with MM fiber. Cladding alignment is performed with [AT2 (MM)] mode.

## 2. Splice Option

Common parameters for all the modes for splicing and tube heating can be set.

- (1) Press **Menu** key at [READY], [PAUSE1], [PAUSE2] or [FINISH] state to open [Splice Menu].
- (2) Select a parameter to be changed.
- (3) Press **Enter** key to change values.



### Setting parameters

Parameter	Description
Pause1	If "Pause1" is set to "ON", splicing operation pauses when fibers are forwarded to gap-set position. Cleave angles are displayed during the pause.
Pause2	If "Pause 2" is set to "ON", splicing operation pauses after fiber alignment is completed. With ECF "ON", core-to-core alignment is made after this pause.
Auto Start	If "Auto Start" is set to "ON", splicing starts automatically as soon as the wind protector is closed. Fibers should be prepared and placed into the splicer in advance.

# Splice Menu

## 3. Splice Memory

This splicer stores up to 2,000 splicing results. Contents of data stored are different depending on splicing mode. No results are stored for "attenuation splicing".

SM / NZ / DS / MM / AUTO



Others



## 3-1. List of Splice Results

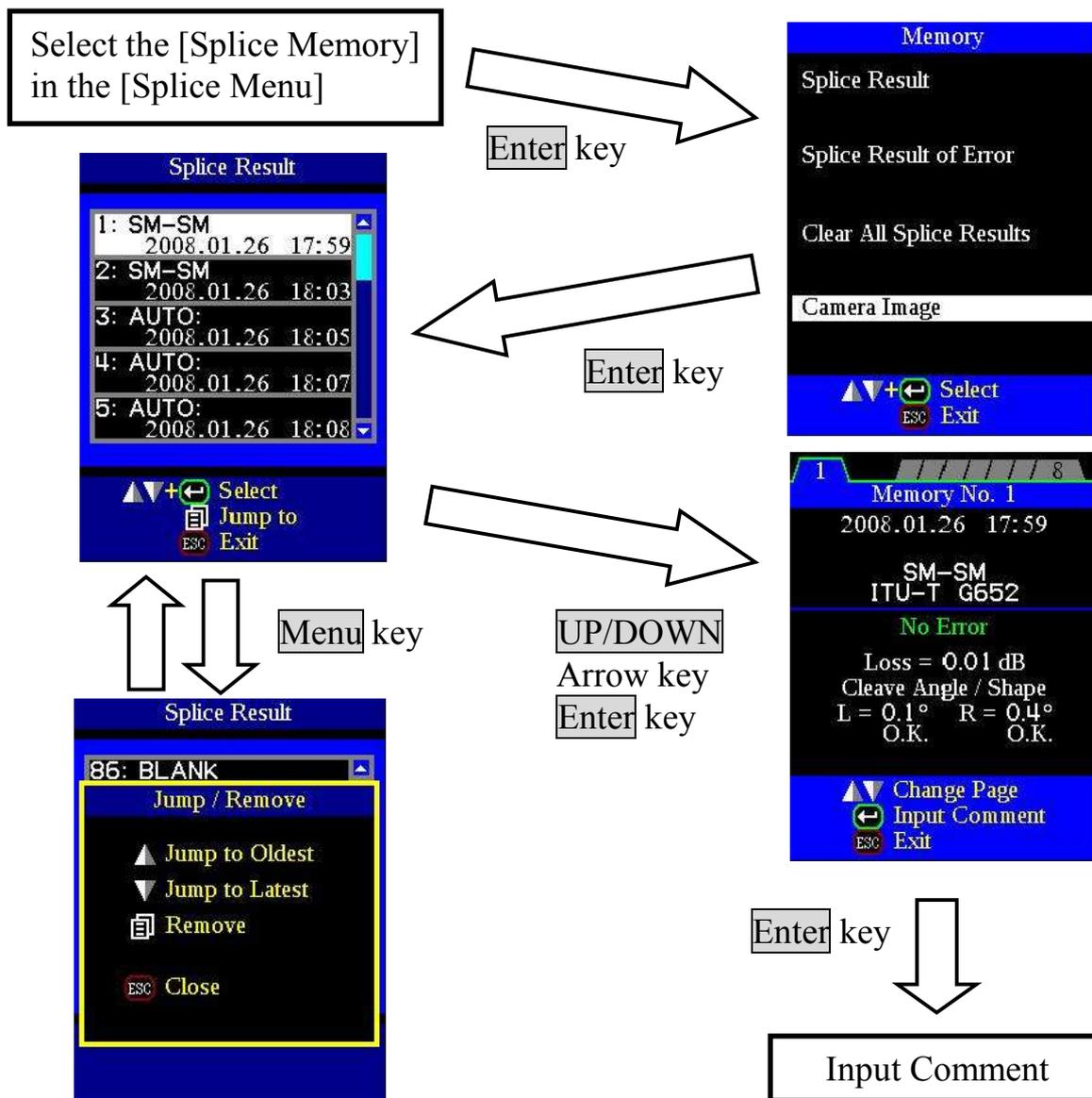
Splicing results stored in the memory can be displayed. Comments can be added or edited.



- Memory Data can be downloaded by USB. Refer to instruction manual of “FSM Data Connection”.

### How to display the splice Result data

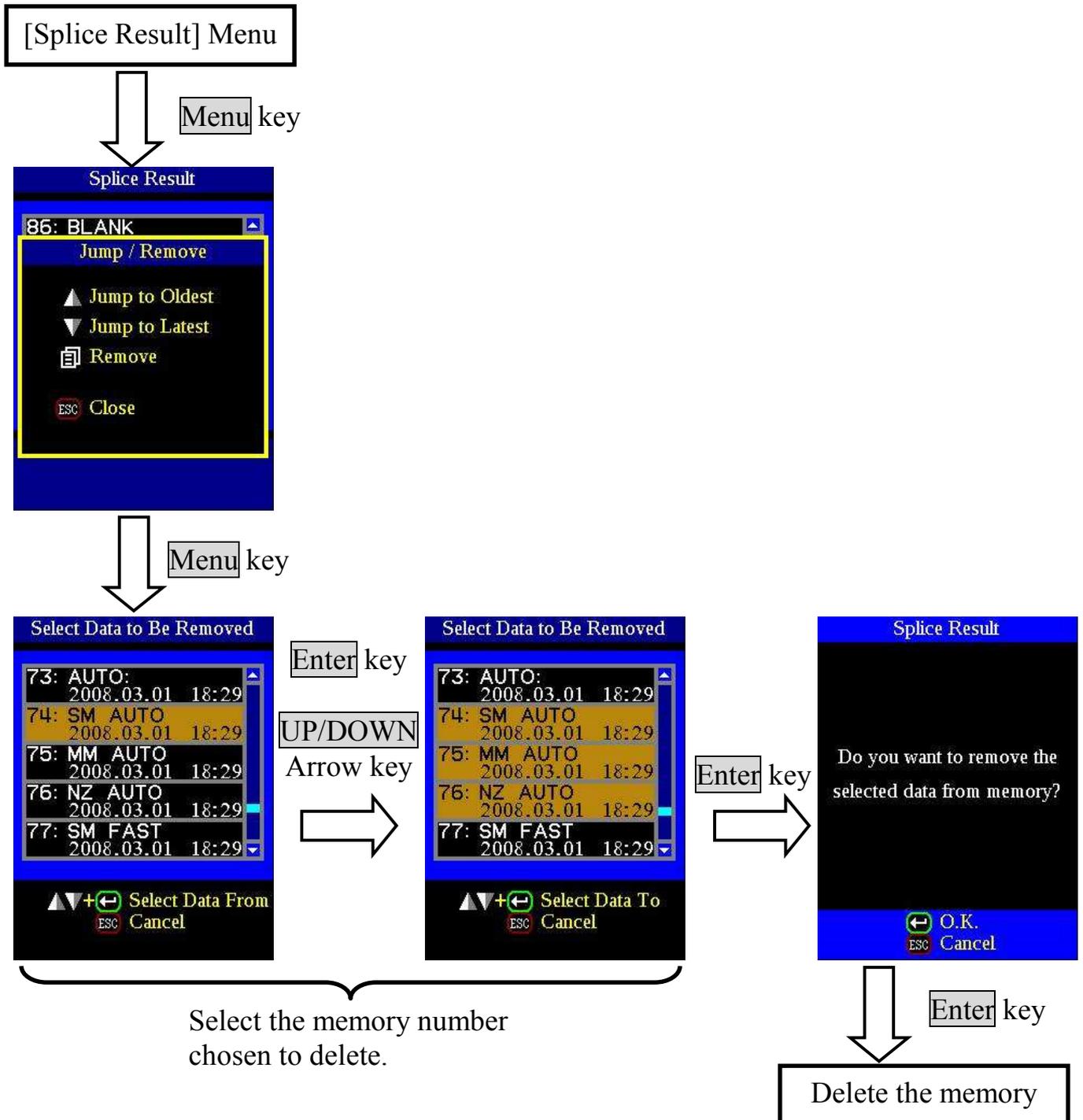
- (1) Select [Memory] in [Splice Menu].
- (2) Select [List of Splice Results] and press **Enter** key to display [List of Splice Results] Menu.
- (3) Select memory number by moving cursor to a specific memory number and press **Enter** key. The selected splicing result is displayed..  
It can jump to press **Menu** key in [Splice Result] Menu to display [Jump /Remove] screen. Select the oldest data or Latest data by pressing **Up/Down** Arrow key.
- (4) The selected splicing result is displayed. For adding or editing comments, press **Enter** key to display [Input Comment] screen.



# Splice Menu

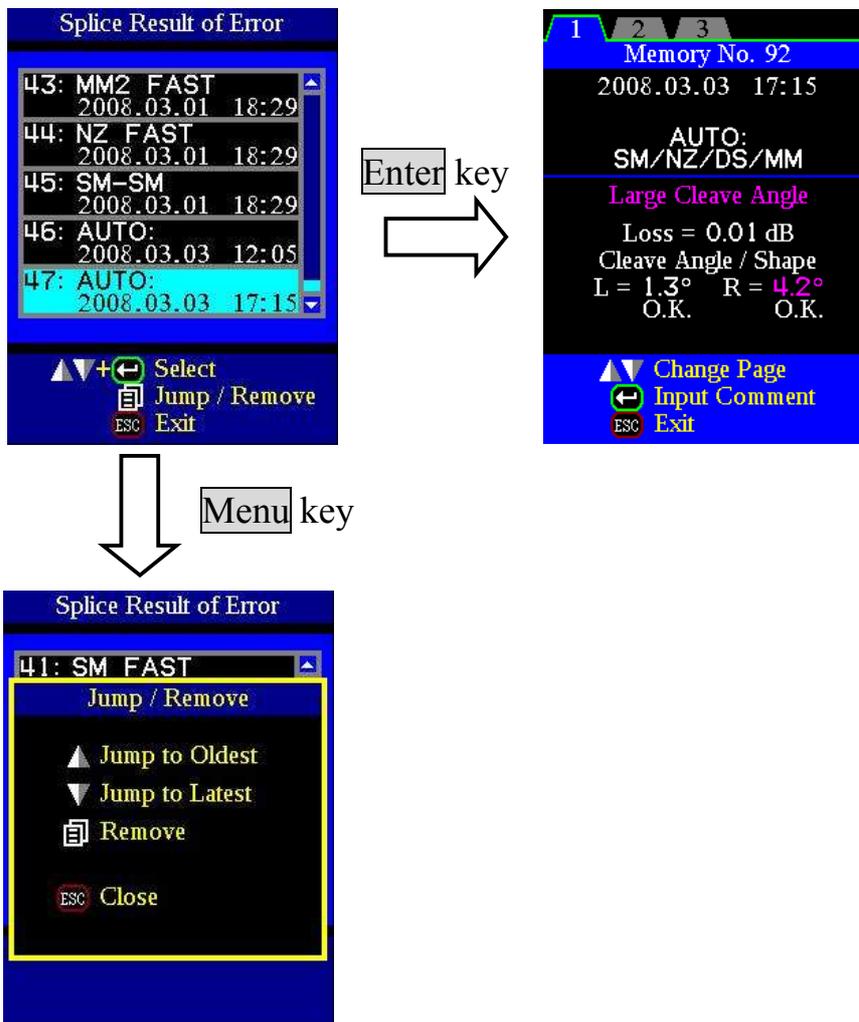
## How to Clear the Splice Results data

- (1) Press **Menu** key in [Splice Result] Menu.
- (2) Press **Menu** key in [Jump / Remove] Menu.
- (3) The memory can be deleted by pushing **Enter** key again.
- (4) Select the memory of beginning of the range that wants to delete by **Enter** key.
- (5) Select the memory of ending of the range that wants to delete by **Up/Down** arrow key.
- (6) Press **Enter** key to decide the range. And press the Enter key to delete the memory.



## 3-2. Splice Result of Error

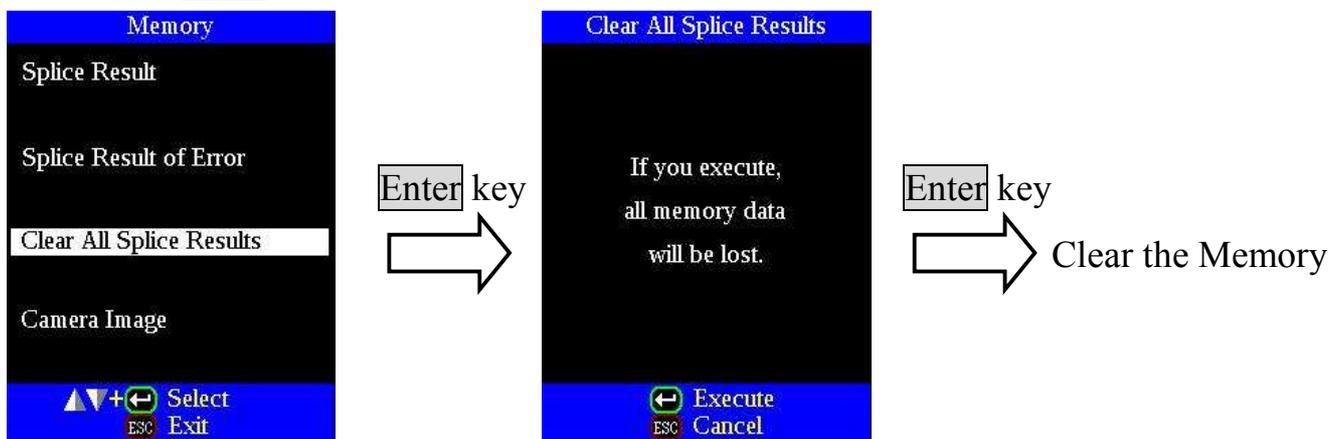
Only splice result with the error is sorted out among Splice Result and displayed. This method of the display and deletion is the same as "List of Splice Results".



## 3-3. Clear All Splice Results

All splicing results can be cleared at once.

- (1) Move cursor to [Clear All Splice Result] in Memory Menu. And Press the **Enter** Key.
- (2) Press **Enter** key to display [Clear All Splice Result].



# Splice Menu

## 3-4. Camera Image

This function is used to store the fiber image after splice or error occurred. A total of 8 images can be stored.

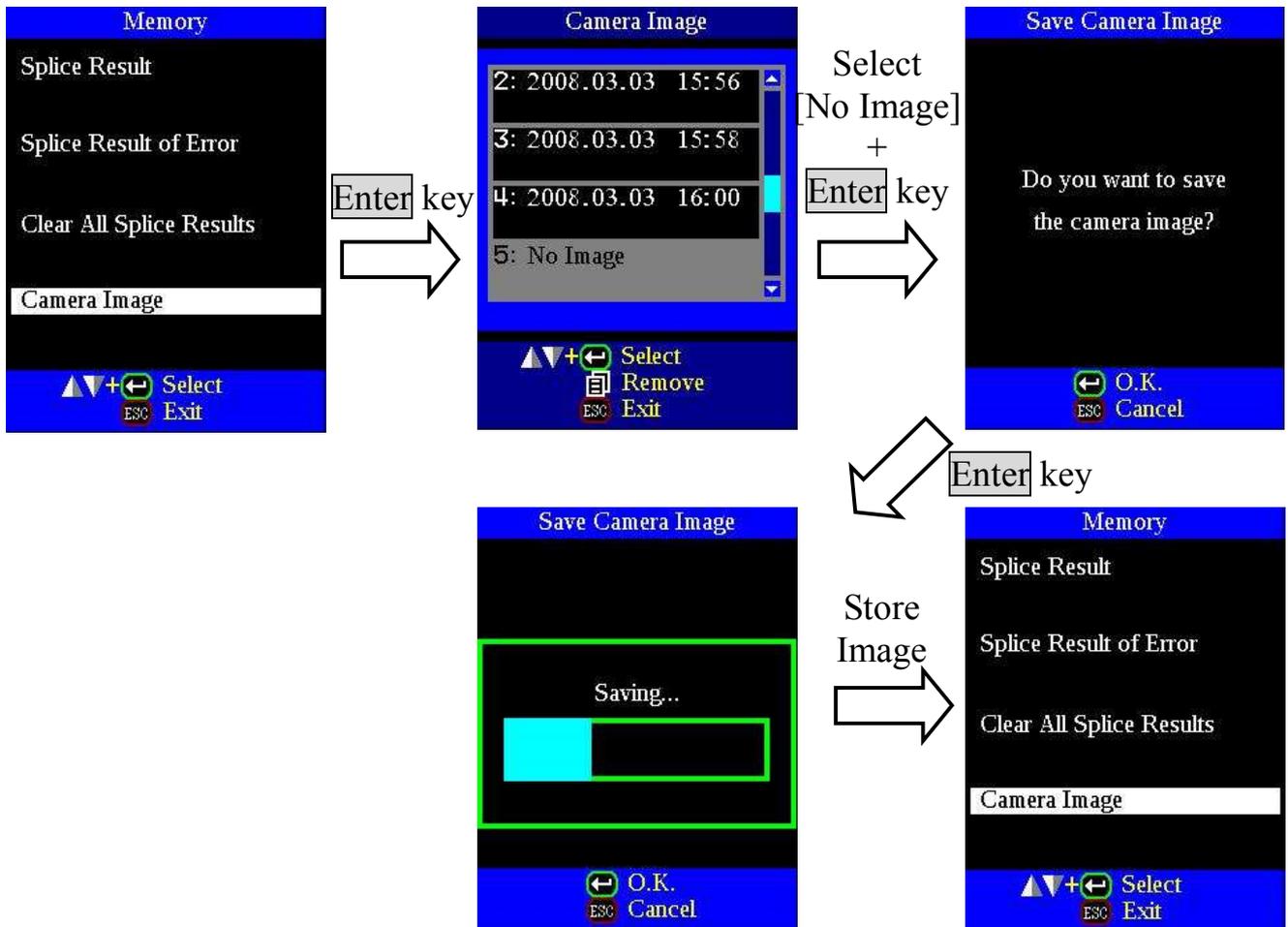
- (1) Select [Memory] in [Splice Menu].
- (2) Select [Camera Image] and press **Enter** key to display [Camera Image] Menu.

### How to store the Camera Image Data

Select [No Image] by moving cursor to a specific memory number and press **Enter** key. The fiber image data is stored.

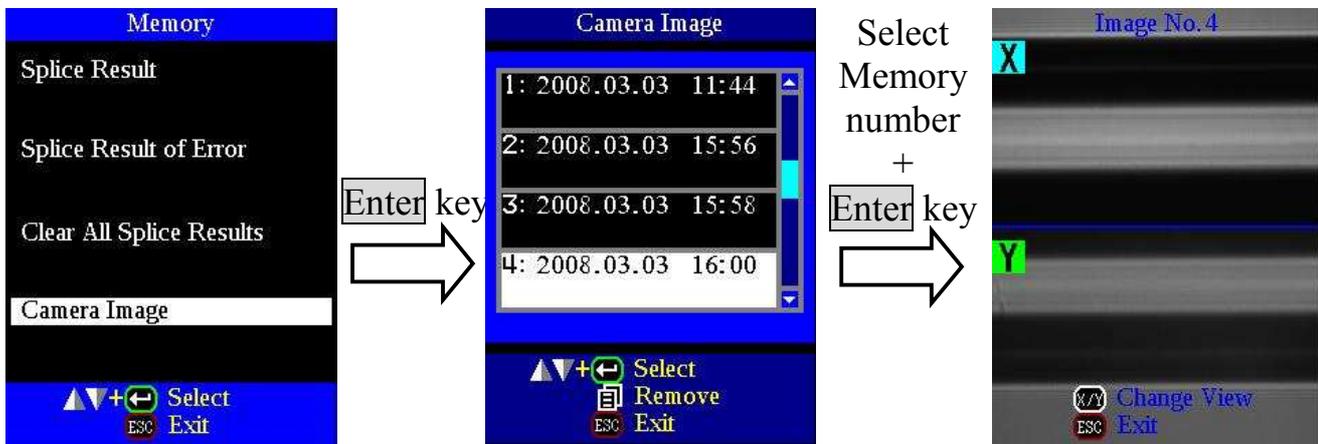


- Max number of image storage is 8, and the image cannot be over-written, so delete some images to store new images..



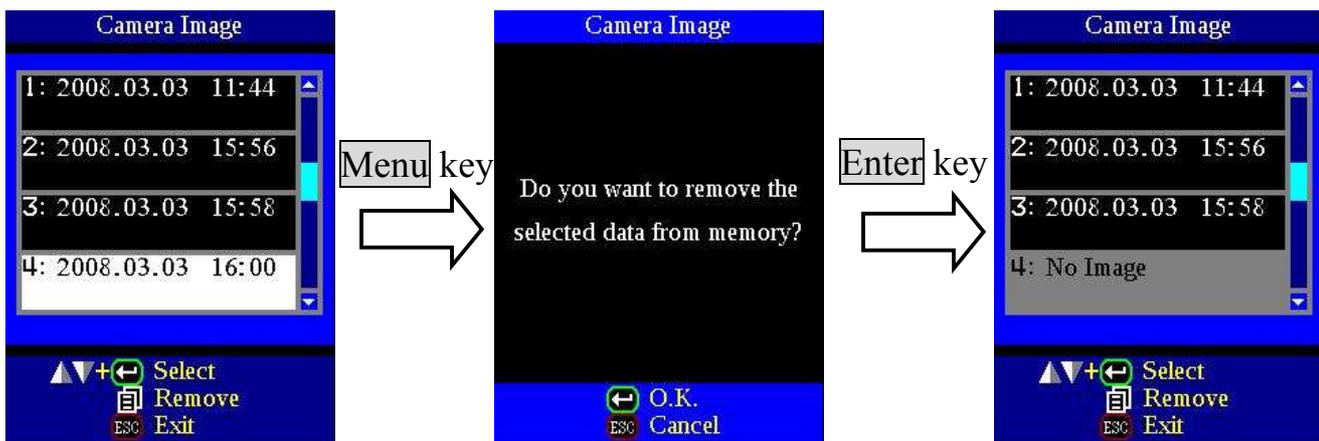
## How to display Camera Image Data

Select memory number by moving cursor to a specific memory number and press **Enter** key. The fiber image data is displayed.



## How to delete Camera Image Data

Select the number in [Camera Image] and press the **Menu** key. The confirmation screen is displayed, and then press **Enter** key.



## **4. Splice Memory Comment**

The splicing result is automatically stored in memory when **SET** or **RESET** is pressed upon completion of the splice at the [Finish] screen, or when the wind protector is opened upon completion of the splice at the [Finish] screen.

Once a certain comment is inputted, the same comment is inputted into subsequent splice results. To change comments, see page 68 [How to input Mode Title / Comment / Password] how to input the comment.

At the time of shipment from factory, there is no comment inputted.