



PCS Optical Fibers for an Automobile Data Bus

Optical fibers have been used for data communications within automobiles for several years. The fiber of choice thus far has been a plastic core/plastic clad optical fiber (POF) consisting of the plastic polymethylmethacrylate (PMMA). Increasing demands regarding temperature performance, transmission losses, and bandwidth have pushed the current limits of the POF fiber, and the automotive industry is now moving towards an optical fiber with a silica glass core/plastic clad (PCS).

1. Introduction

The fiber design tested was a 200 μ m synthetic silica core, a 230 μ m fluoropolymer cladding, and a 1510 μ m nylon buffer (refer to figure 1). Key attributes such as 700-900 nm spectral attenuation, 125 $^{\circ}$ C thermal soak, bending losses, and mechanical strength are presented. There are obvious environmental conditions to be met, such as:

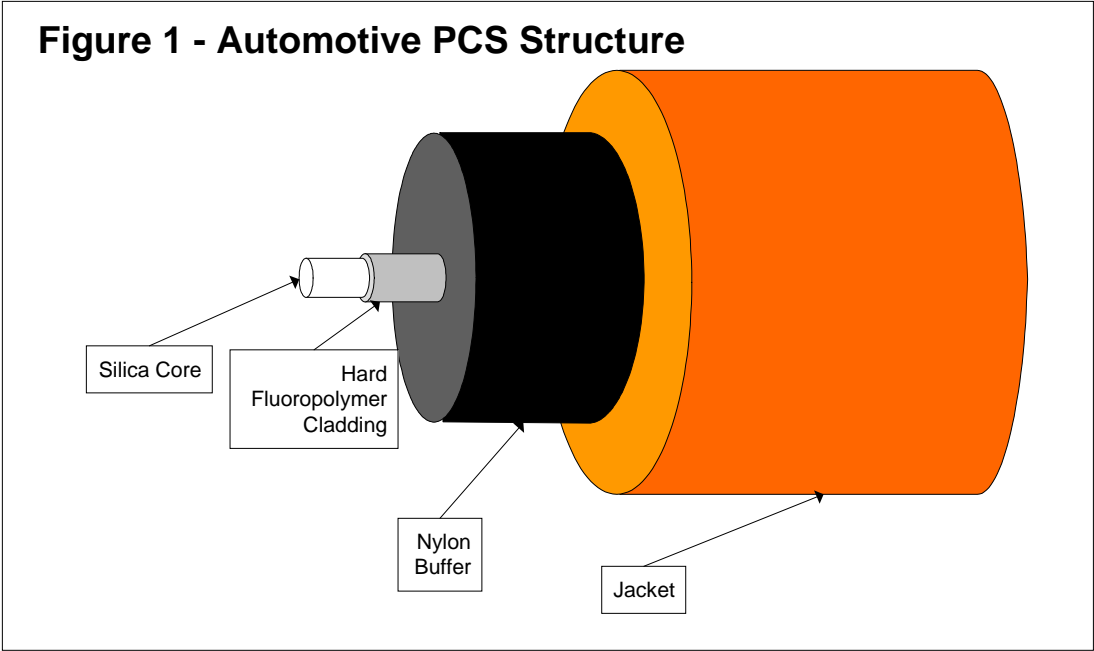
- High temperature (~125 $^{\circ}$ C)
- Temperature cycling (-40 to 125 $^{\circ}$ C)
- Automotive fluid immersion
- Tight bend radius (<9mm)
- High tensile force (>60N)

There are some limitations of the POF which will restrict further expansion of the optical data bus within the car. There is the desire by the auto manufacturers to extend the data bus to additional devices which will require penetration into higher temperature regions of the auto, lower optical loss, greater bandwidth, and possible use of a star network. The difference between the POF and PCS are summarized in Table 1.

	Attenuation (dB/25m)	BW (MHz-km)	NA	Max. Temp.	Flamm- ability	Min. Bend Radius
POF	1.1	4	0.6	90 $^{\circ}$ C	high	~25mm
PCS	< 0.5	> 4	0.37	125 $^{\circ}$ C	low	~9mm

	Ease of Termination	Chem. Durab.	Strength	Weight	Cost
POF	Easy	Low	Moderate	< 5kg/km	Low
PCS	Moderate	High	High	< 5kg/km	Moderate

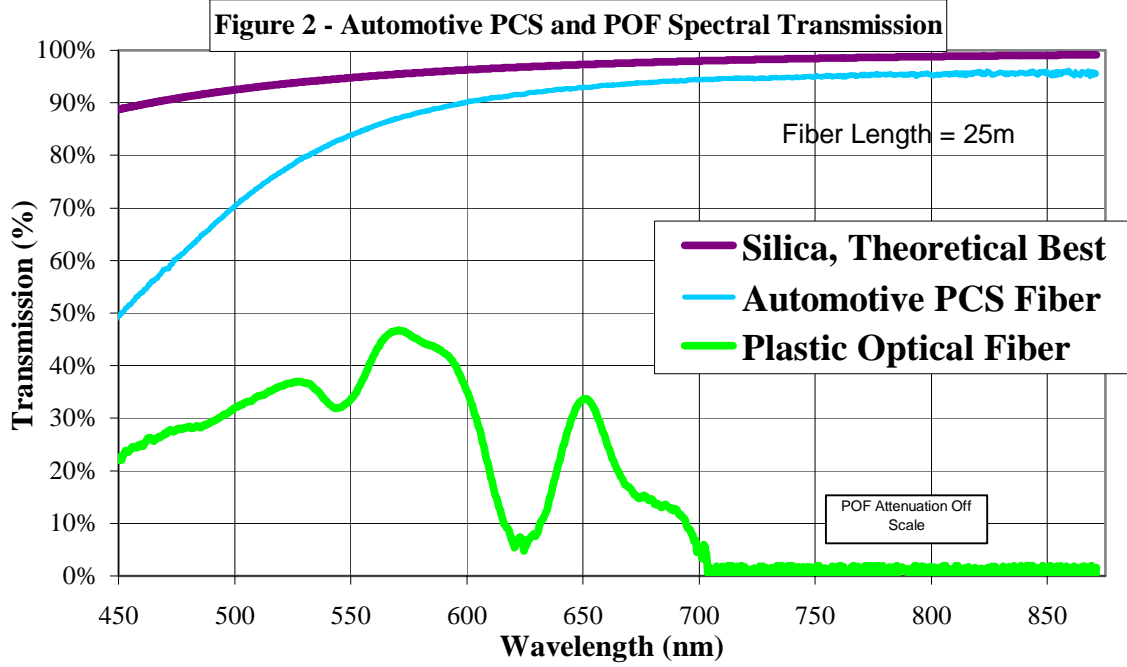
Table 1. POF vs. PCS



2. Measurement Results

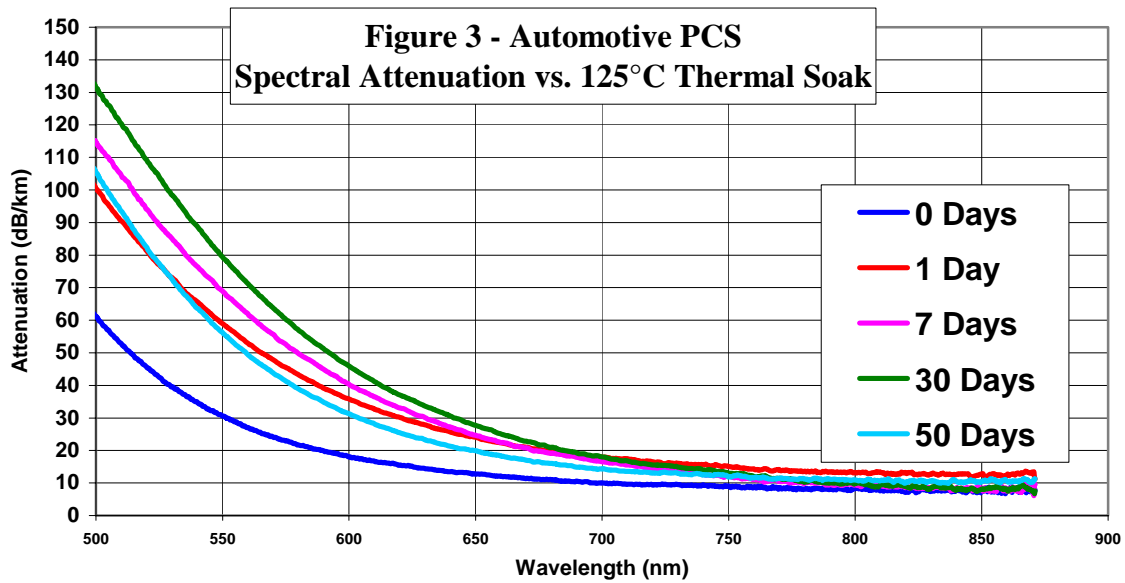
2.1 Spectral Attenuation

The intended operational wavelength of the automotive PCS fibers is 850nm (i.e. 850nm VCSELS), vs. 650nm used for the POF. Figure 2 shows a typical spectral transmission curve for both POF and PCS fibers.



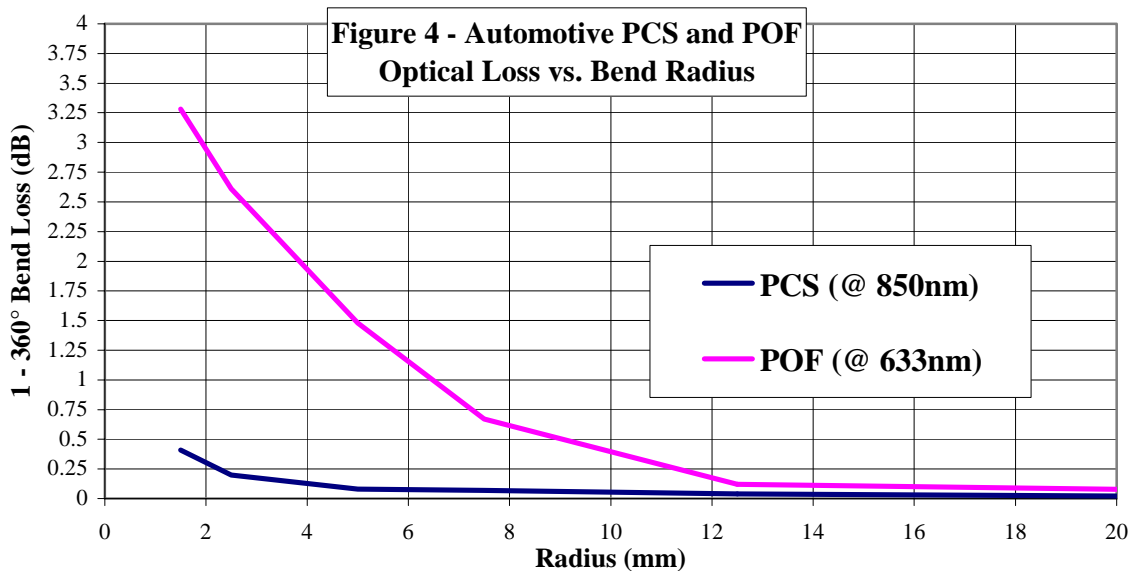
2.2 Spectral Attenuation vs. 125°C Thermal Soak

The spectral attenuation of the automotive PCS fiber vs. thermal soak at 125°C is shown in Figure 3. This test could not be performed on the POF because 125°C exceeds the working range of POF.



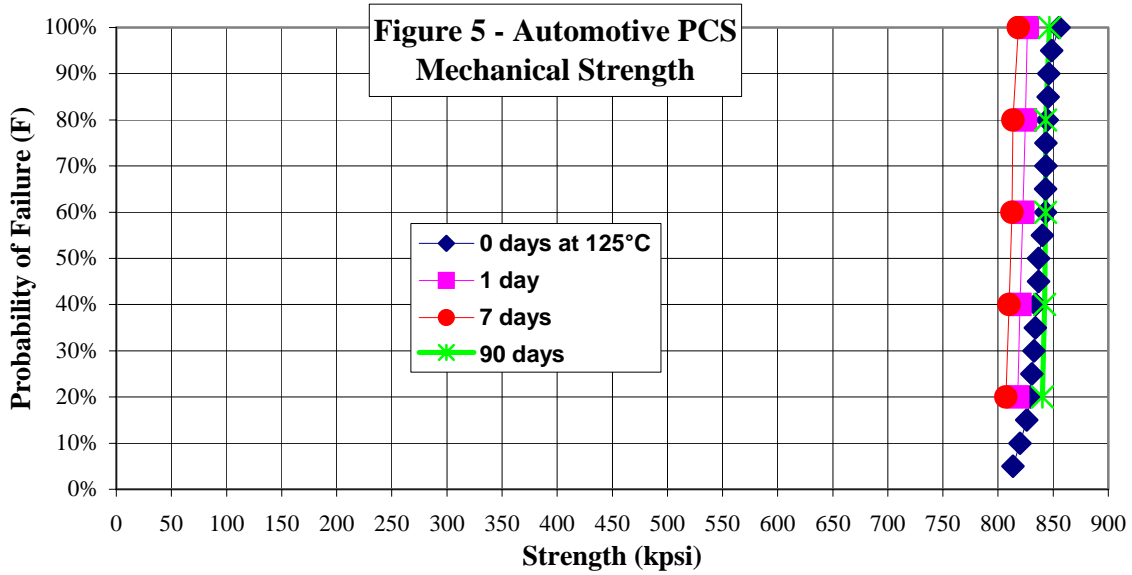
2.3 Optical Loss vs. Bend Radius

The bend loss of the automotive PCS and POF was measured for (1) x 360° bend at various bend radii. The PCS fiber demonstrated very little added optical loss until ~4mm bend radius, where the added loss was ~0.1dB.



2.4 Mechanical Strength

The mechanical strength of the PCS fiber was measured before and after the 125°C thermal soak. The initial PCS fiber strength was approximately 850kpsi as shown on the weibull plot on Figure 5. After 90 days the PCS fiber strength was unchanged.



3. Conclusions

Overall, a specifically designed PCS fiber is expected to be acceptable for use in an automotive data bus, and will show improvement in optical transmission, temperature range, and bandwidth. However, the final selection of buffer and jacket materials and properties will be most dependent on the selection of a reliable and economical termination method.

Polymicro Technologies, LLC
 18019 N 25th Ave., Phoenix, AZ 85023-1200
 Ph: 602.375.4100
 Fax: 602.375.4110
 E-mail: sales@polymicro.com
www.polymicro.com