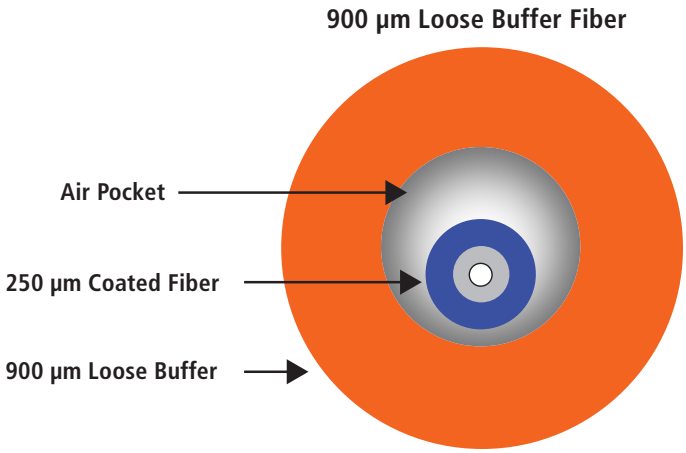
Application Note
Splicing 900 µm Loose Buffer Fiber

A common challenge faced by technicians today is splicing 900 µm loose buffer fiber. The challenge for the technician is distinguishing fiber related problems from splicer related problems. By understanding the unique characteristics of this fiber type and the interaction with standard splicing equipment, the splicing technician can distinguish fiber related problems from splicer related problems, thereby, eliminating frustrations and increasing productivity.

This Application Note will address:

- Standard 900 µm fiber construction
- Common splicing challenges
- Splicing solutions for 900 µm fibers
- Products available from AFL



Standard 900 µm Fiber Construction

Immediately after optical fiber is drawn, primary and secondary acrylate coatings are applied to the fiber to protect it from abrasion and environmental exposure. These coatings have an industry standard outer diameter of 250 µm. Applications requiring a more rugged fiber coating for additional protection are typically coated at the time of manufacture with either a "tight buffer" or "loose buffer" design.

Tight buffered fiber has a thermoplastic material extruded directly over the acrylate coating creating a strong bond between the outer 900 µm buffer and the 250 µm coated fiber. Tight buffered 900 µm fiber is relatively easy to splice using standard splicing practices and rarely poses problems for the splicing technician.

Loose buffer fiber, on the other hand, can present splicing challenges that require special fiber handling and a thorough understanding of the splicing process. With the loose buffer design, the outer 900 µm buffer is not bonded to the internal 250 µm coated fiber. Thus, the 250 µm fiber has a tendency to "float" within the structure. Consequently, external force placed on the outer 900 µm buffer will not transfer to the fiber within the structure. This allows the outer 900 µm buffer to slide over the internal fiber. This phenomenon is commonly referred to as "pistoning" of the fiber which can create challenges when splicing. This is discussed in more detail below.

Another application that is similar to 900 µm loose buffer fiber is a 250 µm fiber that has been up- jacketed with furcation tubing by the installer (also known as a "fan-out" kit). This thin-wall, flexible plastic tubing with a relatively large inside diameter is placed over 250 µm coated fibers for additional environmental protection. However, the outer jacket is not bonded to the inner fiber and the inner fiber moves freely within the 900 µm tubing. Consequently, an external force applied to the outer tubing will not transfer to the fiber within the structure and will result in the same "pistoning" action as occurs with 900 µm loose buffer fiber. Again, this creates splicing challenges for the technician.

It is common within the industry to hear both 900 µm loose buffer fiber and fiber that is up- jacketed with furcation tubing referred to as "loose tube fiber." This should not be confused with standard fiber optic cable construction terminology referring to "gel-filled loose buffer tubes."

Common Splicing Challenges

Standard splicing practice requires any movement of the fibers being spliced to be fully controlled by the splicing equipment. In general, the splicer V-grooves, clamping devices and precise motor movements guide and control the movement of the fibers, within micron tolerances, throughout the alignment and splicing process. Clamping is achieved by using either sheath clamps or fiber holders, depending on the design of the splicer.

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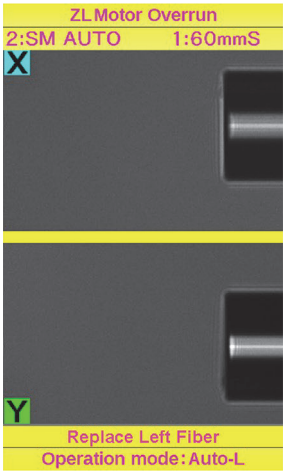
When the splicing process begins, the Z-motors in the fusion splicer drive the sheath clamps (or fiber holders) together in the Z-axis. When 900 µm loose buffer fiber is clamped in the sheath clamps (or fiber holders), the force is applied to the outer 900 µm coating, and as noted above, this force will not transfer to the inner 250 µm coated fiber due to the construction of the 900 µm fiber. Thus, the outer coating will ride over the inner 250 µm fiber, creating a pistoning type of action that prevents the fiber from entering the field of view of the splicer optical system. The fiber may partially appear then stop or not appear at all and this can vary from splice to splice.

If pistoning occurs, the fiber may not come into range of the splicer camera system and a likely result will be an error message by the fusion splicer. It is also possible that the fibers could make it into range of the camera but piston during overlap of the splicing process resulting in high insertion loss and or a weak splice. Either situation is undesirable but controllable if the proper action is taken by the splicing technician.

Some 900 µm loose buffer fiber tends to piston more than others and a 250 µm coated fiber inside furcation tubing will piston more than 900 µm loose buffer fiber. In either case pistoning of several millimeters is possible.

Splicing Solutions for 900 µm Fibers

A common problem for the splicing technician is repeated Motor Overrun error messages that can be frustrating and time consuming to overcome. It is not uncommon to also see Motor Trouble errors as well, depending on the particular movement of the fiber. Pistoning of the 250 µm fiber inside the 900 µm buffer must be controlled in order to successfully splice loose tube fiber.



One obvious practice is to remove enough of the 900 µm buffer in order to clamp the 250 µm coating in the fiber holders or sheath clamps. Depending on the application, however, it may be required to clamp the 900 µm buffer. In that case, the splicing technician must find some means to prevent any pistoning movement and gain full control of fiber movement during the splicing process.

A common practice is to clamp the outer 900 µm fiber in such a way that a compression force controls the inner 250 µm fiber and prevents it from pistoning but without excessive force that may damage the fiber. The closer to the splice point that the fiber is clamped, the better the control of the fiber. However, if the application does not permit clamping near the splice point, other clamping devices can be used along the length of the fiber, external to the splicer.

AFL offers several products to successfully clamp 900 µm loose buffer fibers and eliminate problems during the splicing process. The particular products are detailed below and vary depending on splicer model and application. Generally speaking, these products control the fiber in one of the following ways:

- Clamping within the splicer Wind Protector utilizing a sheath clamp or fiber holder specifically designed for 900 µm loose tube fiber
- Clamping external to the splicer utilizing a clip specifically designed for 900 µm loose tube fiber

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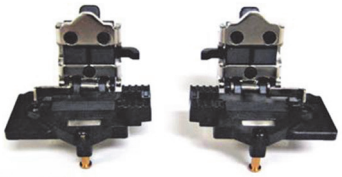
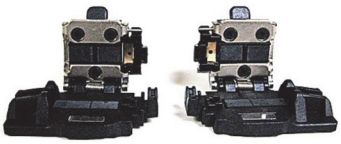
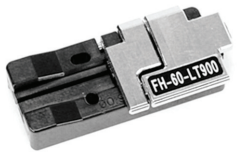
Product Solutions Available from AFL

DESCRIPTION	AFL NO.	FUNCTIONALITY	IMAGE
Fujikura 70S and 19S S70D Sheath Clamp	S015862 (Pair)	• Compatible with (900 µm) AFL FUSEConnect® connectors • 5-16 mm cleave length • Easily exchanged in the field	
Fujikura 31S and 41S CLAMP-S31B Sheath Clamp	S017101 (Pair)	• Compatible with (900 µm) AFL FUSEConnect® connectors • 5-16 mm cleave length • Easily exchanged in the field	
Fujikura 60S and 18S S60C Sheath Clamp	S014552 (Pair)	• 16 mm cleave length (not compatible with AFL FUSEConnect connectors) • Easily exchanged in the field	
Fujikura 60S and 18S S60D Sheath Clamp	S014750 (Pair) S014752 (Left side only)	• Compatible with (900 µm) AFL FUSEConnect connectors • 8-16 mm cleave length • Easily exchanged in the field	
Fujikura 12S-C, 21S, 22S and 62S S21B Sheath Clamp	S016853 (Pair)	• Compatible with (900 µm) AFL FUSEConnect connectors • 5-16 mm cleave length • Easily exchanged in the field	
Fujikura 11S/R, 12S/R, 18S/R, 19S/R, 21S, 22S, 31S, 41S, 60S/R, 62S and 70S/R FH-60-LT900 Fiber Holders	S015181 (Pair)	• 14 mm cleave length from buffer (not compatible with AFL FUSEConnect connectors) • Repeatable cleave length • Repeatable results loading into splicer	
Fujikura 40F/PM, 45F/PM, 100M (+) and 100P (+) FH-40-LT900	S013584	• 4-10 mm cleave length • Repeatable cleave length • Repeatable results loading into splicer	
Any model splicer Mechanical Splice Fiber Holder 250 µm	CS004442	• Compatible with (900 µm) AFL FUSEConnect connectors • Compatible with any fusion splicer • Compatible with PVC furcation kit, PVC breakout kit or PVC fan-out kit • May be used independently or in conjunction with sheath clamps above for additional clamping pressure