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Active Cladding Alignment Fusion Splicing

This document details the principles and practices involved in fusion splicing optical fibres at the customer premises and splitter node. It provides practical information concerning the use of fusion splicing machines, plus preparing, stripping, cleaving, and protecting the fibres. The sequence of splicing machine operations and maintenance procedures are described.

About this document ...

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Issue 9	02-Feb-2023	David Wilson	Updated calibration sections
Issue 8	31-Jan-2023	David Wilson	Splice protector Item Update
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Issue 3	04-Nov-2020	Michael Rose	Item Codes, Shrinkdown time, Water damage updates, Gloves wearing
Issue 2	22-Jul-2020	Michael Rose	Item codes, safety update
Issue 1	05-Aug-2019	Michael Rose	Initial issue

Table of Content

1 Introduction

This document details the principles and practices involved in fusion splicing optical fibres. It provides practical information concerning the use of cladding alignment fusion splicing machines, plus preparing, stripping, cleaving, and protecting the fibres. The sequence of splicing machine operations and basic maintenance procedures are described.

2 Suitability

Active cladding splicing machines rely on cladding alignment. The splicer has no ability to view and manipulate the fibres to achieve good core alignment in the way a core alignment machine does. Therefore **the application of this splicer is more limited to more recent cable manufactured to a higher standard**.

The splicer **should be used on cable produced post 2010**. This will be for splicing at customer splice points and splitter nodes, occasionally aggregation nodes. You may experience higher loss with older cables that were not produced to a higher standard. Additionally, the splicer machine's loss estimate may be incorrect on these cables.

This splicer does not have a clamp for 0.2 micron coated fibre that is used in some overblow applications.

3 Splicing Instructions

3.1 Important Safety Precautions:

> **Warning:** Splicing Machines are designed and manufactured to assure personal safety. Improper use can result in fire, electric shock, or injury to persons.

This can also result in damage to equipment.

> **Warning:** Live lasers in optical fibre systems can cause serious injury.

The practices described and linked to in ISIS Directive SFY/CSP/B039 "Safe working practices for optical fibre systems" must be followed.

> **Warning:** There is a risk of serious injury to eyes and other body parts from fibre shards.

During Fibre preparation, broken Fibre may injure the eyes or other parts of the body. Always put on eye protection when handling optical Fibres, the cleaver and splicer and dispose of any fibre sharps properly.

Please see the Safety Handbook, Fibre and also the document "Cable Jointing including the provision of blown fibre" SFY/GRA/B002 and the associated risk

assessment for likely hazards and their mitigations, including the attachments that relate to these and instruction on control measures that must be adhered to.

3.2 Fibre Preparation and Cleanliness

- It is *essential* when splicing fibres that the fusion splicing machine, the fibre preparation tools and the fibres are kept extremely clean throughout the splicing process in order to achieve an acceptable, high strength, low loss splice.
- The cleaning should be done with lint-free wipes and buds and a small amount of an approved cleaning fluid, such as Sticklers fluid (All other IPA impregnated wipes are NOT approved) Gloves should be worn to avoid repeated skin contact with the fluid, as frequent contact may cause skin dryness/dermatitis.

> **Warning:** Toxic and Acidic Gases

- After cleaning fibre or the splicer with a small amount of Sticklers fluid it is vital to wait 15 seconds after applying fluid before shutting the splicer lid to allow the fluid to evaporate. If the cleaning cloth or grooves are heavily saturated with fluid this can take up to 60 seconds. Arcing with fluid releases toxic and acidic gases which can be a danger to the operator and damage the splicer.

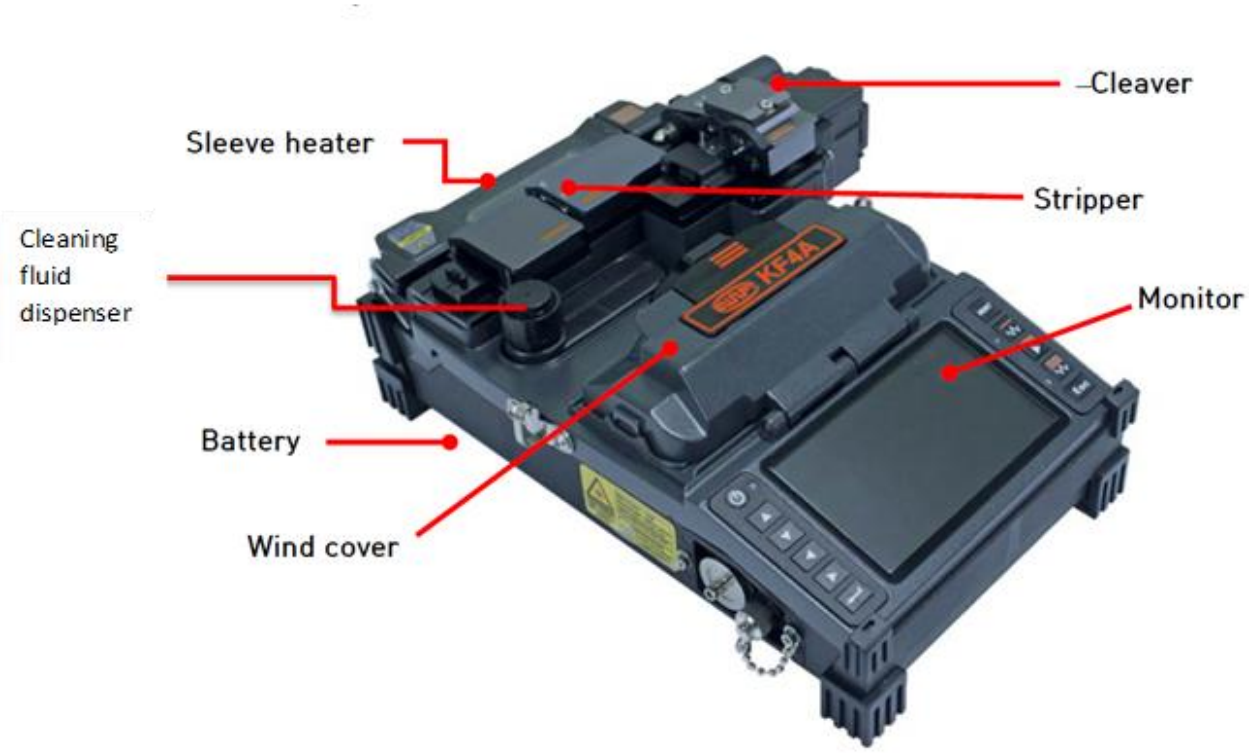
  Gas or canned air spray must not be used.

- It is advised to have a clean working area, to assist with the above. Simple measures such as wiping down a work bench/table with a wet wipe and cleaning hands can help achieve this. Maintain a clean splicer case and do not store rubbish or any dirt in this.

> **Warning:** Do not eat and splice at the same time, there is also a risk of accidentally ingesting fibre shards.

Item Code	Item Description
101271	SD Fibre Cleaning Kit
105490	Fibre Cleaning Fluid 196ml
100204	Cleanwipe Optical Grade Wipe
105488	Lint Free Cotton Buds
112320	Paintbrush

Table 1 Fibre Cleaning Items



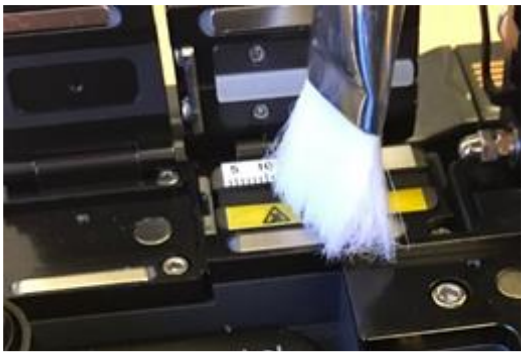
Component Name

3.3 Cleaning After Splicing

CLEANING THE KF4A AFTER USE IS ESSENTIAL FOR GOOD RESULTS!

A video showing the procedure **is** **Here**

- With the brush, clean the hot surface of the stripper.



- Clean the stripper blade and plastic pads.

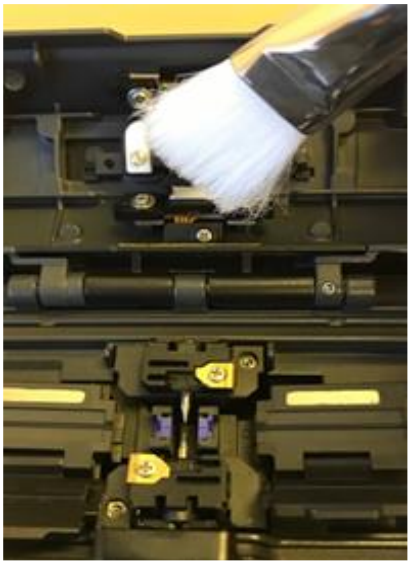
Note: Use a different brush for the next part of the cleaning so as not to introduce more dirt from the stripping process.

- Clean the cleaver pads and blade, Clean the cleaver lid pads too.

- Clean the fibre holders

- Clean the V-Grooves

- Clean the splicer lid clamp pads



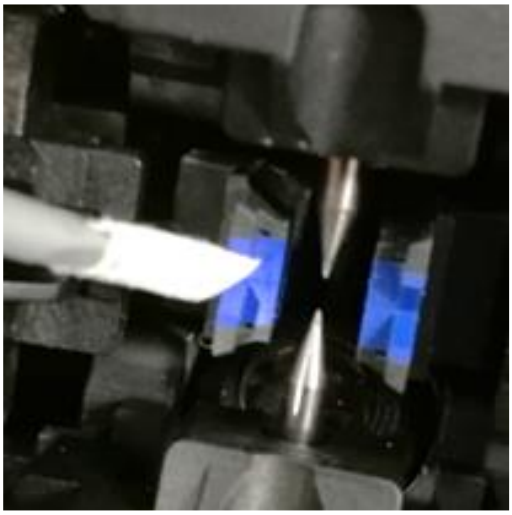
- If after the above method there is still dirt on the machine, or the machine is not aligning correctly or giving bad splices due to dirt, do all of the above cleaning with a lint-free cotton bud, dipped in approved cleaning fluid from Sticklers (*not* IPA) as pictured below, pressing firmly:

Note: **(Do not do this when the stripper is hot!)**

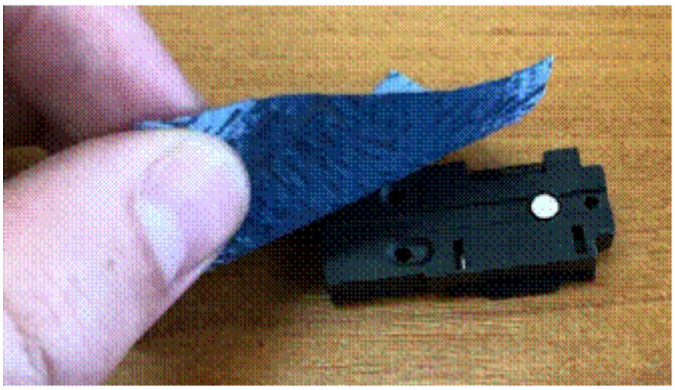
- If needed, clean the cleaver blade with a bud, gently. Clean the cleaver pads, including the ones in the lid.

- Clean from the electrodes outwards, take care not to touch the electrodes or to get anything on them

- Clean the guide plate of the holder using a wipe with cleaning fluid as debris here may cause misalignment.



- Clean the fibre holder with a wipe soaked in cleaning fluid.



- If there is dirt still in the clamp grooves or in the splicer v- groove, clean using a stripped & cleaved fibre, taking care with the exposed fibre:

- Please ensure the carry case is also kept clean and free of debris/dirt as this will contaminate the splicer that has been cleaned.

  Water Damage Warning: To avoid damage to the machine, the machine must be kept dry. If the machine has gotten wet, ensure it is fully dried before storing in the carry case. Use dessicant packs too if required.

3.3.1 Sharps Disposal

- When the sharps bin is close to getting full, pull out the sharps bin and dispose of carefully in a cin-bin.

Warning: Eye injuries have taken place during this operation, eye protection must be worn.

3.4 Fibre Splicing

Item Code	Item Description
119759	Frame KF4A Cooling Tray (Spare)
112940	Splice Protector 5a (45mm) (This is used in the new CSP)
075110	Splice Protector 4a (45mm)
109351	Splice Protector 6 (30mm) (This is used in the old OFS CSP, DO NOT use 5a in old OFS CSP, strip fibre with 10a stripping tool to 0.25 micron to fit splice protector 6)

Note: **Splice protectors should be kept in a sealed bag to prevent contamination.**

Please follow these steps:

1. Switch on the unit and enter the password (if this is the first time of usage, see separate instructions on page 8 for setup).

Note: **A manual arc test should be performed on a regular basis to compensate for changes in the climate (temperature, humidity and air pressure changes) as and when experienced out in the field in order to attain best splice results, See Maintenance, section 4.2 below for more details.**

2. Select program (“1. Inside Out” should be the default)

Select “1. Inside Out” for non-blown fibre customer splice point. (For BFT with ‘Legacy’ splice point use setting 5 for the smaller 30 mm splice protector 6).

Note: Most (but not all) 0.25 micron coated fibres will strip at this setting. If a 0.25micron coated fibre will not strip, use setting 4 as the stripper temperature is hotter with that setting

3. Select program (“2. Splice on Connector”) – for FSOC

4. Select program (“3. Node Splice, 60mm Protection Sleeve”) – for Node Splitter with a 60mm splice protector

5. Select program (“4. Node Splice, 45mm Protection Sleeve”) – for Node Splitter (use this for ‘Openreach Protector Splice 5a’ and 4a’)

6. Select program (“5. Node Splice, 30mm Protection Sleeve”) – for Node Splitter (use this for ‘Openreach Protector Splice 6’)

7. Slide a splice protector onto to one of the fibres to be spliced. Clean the fibre coating. (**So as not to get any dirt at all on the splicer/in the splice protector**)

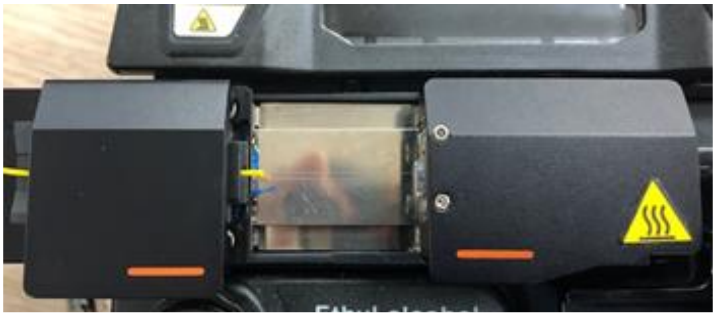
8. Take a Fibre Holder in hand, either an HS-900 or HS-250 (HS-900 is for 900µm plastic coated fibre normally found in drop cable, or HS-250 is for 250 µm fibre if there is a multi-fibre cable).

Open the holder lid and place the fibre in the holder groove so it fits snugly and close the lid, leaving about 25mm protruding of fibre.

9. Turn on the heat stripper by pressing this and it allows to warm up the heat stripper. 

10. Open both lids on the heat stripper and put the holder into the left side as below.

11. Close the left-hand lid first over the holder, and then close the right-hand lid over the fibre. This will start the stripping process.



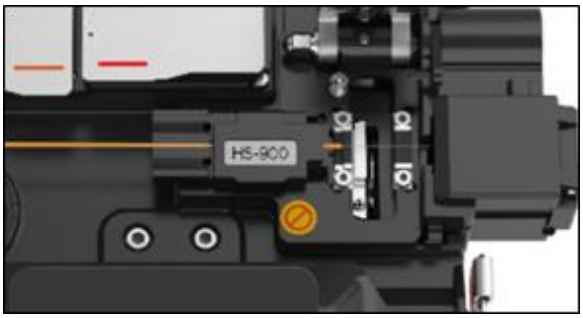
12. After the fibre is stripped, open the lids in reverse order – left-hand lid first, then right-hand lid.

13. Clean the fibre **using a *clean* wipe and fluid (Sticklers) from the fluid dispensing tank (place the wipe over the tank and pump a couple of times) to clean the exposed fibre** (Before cleaning, make sure the dispenser tank has been filled with approved cleaning fluid)

- Use only approved cleaning fluid by Sticklers **(not IPA wipes)**
- Clean the fibre perfectly, with a clean cloth. This is vital.

14. Cleave the fibre

Place the holder into the cleaver, making sure that the cleaver lid and waste bin lids are open first. Allow the waste bin lid to close onto the fibre (Do not force the lid shut, it will break). Close the cleaver lid and press the button on the rear. A “click” should be heard as the cleaver works.



The cleaved fibre should fall into the waste bin. If it does not, open the lid and use the brush to knock it in. DO NOT use your fingers.

- Do not touch the cleaved end of the fibre or clean again.

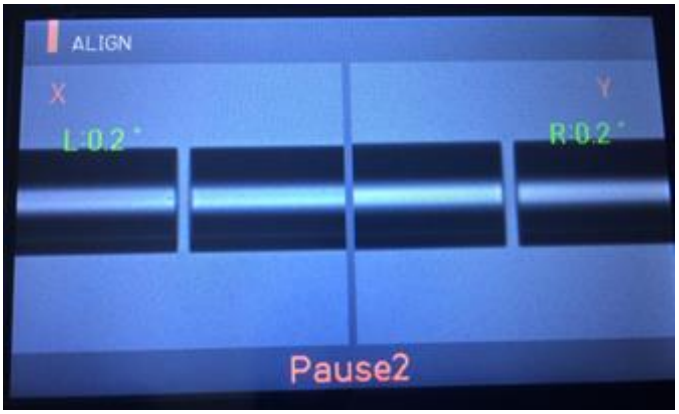
15. Clean the fibre coating debris from the stripper with a brush.

16. Position fibre into the splice area, open the wind cover of the splicer to position the fibre so it is ready for splicing. Place the holder into the splicing area using the two posts to align the holder in place. Note that the holders are left-handed (for use on the left side) and right-handed (for use on the right side)

17. Repeat this process for the other fibre to be spliced.

18. You are now ready to splice.

Close the wind cover and the machine takes over. The machine makes a number of checks before splicing. These include checking fibre positions and making sure the cleave angles are good. The picture below shows the cleave angle, which should be below 2 degrees.



- The condition of fibre can be inspected by the image processing system of KF4A. Nevertheless, visual inspection is necessary to ensure the optimal splice result.
- The function of pause 1 & pause 2 are automatically disabled in quick mode operation to reduce the splice time.

  Press Arc and **await the first beep to indicate the splice has been completed, then await a second beep** to indicate the splice loss estimate has been completed.

  19. after Splicing

- The machine measures the estimated loss of the splice which ideally **should be 0.05dB or lower**.
- If a bubble or crack is viewed, re-splice. Prepare fibres again up to 2 further times to try achieve <0.05dB.
  - **(Clean the machine thoroughly if there is a problem)**
- When finished, open the hood and the machine will perform a tensile test which will pull the fibre to make sure if it is OK, **Allow this to finish before proceeding.**

20. Removing the completed splice

Slide the splice protector along the fibre so that it is close to the splice point. Open the cover of the tube heater at the rear of the unit.

Wait for the tensile test. **After tensile test is complete**, open both holder covers and carefully remove the completed spliced cable. Slide the protector over the splice joint, and now move the completed splice to the heater and place as shown below.

Close the cover and the heater starts automatically. **When finished, you will hear a beep and the light on the control panel will go out**.

- **Do not touch the sleeve or heater shortly after heating**. The hot surface may cause burns to the skin.
- Remove it from the tube heater and **place it into the metal cooling tray connected to the rear of the machine until cool to the touch** to ensure the heatshrink will not be damaged when out away into the splice holder.

A spare Cooling tray is available through eASC stores, item code 119760

Caution: This will be HOT. Allow to cool for **at least 90 seconds** before storing in a splice tray.

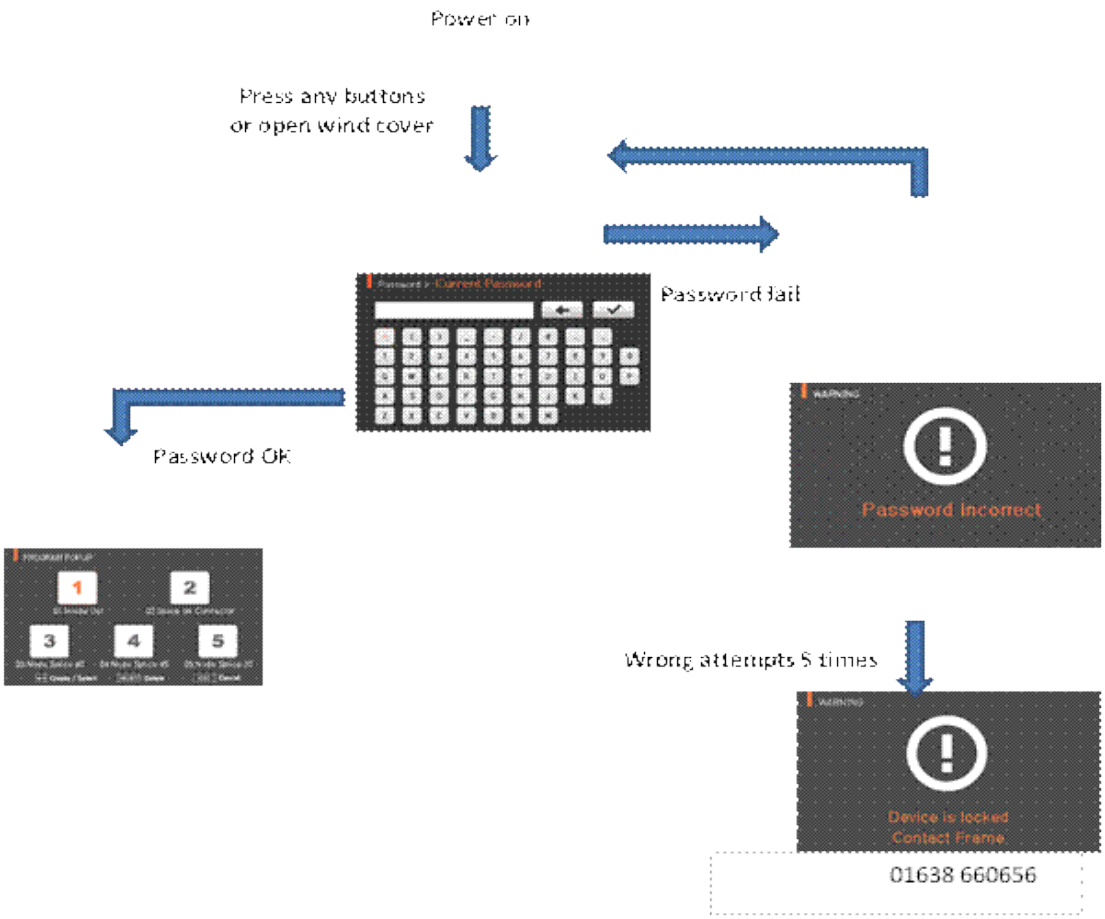
- **Ensure it is sufficiently cool first otherwise this can cause an Early Life Failure.**

- You have now completed the splice, **once fully cooled it can be placed in the CSP** following the instructions on how to install.

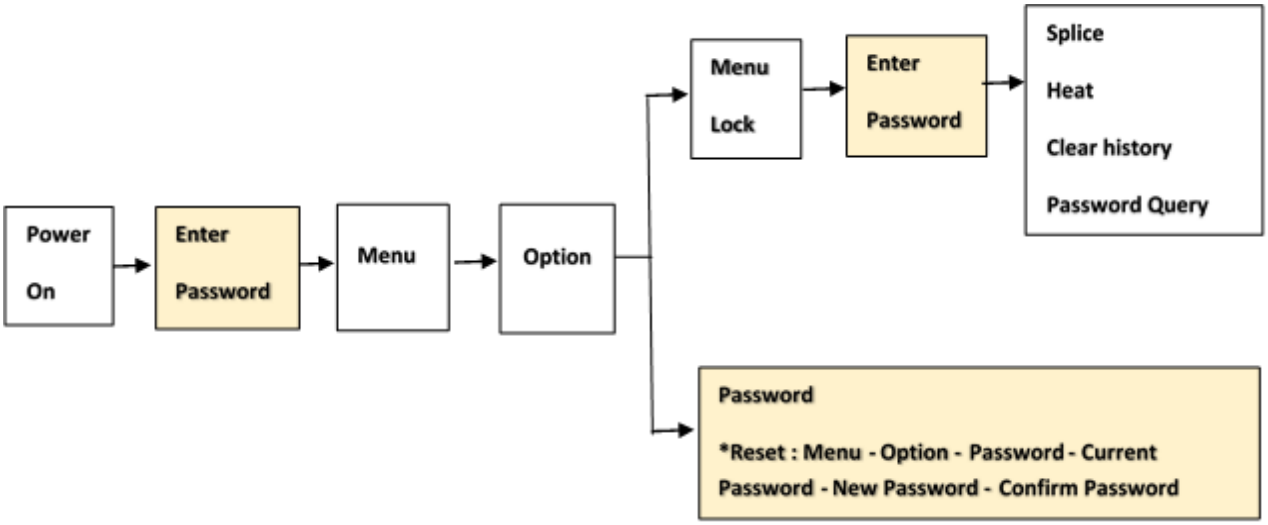
3.5 How to set Password

The Default Password is 000000000

You should set the password to your own UIN Number



How to reset Password



Problems and support

If you are unsure of anything, you should ask before you begin. Ask your manager if available.

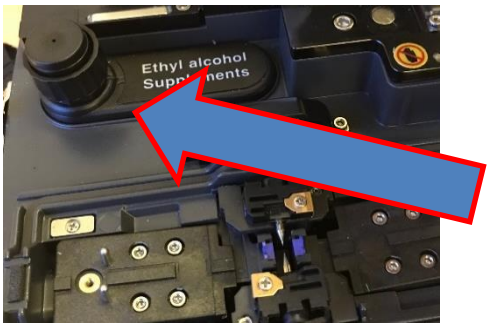
If not, there are online videos and help also available. Simply point your phone at the QR code below, and there you should be able to see several short videos that will help.

Scan me

4 *Maintenance and Repair*

4.1 Cleaning Fluid Replenishment

- Remove the cleaning fluid tank, by pulling upwards on it.

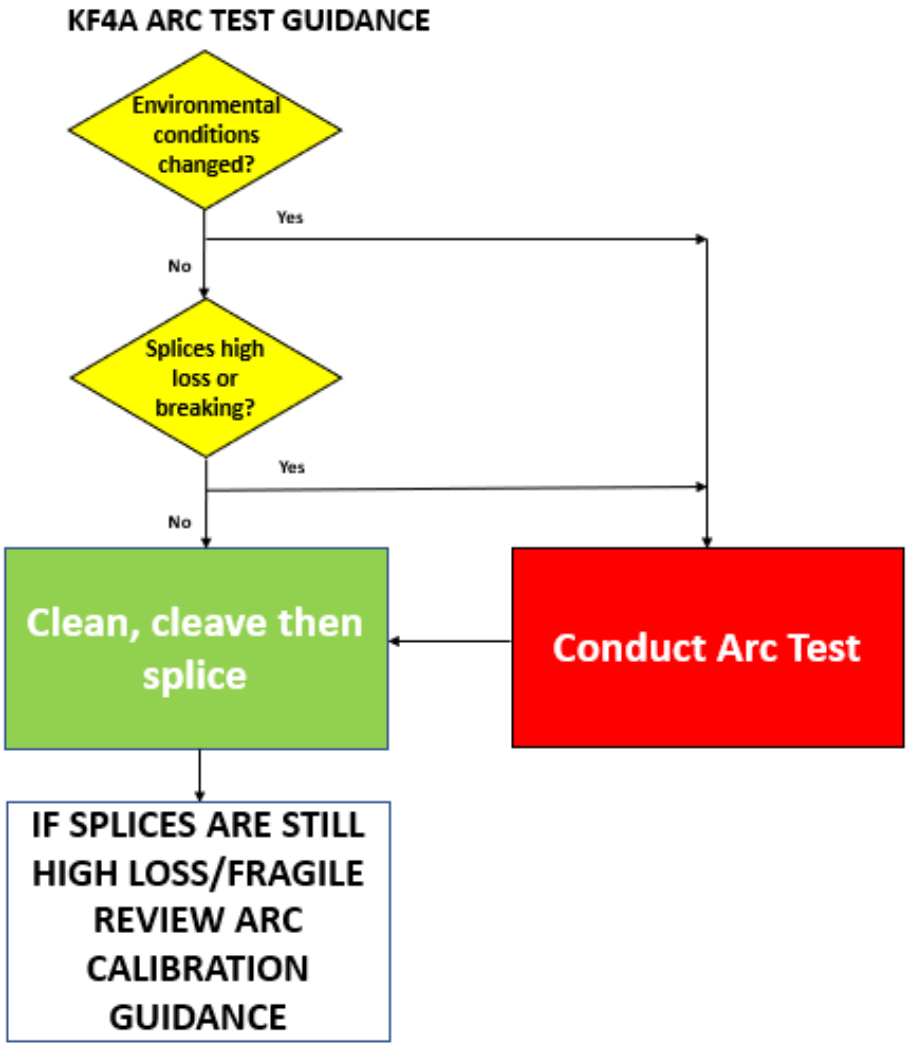


- Open the lid and refill with Sticklers approved cleaning fluid.

- Push it back in its slot.

4.2 Pre–Splice Arc Test

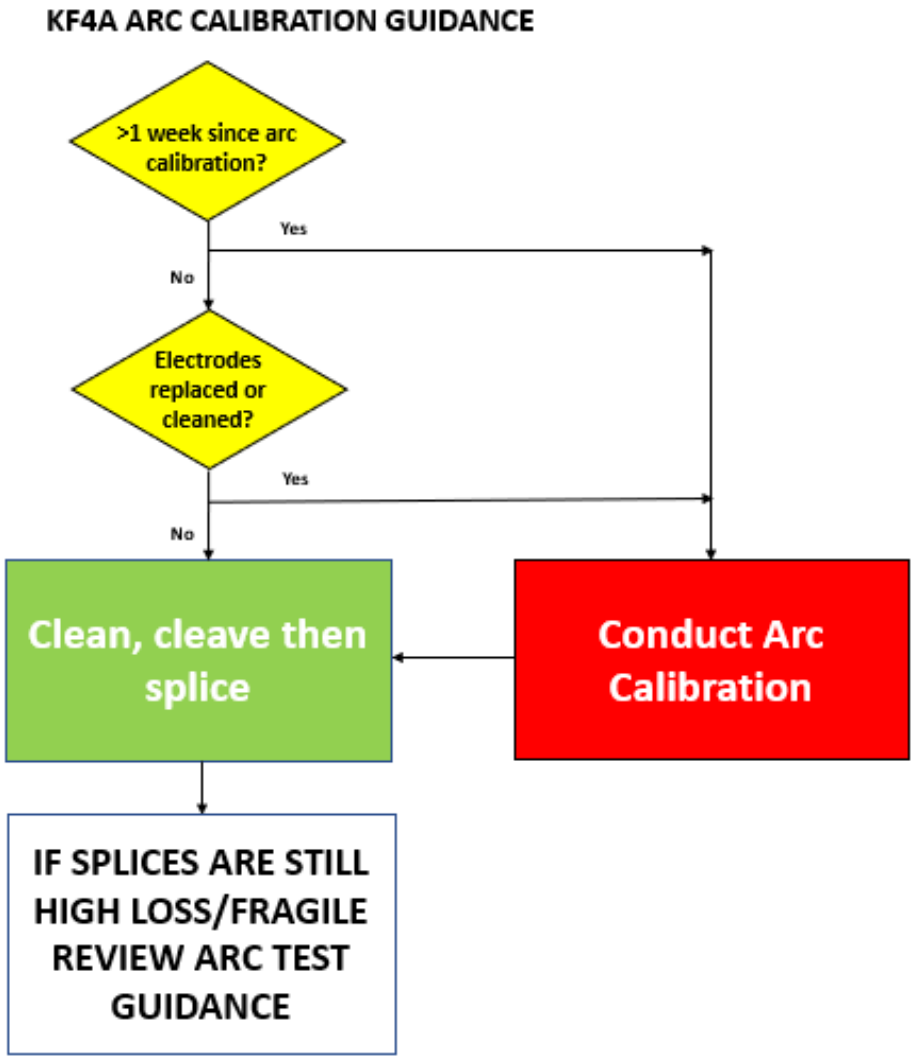
The Swift KF4A continuously checks if there is a change in temperature and air pressure through each sensor. Based on such data the arc amount is automatically adjusted. However, a manual arc test should be performed on a regular basis to compensate for changes in the climate (temperature, humidity and air pressure changes) as and when experienced out in the field in order to attain best splice results.



For the correct arc test procedure, see the arc test procedure video Here

4.3 Manual Arc Calibration

Should be performed at least on a weekly basis (preferably at the start of the working week) due to any change in arc amount (due to abrasion of the electrodes or the fibre splice) or wear and dirt on the electrodes which is not automatically adjusted, plus the central axis of arc can also be moved towards the left or right with a large amount of arc.



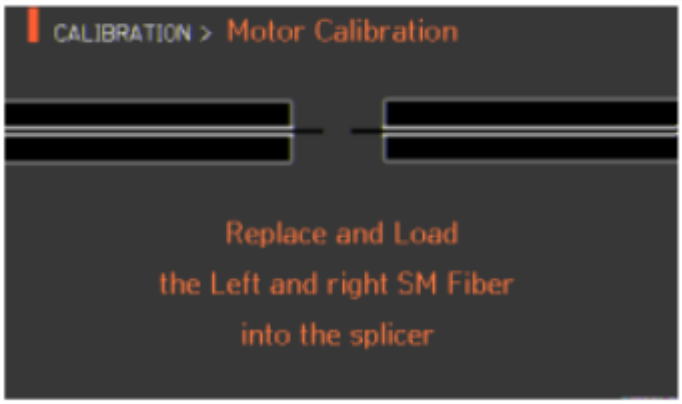
4.4 Motor Calibration

Optimises the positioning of the clamps relative to the electrodes prior to splicing. This will reset the machine back to optimum starting position which over time may change due to the number of splices made. It is also therefore important that this is done after the machine has been subjected to vibration or rugged handling E.G If the splice machine is knocked or bumped significantly, for example not being secured in its respective protective manufacturer box OR not being secured in the back of the users vehicles**. It is therefore recommended to motor calibrate at least weekly to ensure the fusion splicer is working in an optimum way, failure to do this may cause splice faults.**

Motor setting is set on splicer as default but depending on motor setting location, Splice speed may slow down.

If the speed slows down during the splice operation or any abnormality is incurred while in the entering position, the motor setting can be automatically calibrated through this function.

See below for details.



1) Put the fibre on the splicer.
2) Select “Motor calibration” with  button.
3) End the calibration by pressing 

4.5 Cleaver Maintenance

With time, fibre shard and other debris build up can interfere with the operation of the cleaver.

— To remedy this see Cleaver Maintenance Kit

4.6 Battery Replacement

- Make sure the splicer is turned off, the LED light should be off.

- Unscrew the two battery cover retaining screws.
- Lift the cover from the side where the screws are and then slide it out in the direction indicated by the arrow

- Unscrew retaining screw for the rubber leg pictured, with an Allen key.

- Disconnect the cable connector.

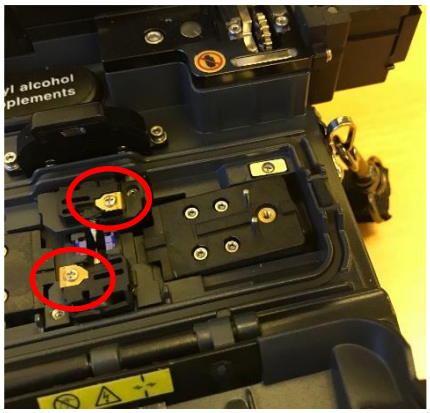
- Lift out battery and replace with new one. Follow the steps above in reverse order:
- Connect the cable connector, screw in the Allen key screw for the rubber leg, replace battery cover, and screw in retaining screws.

4.7 Electrode Replacement

> **Caution: Risk of High Voltage Electric Shock**. Unplug machine and remove battery pack before proceeding.

When the arc seems like it is not working properly, or may sound different or result in lots of bubbles the electrode may need replacing. Usually this should be after over 15,000 splices.

Exchange for a new electrode the old electrode currently attached to the splicer. Use supplied screw driver (SD-01)

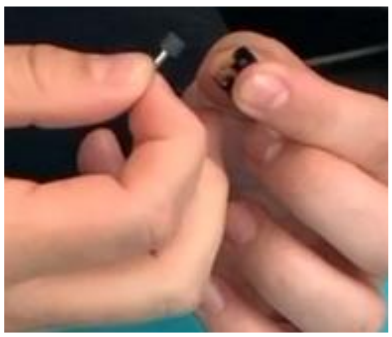


- Unscrew the screws, highlighted in red.

- Remove the first electrode from the holder

- Replace with new electrode, put back in splicer and reinsert the screw.

- Repeat with second electrode.



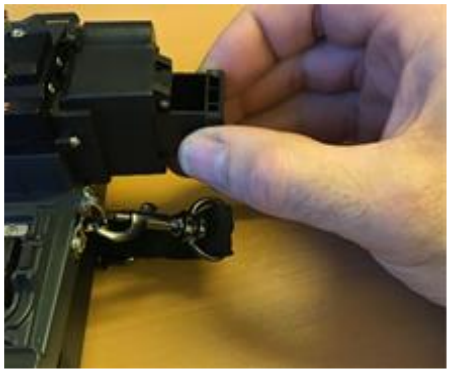
- Load prepared fibres in to the splicer.

- Execute electrode stabilisation and arc calibration in the settings menu **(Section 4.3)**

4.8 Cleaver Blade Replacement

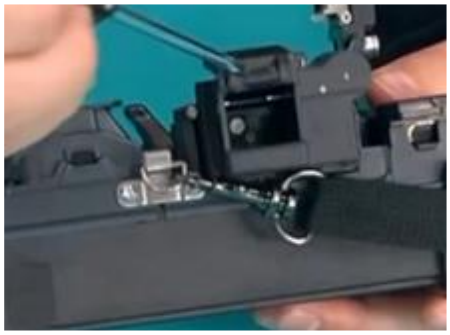
Note: **Due to the sharp blade, this should only be done by specially trained personnel in BT Triage, arrange via FSL (forward stock location)**

- The cleaver blade will need replacing after 75,000 splices, or if the splicer is giving a lot of bad cleave angle errors. (First ensure that these errors are not due to dirt or microscopic dirt on the cleaver blade, or in the grooves, lid or clamps by rigorous cleaning with approved cleaning fluid.)

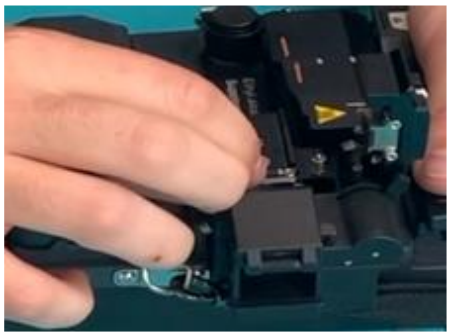


- Remove scrap tray.

- Look inside the scrap tray housing, there is a screw that holds the blade.



- Unscrew with a flathead screwdriver.



- Remove the old blade with tweezers, taking care not to cut yourself.

- Replace with the new blade, keeping the cog on the right side close to the scrap box.
- Take great care not to cut yourself or nick the blade.
- Replace the retaining screw and replace the scrap box.

4.9 Faults and Repair

For a repair, arrange for the repair through the local Forward Stock Location (FSL) who will send off the component for repair through the BT Triage system.

Before any repair, ensure the machine has been thoroughly cleaned as instructed and that there are no shards stuck in the mechanisms to avoid unnecessary repair cost.

5 *Inspection and Testing*

The splicer including the 240v charging lead should be submitted for testing annually (PAT).

Please click here for more details.

6 *Spares*

Item Code	Item Description
119759	Frame KF4A Mains Power Supply
119761	Frame Kf4A Cleaning Brush
119762	Frame KF4A Mini Service Kit (Cleaver Allen Keys for the removal plus spare screws)
119760	Frame KF4A Cooling Tray
112940	Splice Protector 5a (45mm) (This is used in the new CSP)
075110	Splice Protector 4a (45mm)
109351	Splice Protector 6 (30mm) (This is used in the old OFS CSP, DO NOT use 5a in old OFS CSP, strip fibre with 10a stripping tool to 0.25 micron to fit splice protector 6)

END OF DOCUMENT