Center for Astrophysics

Smithsonian Astrophysical Observatory

MEMORANDUM

To: R. Fata
From: J. Zajac
Subject: Fluid Gap Modeling
CC: D. Fabricant, J Barberis

29 October, 2007

This purpose of this study is to understand the relationship between the change in fluid *gap* volume versus the change in the LL5610 volume over a 42˚C temperature drop . Two cases were analyzed, a small gap with little fluid volume, lens 8 & 9 collimator, and a complex gap with a large volume, lens 4 through 7 collimator. Two models of the each assembly were needed, a normal (room temp) and a scaled model based on the individual CTE's of the bezels and lenses. For this study, the large items, the bezels and lenses were scaled, the small items that would produce an insignificant change were ignored; the nubs, pins, and seals.

The process involved scaling the lens and bezel about the point where the center of the nub intersects the optical axis. Since the bezel would shrink in diameter and thickness, the bezel and lens would be moved along the optical axis until the reference surfaces of the bezels are coincident.

Shown below are the cross sections of the fluid gaps.

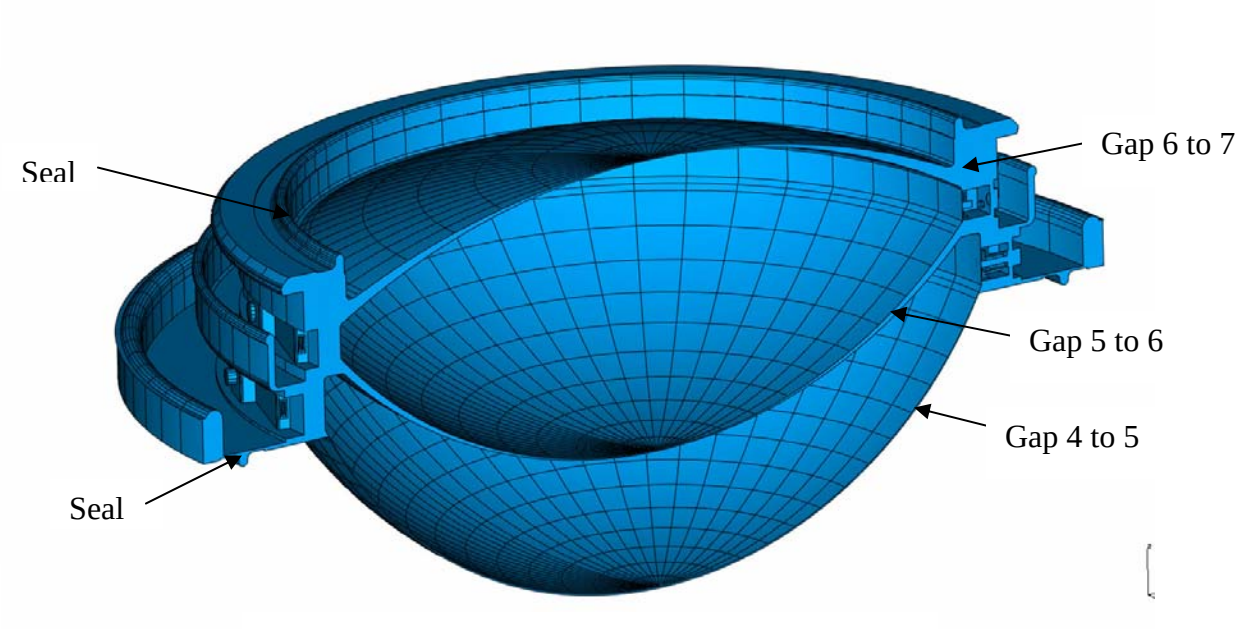

Figure 1. Fluid Gap Lens 4 through 7 Collimator

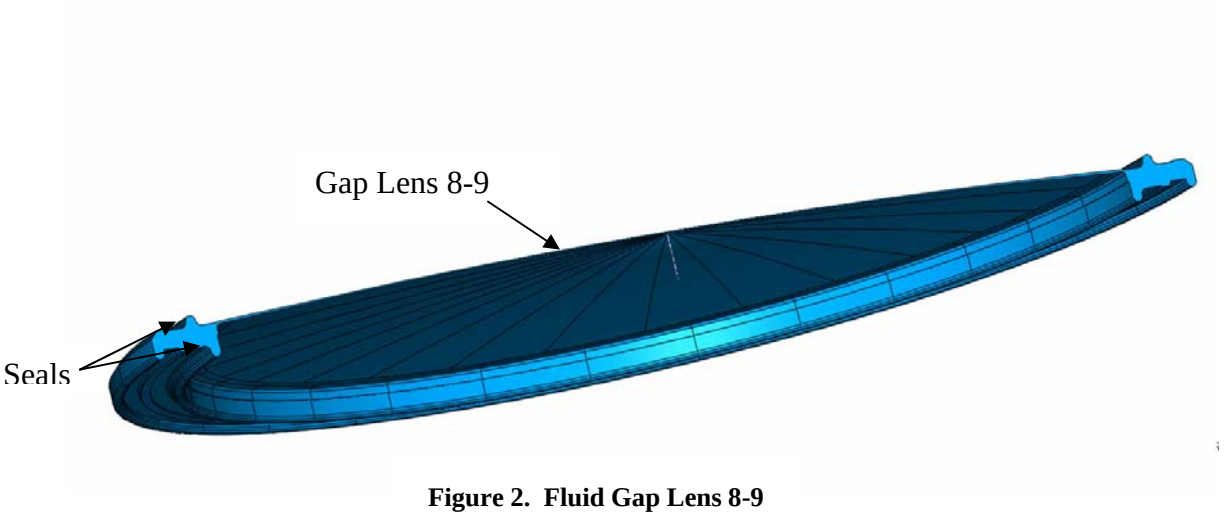

Figure 2. Fluid Gap Lens 8-9

The table below shows the calculated change in gap volume along with the change in volume of the fluid.

Lens Gap	Delta Gap (in^3)	Delta Fluid (in^3)
8 – 9	-0.165	-0.34
4 - 7	-0.46	-1.58

In conclusion, the gap is decreasing less than the fluid volume so a bellows is necessary otherwise a vacuum would be produced. The size of the bellows needed is the difference between the gap and fluid volumes along with the addition of a safety factor.