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1 Introduction

This guide is to complement our YouTube video on how to complete a fusion splice which can be found at: https://www.youtube.com/watch?v=xba2MThR9Ls&t=5s

In this demonstration, we used a FITEL S178 Version 2 Fusion Splicer, however there are many different splicing machines available on the market and most of this guide would be applicable to such machines.

Author's note: as a UK-based company, we are fully aware that we should really spell fibre the traditional English way, but have chosen to adopt the American and more universally popular spelling of "fiber" to embrace our international market.

1.1 A Note on Health and Safety

Remember, you are working with glass fiber which can splinter and crack. If it does, the pieces are often so small that if it gets into your skin then you will struggle to see it, let alone remove it. This could lead to an infection and a trip to hospital.

Gloves and safety glasses with side protection are recommended when doing a fusion splice, to protect your eyes and hands from any splinters of glass as well as from the chemicals on the cleaning wipes which can irritate your skin.

It is also worth noting not to eat or drink in any area where you're working with fiber optics, as shards of glass can get into the air and into your food and drink, which if consumed can cause serious internal injuries.
2 Overview of Fiber

Different cables have different sized cores, claddings, coatings, buffers, strength members and outer jackets - and a variety of different names to refer to all of these things! So you need to know what type of fiber you're working with so that you can use the correct strippers for that fiber.

Here are some examples - all of the fibers above have an identical 9 micron core, but a variety of sizes of outer jacket. From right to left we have 3mm outer jacket, 2mm outer jacket, 900 microns and a bare fiber (I call bare fiber ones that aren't in a jacket). For this demonstration, we're going to be using two 900 micron fibers.

Let's look at a bare fiber even more closely. The core may be 9um (microns), the cladding will be 125um (microns) plus a 250um outer coating. So for that fiber you would need to use strippers that can remove 250um coating and you end up removing the coating and a thin layer of the cladding.

Some fibers that you might need to splice come complete in a jacket (typically white or yellow) as well as a Kevlar strength member, both of which will need to be removed to get at the bare fiber. You can either use normal cutters to carefully remove the jacket and Kevlar, or special strippers that can remove the outer jacket plus strip the coating/cladding. You will still need to use cutters to remove the Kevlar.
3 To complete a fusion splice, you will need:

- Fusion Splicer
- Fiber Strippers
- IPA Cleaning wipes
- Cleaver
- Heat-shrink Protective Sleeve (generally 40mm size however other sizes are available depending on the splice you wish to complete)
- The fiber(s) you wish to splice.

4 Step One: Insert the Heat-shrink Protective Sleeve

Before you do anything else, remember to add your protective sleeve to the fiber. These come in a variety of lengths. In this guide we are using a 40mm sleeve. Remember you have to put the sleeve on BEFORE you start cleaning and cleaving your fiber.
5  Step Two: Stripping the Fiber

Using the strippers, you want to strip away about 30mm of the coating. As you can see from the picture below, the strippers have different sized grooves which can remove different layers of the plastic coating.

The best advice when stripping a fiber is to nibble away at the protective coating and remove it in small sections. If you try and remove too much in one go or clamp too hard you are likely to snap the fiber.

6  Step Three: Cleaning the Fiber

Using an IPA wipe, clean the bare fiber. It is good practice to clean twice, using a different part of the wipe for the second clean.

Once cleaned, refrain from touching or putting the fiber into contact with any dirt.

7  Step Four: Cleaving the Fiber

As mentioned in our video, cleaving is the most important part of the splicing process.

Place the fiber into the appropriate v-groove as indicated on the cleaver. This will depend on the coating size that the fiber has.
When placing the fiber, make sure that the tip of the bare fiber is sitting over the far left rubber pad, as indicated by the arrow in the picture below.

By doing this, the cut end of the fiber will be swept straight into the bin. Should your fiber not reach the roller you will need to remove it manually using tweezers or sticky tape and place it in a sharps bin.

Once in position then close the magnetic panel to hold the fiber in place. Then in one smooth motion close the lid of the cleaver and press down the cleave button.

When you open the lid, you will see the cleaved fiber.
8 Step Five: Using the Fusion Splicer

Make sure your Fusion Splicer is powered on by pressing the red button, warmed up and that all the settings are correct for your chosen fiber type. Lift up the dust/weather guard, and wait as the machine makes its automatic adjustments.

Lift up the magnetic flap and place your cleaved fiber into the v-groove, making sure the tip of the fiber does not cross over the electrode as indicated by the arrow below. Flip down the magnetic panel to secure it in place.

Now start the whole process over again for the second cable.
Once both cables are in place inside the Fusion Splicer, close the dust/weather guard.

The Fusion Splicer will automatically move the fibers in towards each other and an image of the two fiber tips will be displayed onto the screen for you to examine.

Of the two pictures above, the picture on the left shows two good cleaves. In the picture on the right, neither fiber has a straight, clean cut so they would need to be removed and re-cleaved.

If no picture displays then your fiber is too far from the electrode. If your fiber is too far over a warning message will appear.

Once the fibers are in place and you are happy that both are straight then press the green button. The Fusion Splicer will start to line up the cores of the fiber, do a quick automatic pre-clean to blow away any dust residue and report any errors if it cannot do the splice.

Some typical errors are:
• The fiber tip is over the centre of the electrodes
• The fiber is dirty
• Mismatching core dimensions
• The fiber cleave angle is not straight enough

If the Fusion Splicer is able to complete the splice, you will see it take place on the screen.

Once the splicing has finished, you will hear a beep. The screen will display either a green, amber or red light to signify whether the splice is good, ok or poor, as well as showing an estimated dB loss, as seen in the picture above. For a green light and a perfect splice, you would have a 0db loss, but ideally no more than 0.2dB for it to be successful.
If you get an amber light then the splice is ok but the dB loss is higher than ideally acceptable.

A red light indicates the splice has not been successful.

Do not open the cover until the Splicer has finished as you may get a nasty shock from the electric arc produced during splicing.

9  **Step Six: Heat-shrinking the Protective Sleeve**

Lift the cover and wait a few seconds while the Fusion Splicer completes a tension test on the fiber. Once this is complete, carefully remove the fiber from the magnetic flaps. Be careful not to bend or pull on the splice as you run the risk of snapping it.

Close the magnetic panels and the dust/weather guard.

Slide the protection sleeve over the splice, making sure that you have an even amount of clad fiber on either side. Lift up the flap on the heater element and carefully place the completed splice with its protection sleeve into the heater, ensuring it is in the centre of the heater element. Make sure that you don't get the fiber caught underneath the two metal latches on the sides of the Splicer as when you close the lid this could snap the fiber.
Close the heater lid and the unit will automatically start to heat the plastic. This will be indicated by the LED above the yellow heater button.

The heater element shows its progress in the top right corner of the screen, as indicated by the arrow in the picture above. The machine will once again beep when this process is complete and a fan will kick in to cool the heated plastic.

Wait for about 15-20 seconds for the glue to harden before removing it from the heater and do so with caution as it could still be hot.
10  Splice Complete!

And here it is - our completed fusion splice.

There should be no bubbles inside the plastic sleeve which would indicate overheating, and there should be no upturned ends which would indicate not enough heat. You should also be able to see a small amount of glue coming out of each end.

Good job!

11  Any questions about fiber optics?

We're here to help.

Get in touch with us by email: training@utel.co.uk