Fiducial assembly for PFS
Assembly process (ferrule to spine) and validation report

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(Revised: October 5, 2016)
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Abstract
Three fiducial fibers were bonded to spine / stud assemblies and checked for bond strength, and consistency for the height. This document describe the assembly process and the validation process used in August 2016.

Assembly

Tools:
Fiducial bonding adopter for phase 2
Focus adjust fixture
Turn over fixture
Pneumatic epoxy dispenser with appropriate syringe and needle (25 gauge)
Custom open end wrench (2.6mm)
Furcation tube as a fiber guide (Microlumen Polyimide 095-II)
Torque wrench (set to 1.4 Nm)
White marker

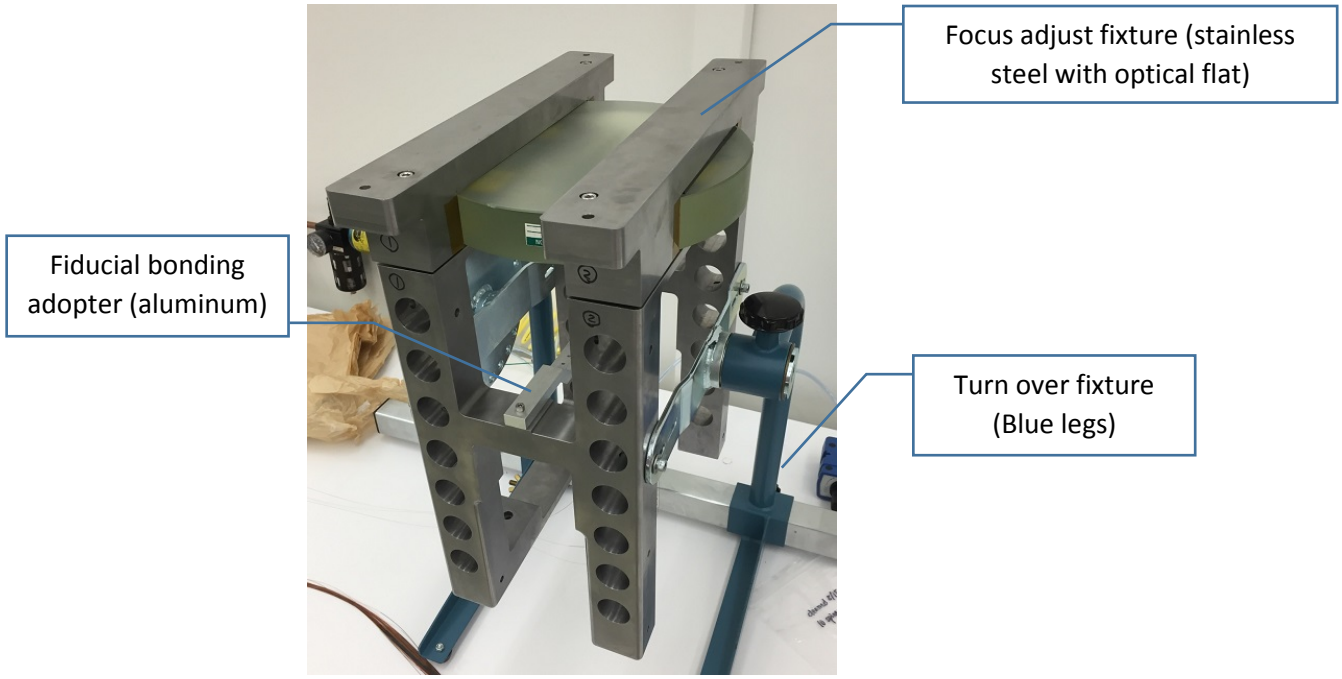


Fig 1: Focus adjust fixture with fiducial bonding adopter installed on turn over fixture

Materials:
Fiducial stud / spine assembly (3 pieces)
Epotek 301
IPA
Few foam swabs
Grease (Dow Corning High Vacuum Grease)
Fiducial fiber assemblies with microlens and ferrule (3 pieces)
Silicone cap (3 pieces, Stockcap.com, 0.125 - 0.500)

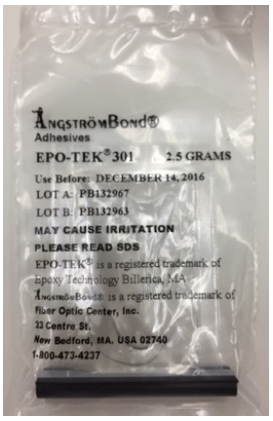


Fig 2: epoxy used


Fig 3: Spine/Stud assembly


Fig 4: Fiducial fibers

Preparation for assembly

1. Focus adjust fixture without optical flat was installed onto turn over fixture. Make sure the turn over fixture is locked.
2. Fiducial bonding adopter was ultrasonically cleaned, rinsed in DI water and IPA, and blow dried. Grease was applied inside the threaded holes using foam swabs.
3. Fiducial fibers are laid out on a long table.

Assembly Process

1. Studs of each spine/stud assembly were wiped clean with IPA, and then grease was generously applied on the threads, and leading edge of shanks.


Fig 5: An example of greased stud

2. Studs were gently inserted into fiducial bonding adopter, and then screwed down by hands.
3. When resistance was experienced, back and forth motion was used with very light torque using custom 2.6mm wrench (Fig 6). This makes the grease spread on the thread, and thus the resistance is minimal until the shank reaches the bottom. When shank reaches the bottom surface inside, the resistance will suddenly increase. It was made sure that this happened at the same angular position by continue to use back and forth motion with no more than 4 ounce-inch force (0.03 Nm). It was also made sure that shank part of the stud was all the way into the fixture (Fig 7).

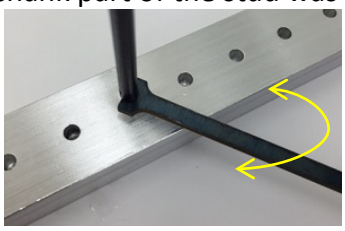


Fig 6: using wrench

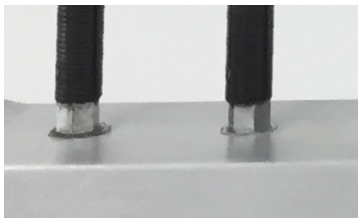


Fig 7: Appearance of studs when they reached the bottom

4. All 3 spine/stud assemblies were installed on fiducial bonding adopter. Then the adopter was installed on the focus adjust fixture.
5. Spines were marked with white marker approximately 8mm from the top (served as reference positions for silicone caps).
6. One fiducial fiber with microlens was carefully pulled out of the bundle by pulling yellow capped ferrule in the direction of the fibers. Weights and non-slip foam pieces were used as appropriately to keep the rest of the fibers on the table.

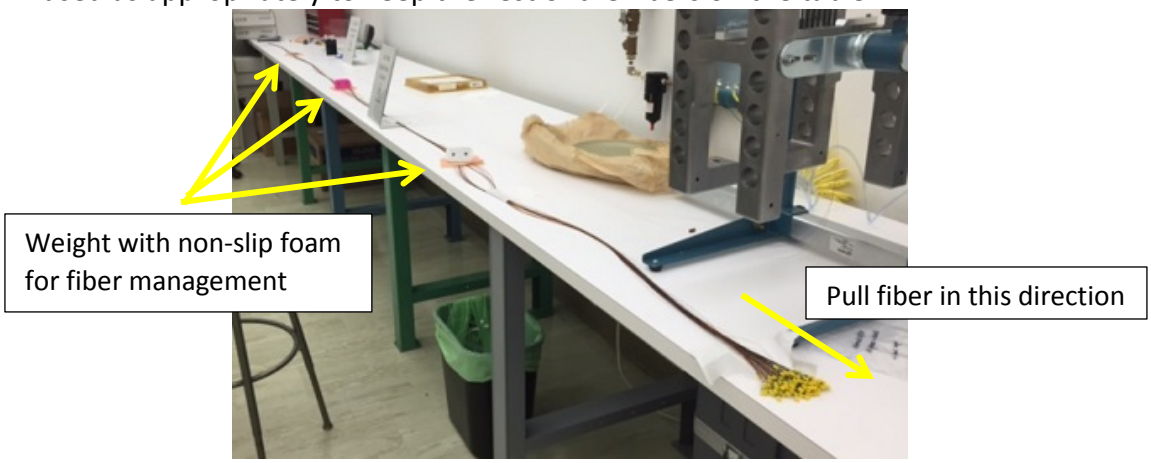


Fig 8: Pulling fiducial fibers out of bundle

7. The end of fiber without ferrule was inserted into the spines. Furcation tube was used as a fiber guide.
8. The fiber was carefully pulled through the spine on long table until ferrule was on top of the spine.
9. Steps 6, 7 and 8 were repeated for all fibers.

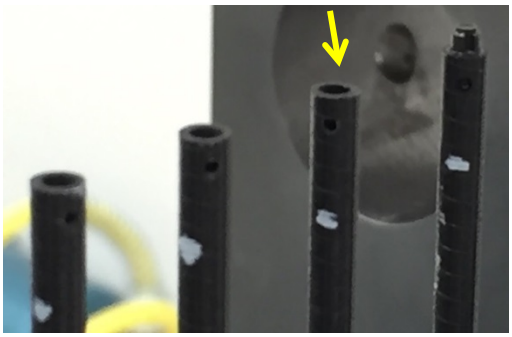
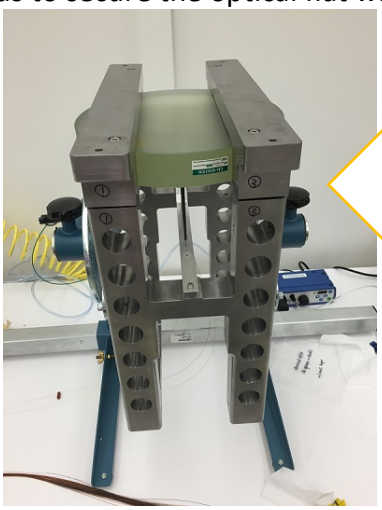


Fig 9: Insert end of fiber and thread fiber through the spine

10. Yellow caps on ferrule were removed, then optical flat was installed. The screws that hold optical flat were tightened with torque wrench (1.4Nm). The torque setting was chosen so that the optical flat was visually confirmed to be firmly secure but the rubber pads to secure the optical flat was not all the way compressed.



Shim will be inserted between optical flat and focus adjust fixture to make fiducial longer (See revision at last page)

Fig 10: Optical flat installed

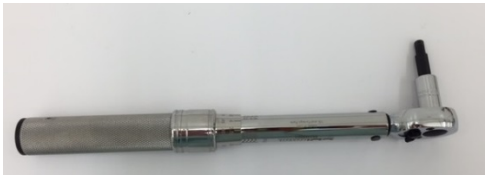


Fig 11: Torque wrench used

11. Turn over fixture's turning wheel was unlocked, and the fixture was turned 180 degrees. It was made sure that the fibers were not caught anywhere. The fixture was locked.

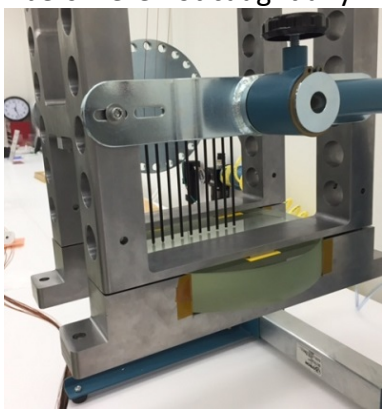


Fig 12: Turn over fixture with optical flat at the bottom

12. It was made sure that the microlenses were contacting optical flat, then Epotek 301 was injected into injection hole on the spine. Injections from both sides were repeated until the droplets of epoxy placed on the injection holes did not wick into the holes any more. The coverage is visually confirmed after approximately 8-12 drops (total from both sides).

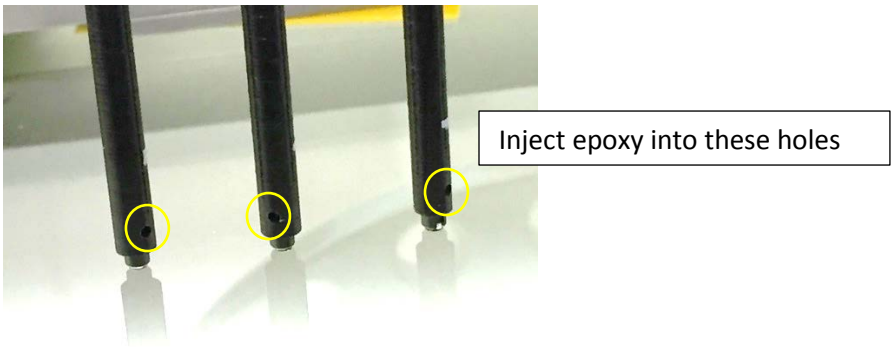


Fig 13: Microlenses contacting optical flat

13. Assembly was left undisturbed over night for cure.
14. The focus adjust fixture was turned so that optical flat is on the top using turn over fixture wheel. Optical flat was removed.
15. Silicone caps were placed on each of the finished fiducial fiber assembly. The edges of the caps did not go past the 8mm white mark.
16. Finished fiducial fiber assemblies were removed from the fixture one by one. The assemblies were packed into shipping box after the studs were wiped clean with IPA.

Fig 14 a & b: Fiber packed for shipping

Validation

Vertical and horizontal positions of the microlenses were observed after bonding at step 14 for consistency. Vertical positions were consistent to visual inspection. Horizontal positions revealed approximately 10-20% variation of the diameter of the spines, which are about 3mm in diameter. Figure 15 shows 3 complete fiducial assemblies and 7 stud/spine assemblies (total 10 spines).

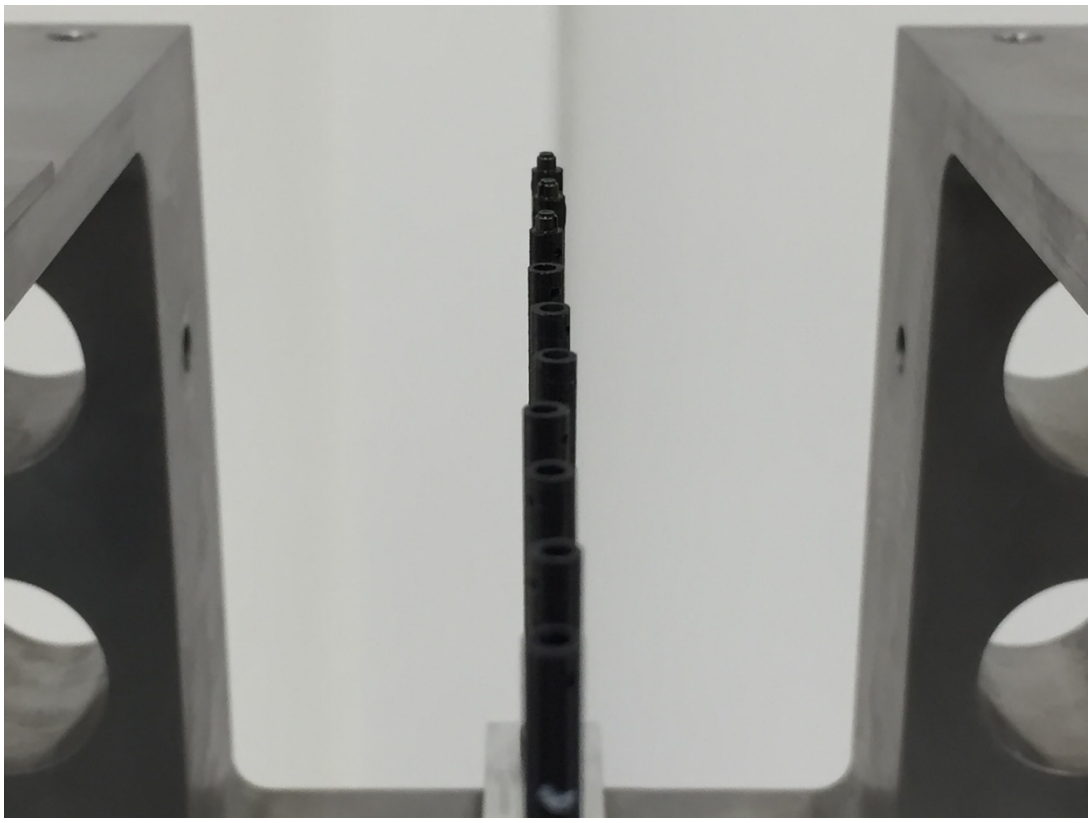


Fig 15: 3 Finished fiducial assemblies and 7 spines/studs assemblies

Bond line of finished fiducial fiber assemblies were observed under microscope. Figure 16 shows how epoxy covered all edges of the spine, but did not run down to microlens.

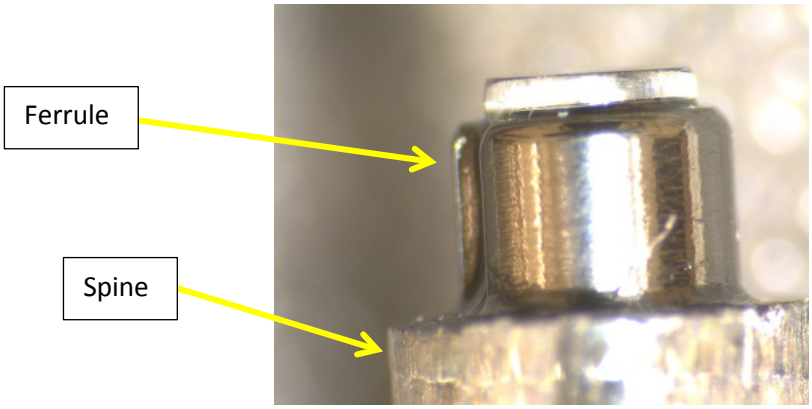


Fig 16: An example bond line of finished fiducial fiber assembly

Conclusion

The validation process confirms that the process used for this assembly achieves satisfactory results in bond line appearance and consistency of the fiducial ferrule height.

Revision on October 5:

In order to mitigate the COB out of spec non-flatness, Fiducial fibers will be 80 um longer than designed. In step 10, the designed shim will be inserted for future process.