Polarization Maintaining splicing protocol for iXblue PMG Tiger IB IXF-PMG-IB-1550-80-019-LS using the Fujikura FSM-100P splicer

APPLICATION NOTE | iXblue PHOTONICS

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1.1 | PM fibers

There are different kinds of PM fibers with stress-induced birefringence:

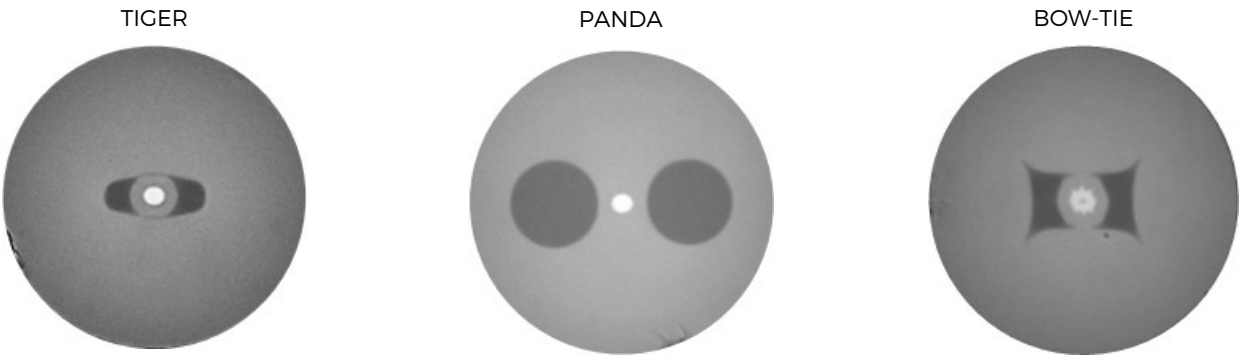

Figure 1: cross-sections for different PM fibers types

The iXblue PMG-IB is a TIGER type PM fiber.

1.2 | Polarization Extinction Ratio (PER)

The PER is important because it is a measure of the polarization-maintaining performance of an optical fiber.
The light is launched onto one axis from a polarized source, and the PER is a ratio of the light which remains on the wanted axis to that which has managed to couple onto the unwanted axis.

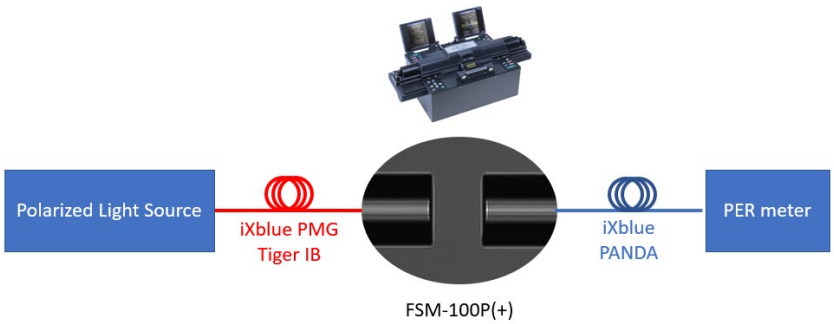

Figure 2: Synoptic

Polarization extinction ratio of a junction between two PM fibers depends on the offset angle θ between the polarization axis (fast and slow):

$$PER_{junct} = -10\log[\tan^2(\theta)]$$

This formula gives an extinction ratio of infinity for a zero-offset angle, which is not accurately reflect reality. Consider that the PER before splicing is 50 dB (assuming a short fiber length):

$$PER_{junct\_50\,dB} = -10\log[\tan^2(\theta) + 0{,}00001]$$

According to this formula, we obtain the variation of PER as a function of θ:

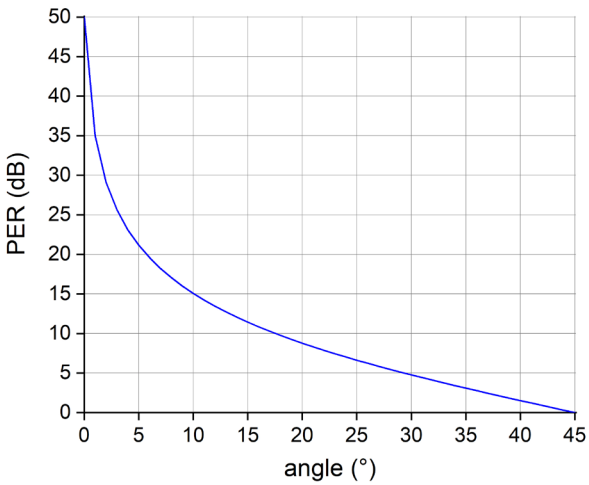

Figure 3: PER = f(θ)

Splicing protocol for iXblue PMG Tiger IB using FSM-100 _edA_30112020 PSD-L-Q-V-121

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1.3 | PMG-IB fiber profile

An elliptical cladding of doped glass around the core causes an asymmetric stress on the core, which leads to stress induced birefringence.
A high polarization extinction ratio splice is possible through a splice profile recognition process that we describe in this document.

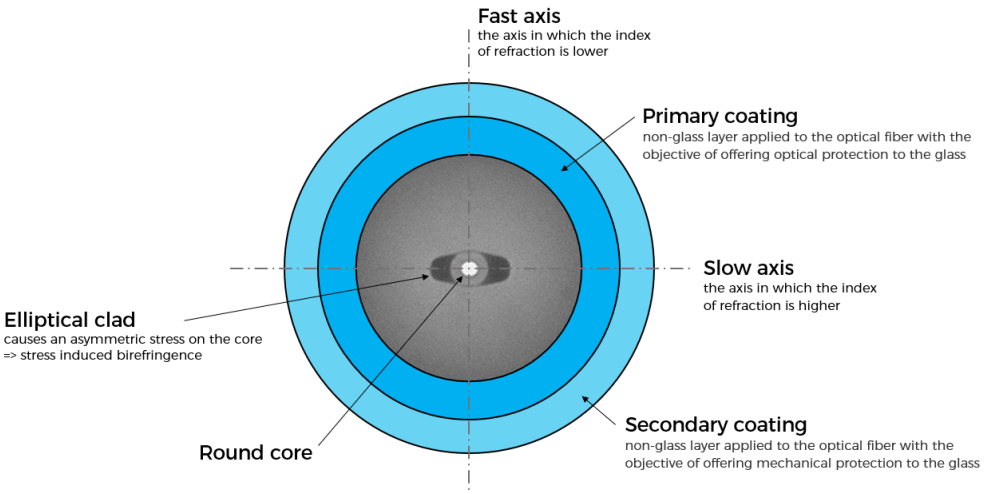

Figure 4: Structure of the IB fiber

During the development of this fiber we took care to obtain an easily recognizable and repetitive IPA data profile.

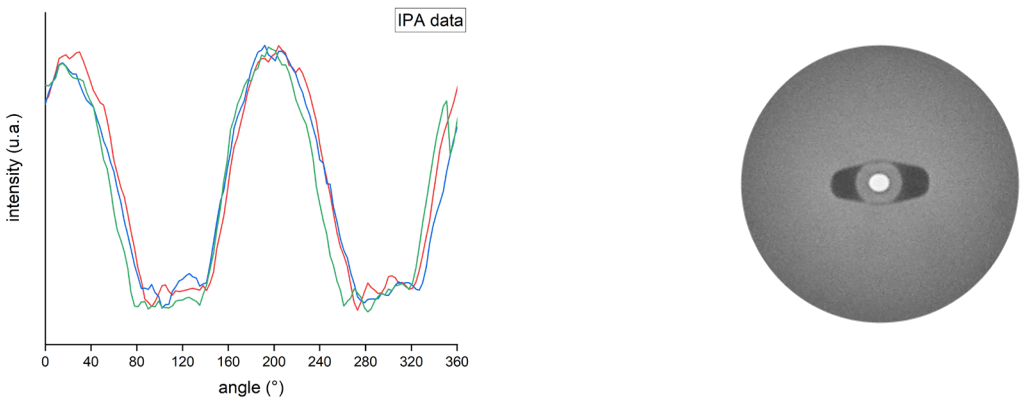

Figure 5: IPA data profile for the PMG Tiger IB from different batches

For comparison, the typical IPA data profiles for PANDA and BOW-Tie fibers are as following :

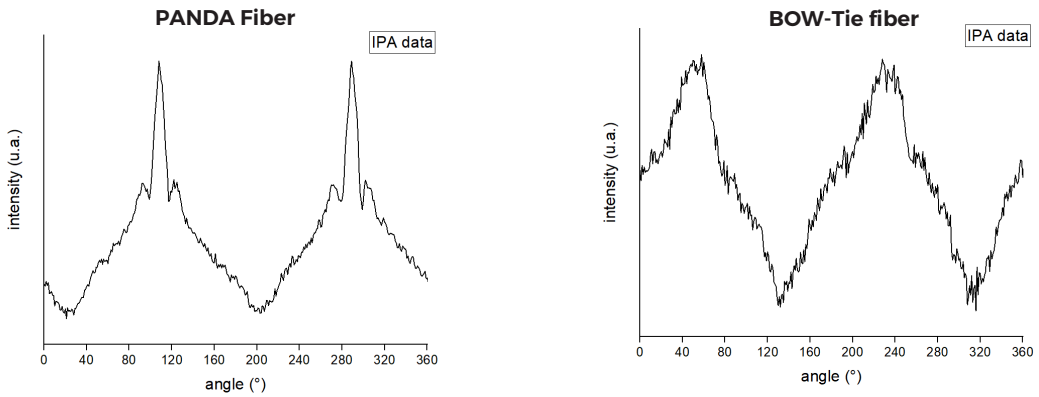

Figure 6: IPA data profile for PANDA and BOW-TIE fibers

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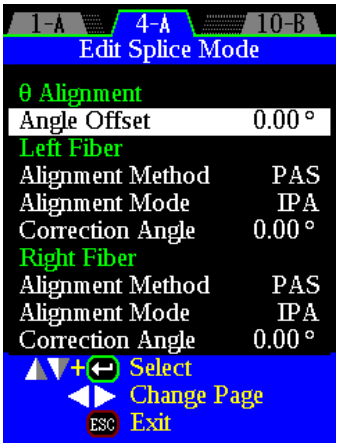
1.4 | How to splice it?

The best solution for polarization-maintaining splicing with Fujikura FSM-100P(+) is to use:

- Alignment Method:
  PAS (Profile Alignment System)
- Alignment Mode:
  IPA (Interrelation Profile Alignment)



The splicer aligns theta by using the memorized IPA data of each fiber.

This process should be done once per splicer and per fiber type.

2 | PAS-IPA alignment optimization

2.1 | Method

The method to acquire fiber profiling data is described in the instruction manual:
The fiber to memorize the profile data is set on the left side with glass clamping. On the right side, the PM fiber that profiled data is already memorized in the splicer with glass clamping.

After data acquisition of the profile, the fiber is aligned by the splicer and you must manually align more precisely. For this, you use a polarized light source and a PER meter.

2.2 | Implementation results

By default, the PMG Tiger IB is recognized as a bow-tie fiber. It is not ideal because the IPA profile of these two fibers are different. The alignment will not be optimal and will yield to a degraded PER. Nevertheless, we obtained an average PER of 26.6 dB and 3.5 dB deviation when spliced with a PANDA fiber.

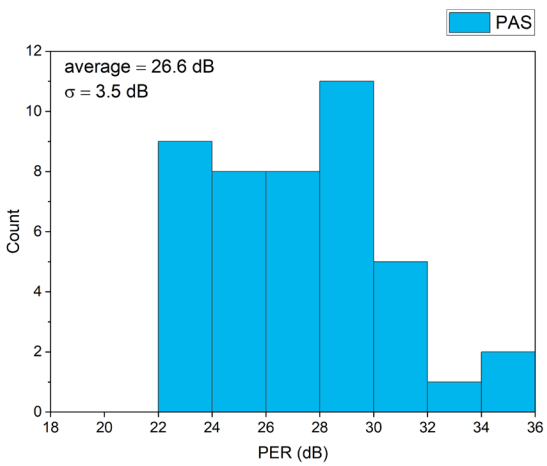


Figure 7: PER of the junction PMG-IB/PANDA fibers using default settings

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To improve the PER, the user needs to implement the learning IPA data process to record the angular profile of the PMG-IB fiber in the splicer. This will lead to optimal alignment and maximum PER. We obtained an average PER of 34.8 dB and 3.1 dB deviation when this fiber is spliced with a PANDA fiber.

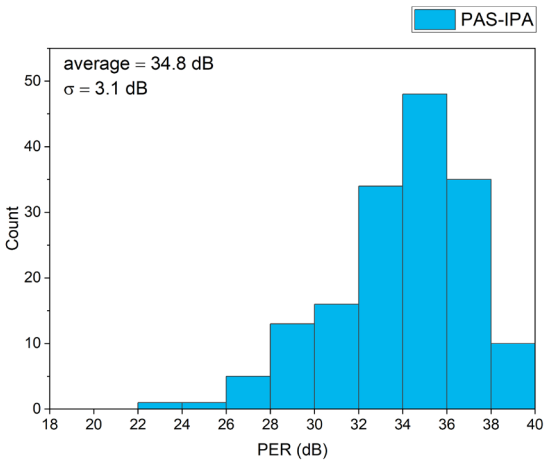

Figure 8: PER of the junction PMG-IB/PANDA fibers using memorized IPA data

3 | CONCLUSION

IXF-IB, thanks to its smart design profile, allows splicing with excellent PER to any PM fibers, including Panda types.

Higher than 30 dB PER are easily obtained when using the learning IPA process available on the Fujikura FSM-100P splicer. This one-time operation must be performed on each splicer used.

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