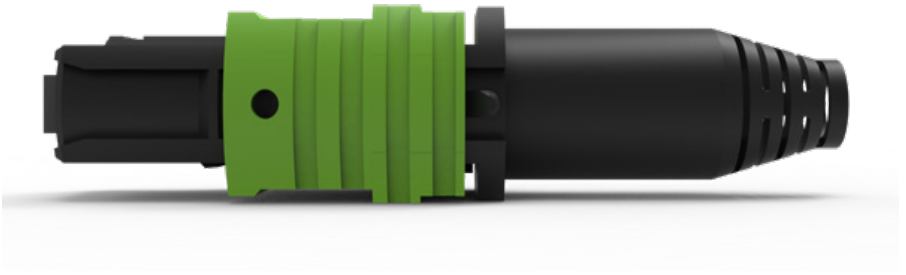
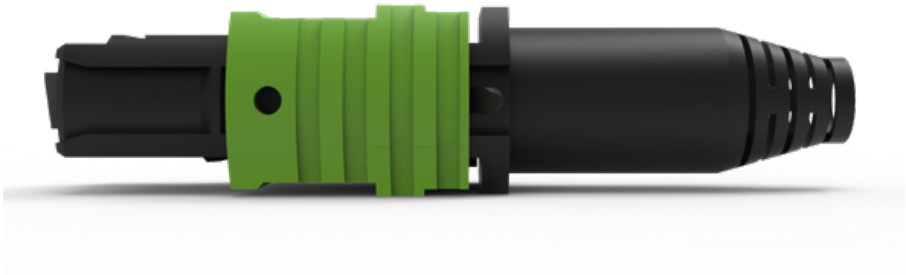
SENKO®
Advanced Components

Application Note

Direct MT Angle Polishing for MT Flat Ferrules





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1.0 Introduction

Historically, when polishing MT ferrules on an angle, a two-step polishing process is performed: first, a flat MT ferrule polishing fixture is used to remove epoxy beads making all ferrules uniformly flat. Second, load the ferrules into an 8-degree angle polishing fixture to create a final result of an angled physical contact (APC). This is not efficient from a mass production standpoint as it adds additional time to the process while unloading and reloading ferrules from the fixtures. Even after polishing all the ferrules for a presumably flat shape from the first polish, the MT termination process, the epoxy bead size and debris, the cleanliness of the fixtures and the operator's experience, all will play a major role. The less time that is spent handling the terminated cables the lesser the opportunity for error.

In some instances, pre-angled MT ferrules are introduced in hopes to simplify the polishing process by promoting usage of only one angled fixture. In reality, the original angle will likely be altered based on the process variabilities outlined above. Also, the angle could be inconsistent across the surface if the process does not allow sufficient time for removing ferrule material and is set up just to remove epoxy with the assumption of perfect ferrule placement. See Figure 1 where slight angle variations can be seen. The blue line indicates an original angle from a ferrule manufacturer. Red line indicates an angle formed by a polishing process.

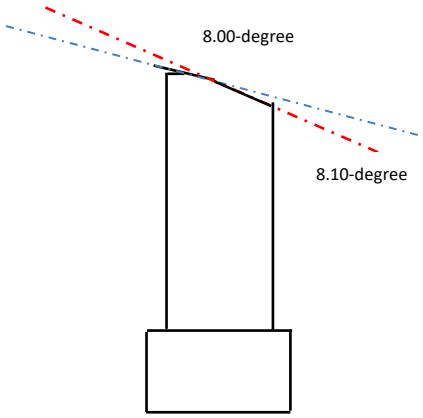


Figure 1: Pre-angle ferrule post polish angle possible variation

At Senko the polishing process for MT ferrules on an angle was developed using angled MT ferrule fixture eliminating the use of a flat MT polishing fixture.

2.0 Key points for successful MT/APC polish

2.1 Proper epoxy mixing

Successful polishing starts with proper manufacturing techniques. Proper epoxy mixing, application and curing is necessary for a successful result.

Senko's recommended epoxy is S-123 which consists of Parts A and B that needs to be thoroughly mixed. After mixing the epoxy air bubbles will inevitably be present. A 7-to-10-minute spin cycle in a centrifuge will draw the air out. Failing to degas the epoxy could reduce the proper fiber to ferrule bond as the air expands at high curing temperatures. This reduces epoxy bonding strength, which causes the fiber to move during environmental temperature changes.

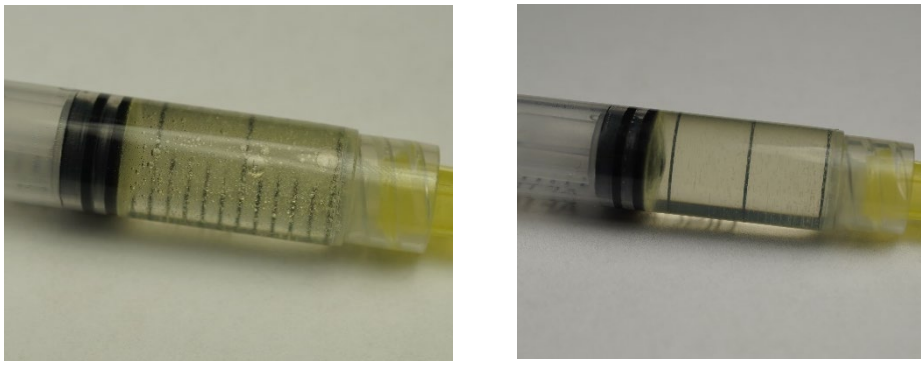


Figure 2: Epoxy on the left with air bubbles after mixing and on the right degassed in centrifuge

2.2 Proper epoxy application into ferrule and epoxy bead size

2.1.1 Inject a small amount of epoxy into the MT ferrule covering all of the v-groves. It can be done from the top window, but its more precise to inject it into the rear of the ferrule and spread it along the far wall covering all of the v-groves inside.

Figure 3: Epoxy application using 20 AWG needle

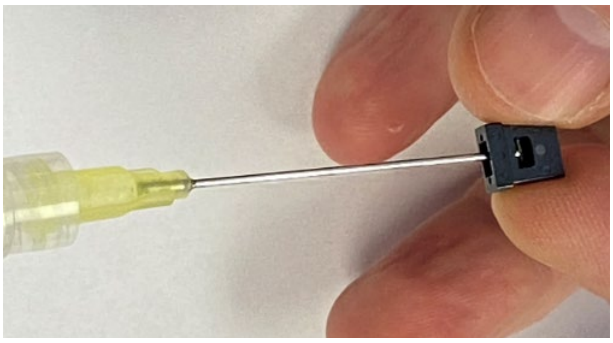


Figure 4: Proper epoxy dispensing into MT ferrule

2.1.2 Install rubber mini boot closing ferrule rear opening. This prevents epoxy from flowing out of the back of the ferrule.

2.1.3 You should see an epoxy bead on the front of the ferrule, clean the stripped fibers with isopropanol alcohol and a lint-free tissue. Carefully slide the fiber through the rear of the ferrule until the exposed fibers emerge from the epoxy bead. It is important to check through the window of the ferrule to make sure the fibers are not bending or meeting resistance as they are being pushed through. You should see fibers pushing more epoxy out forming a uniform bead at approximately 0.2mm in thickness. Epoxy must encapsulate the fibers completely at the ferrule/fiber bond on top.

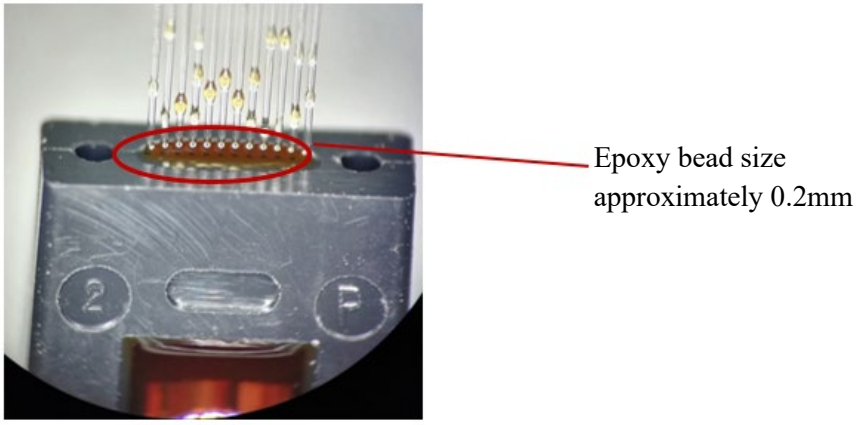


Figure 4: Proper epoxy bead

2.1.4 Once the fibers are properly inserted, slide them forward until you feel some resistance. This is from the buffers hitting the end of the grooves (ferrule pedestal). Stop pushing at this point. Move the ferrule back and force two-three times in order to distribute epoxy evenly inside the ferrule. Ensure the ferrule boot snug and strait. No epoxy should leak through the edges of the boot. Retract the fibers from the end of the grooves leaving a

gap of 0.25 – 0.50mm between the groves and fiber coating. This is a necessary step, because during heat curing the coated fiber could be pulled up over the pedestal ledge creating microbends.

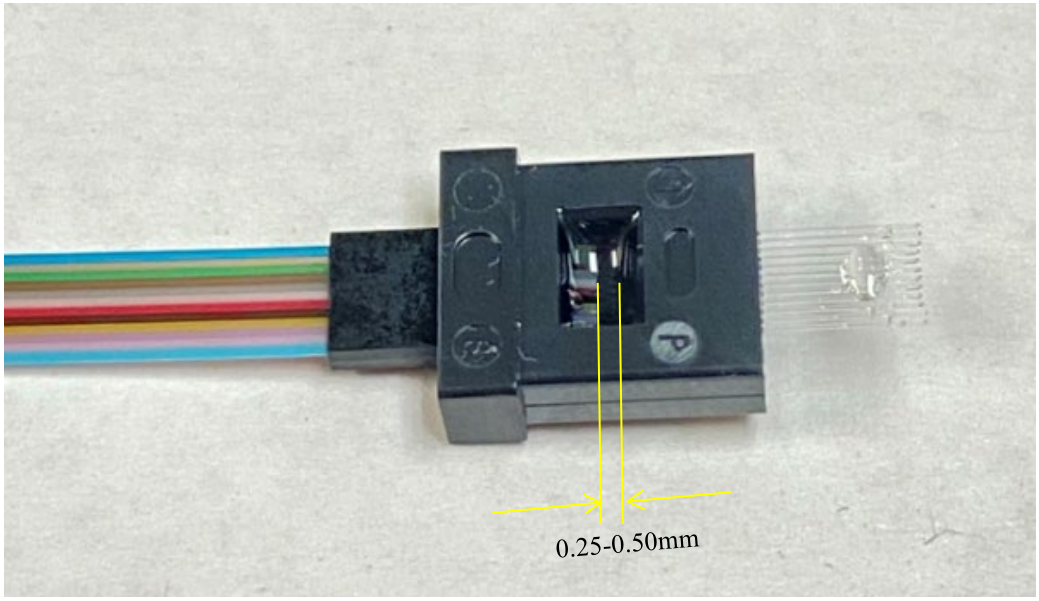
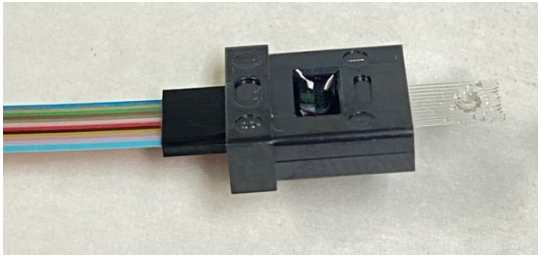
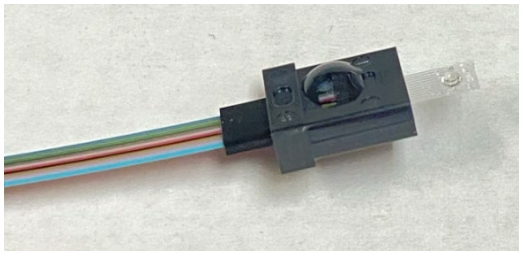


Figure 5: Proper space 0.25 to 0.50mm between the ribbon coating and MT ferrule pedestal inside

2.1.5 At this stage, if necessary, carefully apply a drop of epoxy to the window, but be sure not to over fill. Be very careful not to get any epoxy on the outer surface of the ferrule, as this will affect how it sits in the polishing fixture. If necessary, carefully wipe off the outside surface of the ferrule with an alcohol-soaked lint-free tissue to remove any extra epoxy. The end-face epoxy lines must be consistent from ferrule to ferrule as this will be the key to successful polishing.





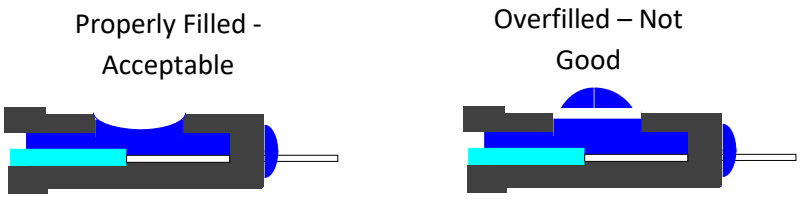


Figure 6: Proper epoxy amount on MT ferrule window (left) vs overfill (right)

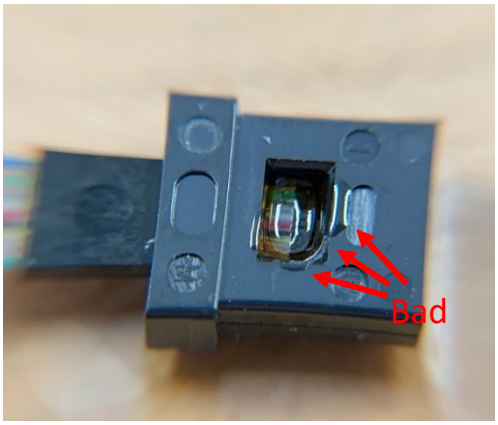


Figure 7: Epoxy outside of ferrule window

2.1.6 Some companies recommend using a vacuum pump to draw epoxy onto the end-face. In the case of APC polishing, using the described technique is not necessary as the polishing will reach the fibers inside the ferrule sufficiently recovering any miscleaved fibers.

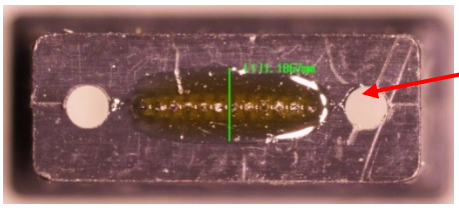


Figure 8 Good example of epoxy bead

Epoxy bead should not extend to the guide holes as this will cause them to get contaminated.

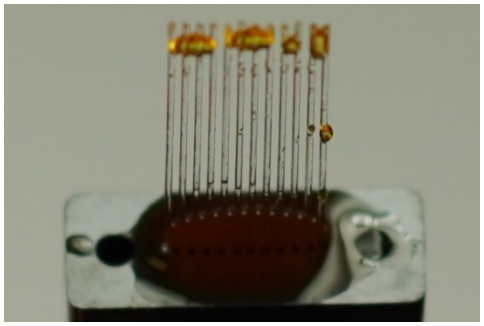


Figure 9: Improper bead shown – Epoxy should not wick into the holes

3.0 Polishing directly on the Angle fixture

3.1 Polishing Preparation

3.1.1 Prior to loading of the ferrules into the polishing fixture, there should not be any excess epoxy coming out of the MT ferrule window. Refer to Figure 7. Excess epoxy in the MT ferrule window can cause improper loading of the ferrules into the fixture which will cause bad polishing and 3D geometry.

3.1.2 It's important to load the ferrules properly into the angled fixture. During the loading of the ferrules into the fixture, press the ferrule fully downwards and then tighten the torque screw to secure them in place. Different fixtures have different locking mechanisms. Make sure all the ferrules are at the same height after loading them into the fixture. Inconsistent heights can cause some of the ferrules to be over-polished and some to not be polished enough.

3.1.3 Check the epoxy bead sizes and their consistency against each other in the polishing fixture. Epoxy beads should be hand polished using 30um or 15um Silicon-Carbide film to reduce the bead height and to be even more uniform in size. Operators should do this step once ferrules are loaded into the fixture, unless another tool is used such as a laser or mechanical cleaver. See below image for guidance.

Figure 10 Consistent bead size throughout fixture

3.2 Polishing on the angled fixture

3.2.1 Follow the SENKO recommended polishing procedure developed for the APC-80XX. If your facility is using a different polishing machine, the procedure can vary. There may need to be pressure, rotation speed, and time adjustments. Contact your SENKO representative for additional guidance.

3.2.2 MT SM ferrule polishing procedure is available upon request via your SENKO Account Representative.

3.2 Ideal amount of polished surface

The proper angle is generated after the Silicon-Carbide steps. The steps that follow involve slurry based polishing films and they add very little to the angle formation process. In theory, the Silicon-Carbide steps should leave around 5% to 30% of unpolished surface area, *T* (Refer to Figure 11). There is a common opinion that if the flat line is gone the ferrule is automatically considered to be over polished, but is that true?

There is a perception that having a flat line indicates the manufacturing process is thought to be highly under control. For clarity, a standardized polish and passing performance criteria depends on the overall ferrule length that can be measured. For SM 8º MT/APC ferrules, the International Standard (IS) IEC 61755-3-31 identifies end-face geometry parameters and dimensional limits for 4 through 12 fiber rectangular end-face ferrules to ensure effective optical performance. The IEC final dimensions for MT/APC ferrules are shown below in Table 1. In summary, per IEC, it is perfectly acceptable not to have a flat line as long as the overall ferrule length is over 7.9mm.

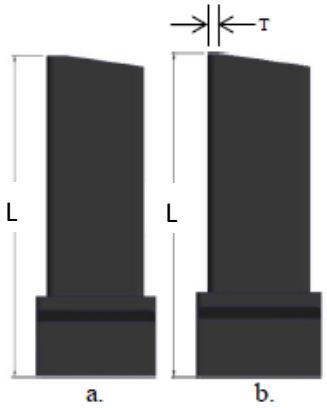


Figure 11 Before (a) and After (b) MT ferrule profile

		Dimention L, mm		Dimention T, mm	
Figure #	**Description**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
	Before Polish	8.0	8.1	na	na
	After Polish	7.9	8.1	0	0.8

Table 1: Ferrule Dimensions

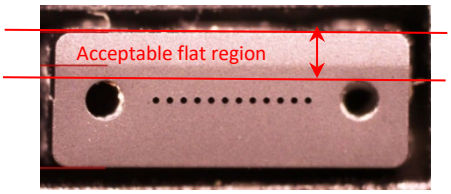


Figure 12 Acceptable flat portion

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