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DEIMOS PROJECT

Best fit of simple curved surfaces to spherical slit mask

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ABSTRACT

The focal surface of the DEIMOS spectrograph is approximately a sphere about 83.6 inches in radius. For a slit mask to be placed on this surface it would ideally need to be a section of a similar sphere. The fabrication of the masks will likely be from a material that is initially flat. Forcing the material into a compound curve like a sphere introduces either wrinkles or the necessity of reforming the material. Also, storage of the masks in a spherical form will require significantly more space than if they were flat. This study explores the feasibility of using a singly curved surface fitted as closely as possible to the ideal spherical area and then examines the deviations that are introduced. Two shapes were tried - a cone and a cylinder.

An added complication of the problem is that the allowable deviation becomes greater as the radial distance from the optical axis increases.

CONTENTS

1. THE SPHERICAL SLIT MASK

The spherical mask surface is described in Lick Drawing D1705.F reproduced in Figure 1.1. Also shown is its position and orientation with respect to the center of the focal sphere.

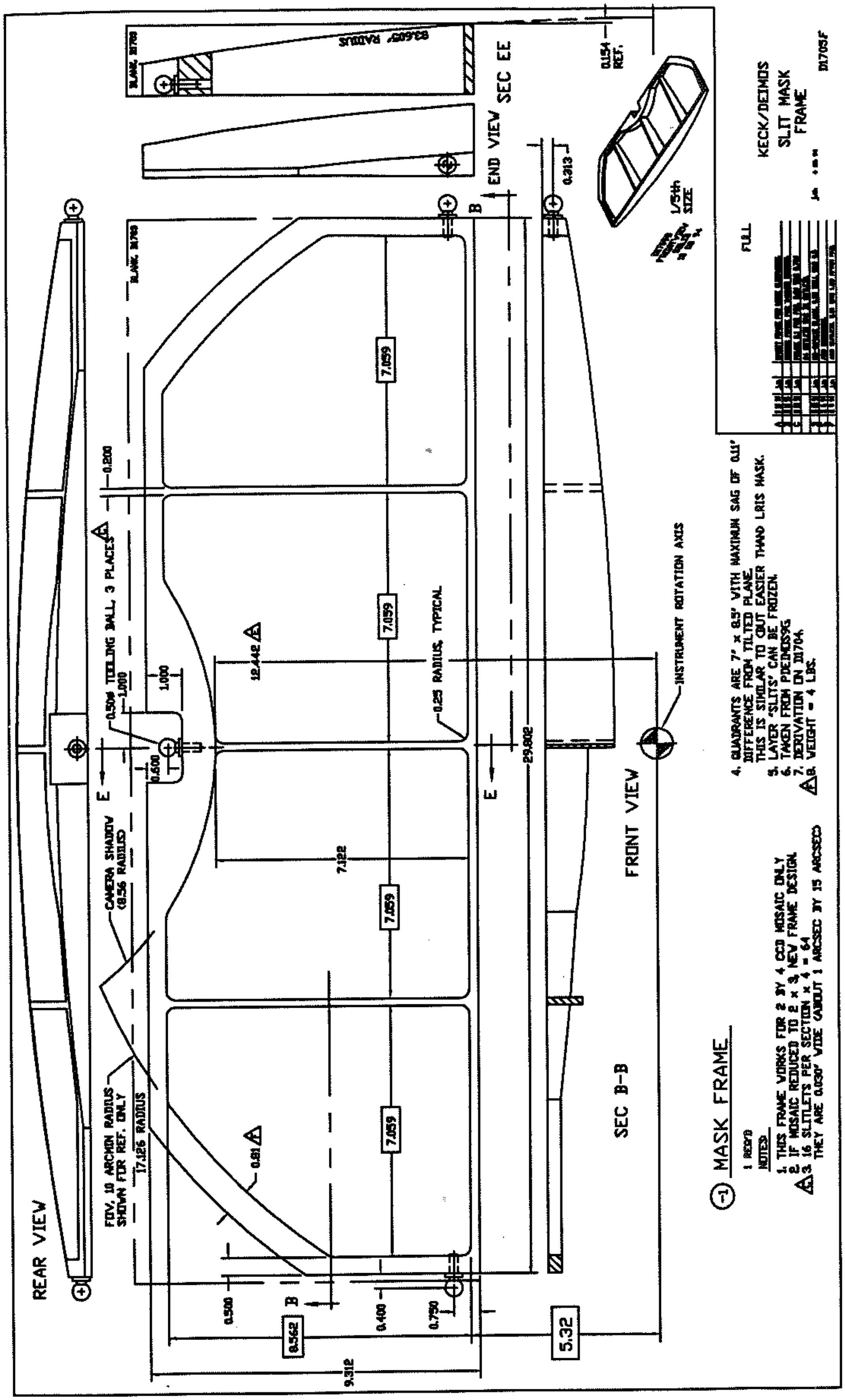
REAR VIEW
FRONT VIEW
SEC B-B
END VIEW
SEC EE
INSTRUMENT ROTATION AXIS
CAMERA SHADOW (8.56 RADIUS)
FOV, 10 ARCMIN RADIUS SHOWN FOR REF. ONLY
17.126 RADIUS
0.50ø TOOLING BALL, 3 PLACES
0.25 RADIUS, TYPICAL
83.605" RADIUS
1/5th SIZE
-1 MASK FRAME
1 REQ'D
NOTES:
1. THIS FRAME WORKS FOR 2 BY 4 CCD MOSAIC ONLY.
2. IF MOSAIC REDUCED TO 2 x 3, NEW FRAME DESIGN.
3. 16 SLITLETS PER SECTION x 4 = 64
THEY ARE 0.030" WIDE (ABOUT 1 ARCSEC BY 15 ARCSEC)
4. QUADRANTS ARE 7" x 8.5" WITH MAXIMUM SAG OF 0.11" DIFFERENCE FROM TILTED PLANE.
THIS IS SIMILAR TO (BUT EASIER THAN) LRIS MASK.
5. LAYER "SLITS" CAN BE FROZEN.
6. TAKEN FROM PDEIMOS9G
7. DERIVATION ON D1704.
8. WEIGHT = 4 LBS.
KECK/DEIMOS
SLIT MASK
FRAME
D1705F
FULL
7.059
7.122
12.442
29.802
9.312
8.562
5.32
0.500
0.400
0.750
1.000
0.200
0.313
0.154 REF.
0.81

Figure 1.1

2. A CONE

In this study, a cone with its axis of revolution colinear with the optical axis (and therefore passing through the center of the focal sphere) is placed so that its tangent loci with the sphere forms a circle with a radius of 8.5 inches as shown in Figure 2.1. The 8.5 inch dimension is somewhat arbitrary except that it favors the inner mask edge at what seemed to be about the right amount. The point of tangency becomes a circle of tangency when it is rotated about the axis of revolution. The deviation,which is defined as the distance from the conical surface to the spherical surface along a ray coming from the center of the sphere, is zero at the tangent circle. With this configuration the deviation is .061 inches at the inner edge and .449 inches at the outer edge.

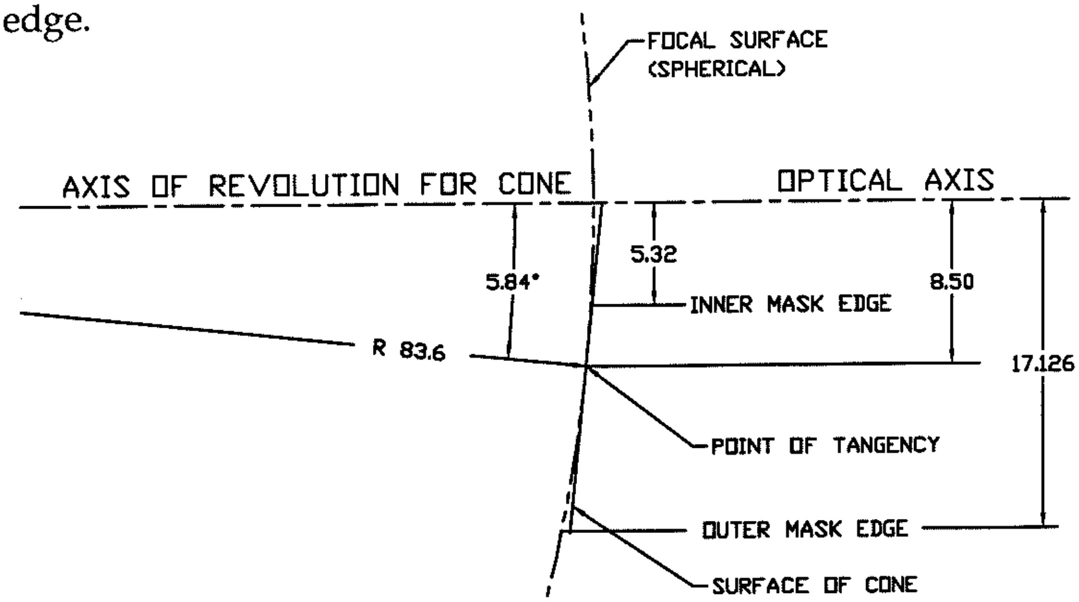

Figure 2.1

By offsetting the cone to the left about .1 inches along the axis of revolution, the deviations are changed to the values shown in Figure 2.2. This configuration has a deviation of .039 inches at the inner edge, a .100 deviation at what was the point of tangency, zero deviation at a radius of 12.5 inches and .349 deviation at the outer edge. These deviations are constant along circles when the profile is rotated.

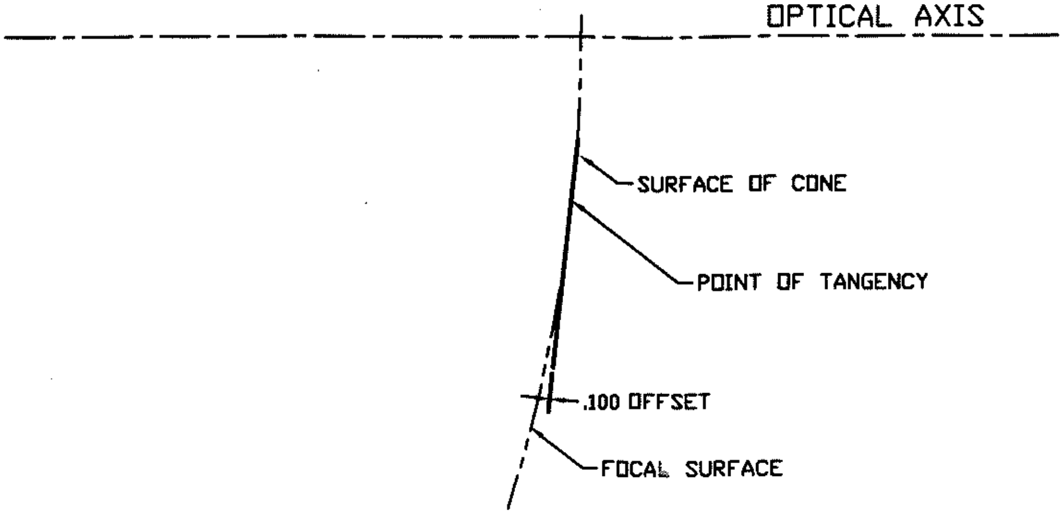

Figure 2.2

The circles of constant deviation are shown in Figure 2.3. The deviations could be optimized by adjusting the point of tangency and the amount of subsequent offset.

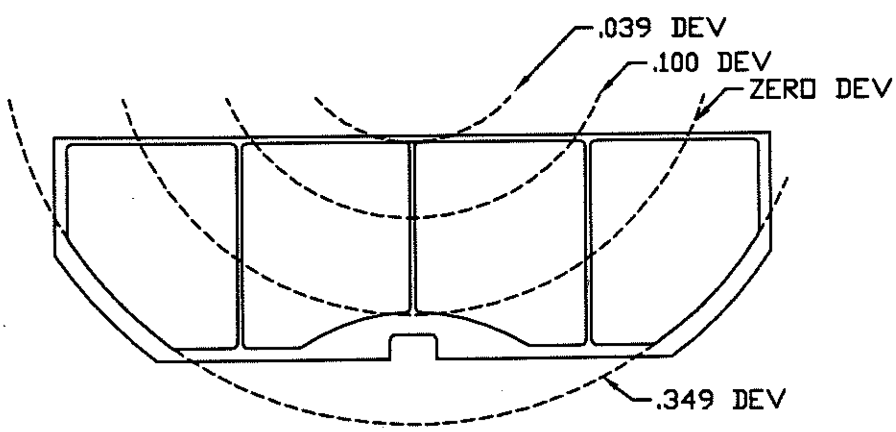

Figure 2.3

3.0 A CYLINDER

In this study, a cylinder with its axis of revolution through the center of the focal sphere and with the same radius as the sphere is placed so that it is tangent at the same point we used for the cone study. This is shown in Figure 3.1. The point of tangency traces a great circle on the surface of the focal sphere when it is rotated about its axis of revolution. The profile is the same as the one we explored in the cone study, but the axis of revolution is very different.

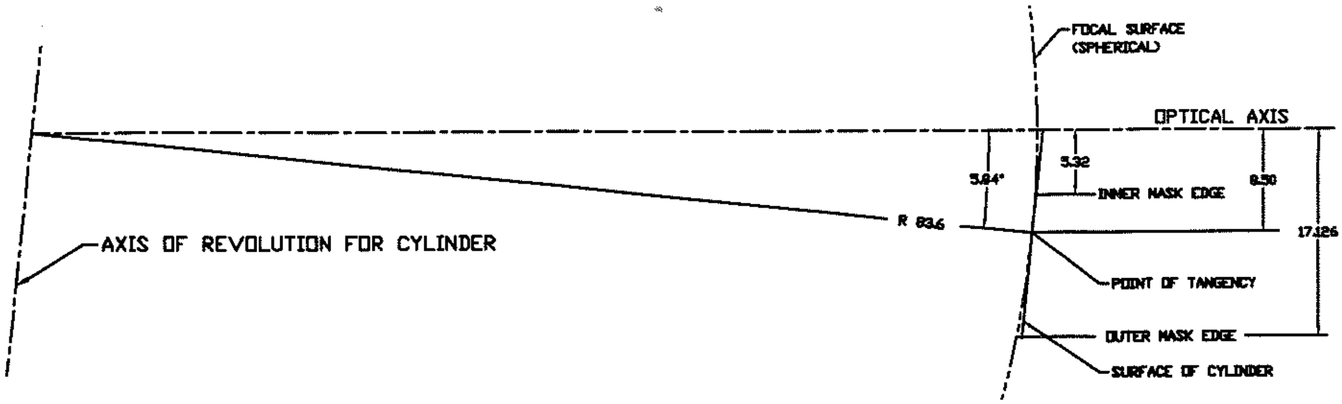

Figure 3.1

Similar to what was done in the cone study, the cylinder wall is offset by .030 to reduce the deviations. This is shown in Figure 3.2. With this configuration the deviation is .031 inches at the inner edge and .147 inches at the outer edge. There are two points of zero deviation and where the point of tangency was there is now .030 deviation.

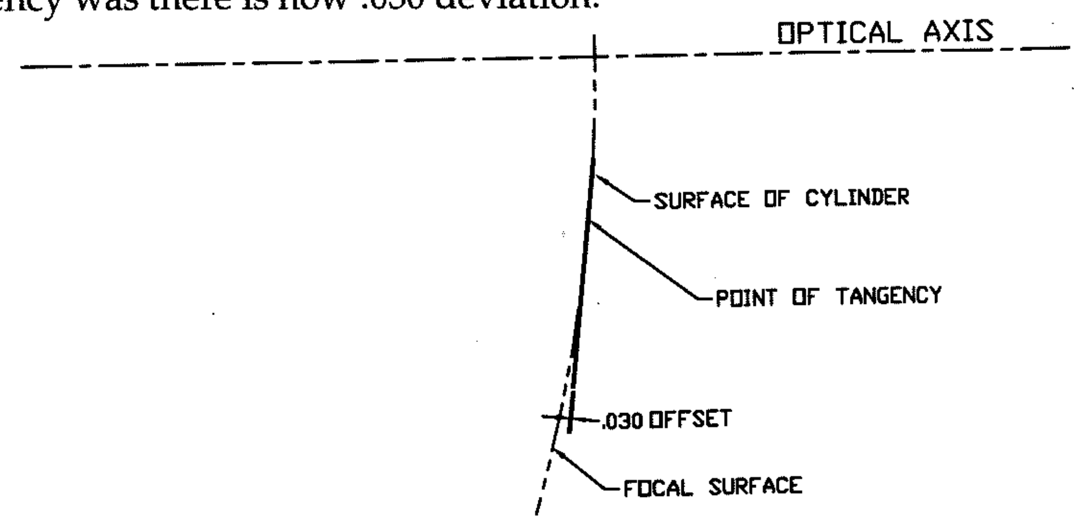

Figure 3.2

The great circle is an ellipse when viewed along a line of sight parallel with the optical axis. This ellipse is the line of constant deviation of .030. This ellipse and the other significant ellipses of constant deviation are shown in Figure 3.3.

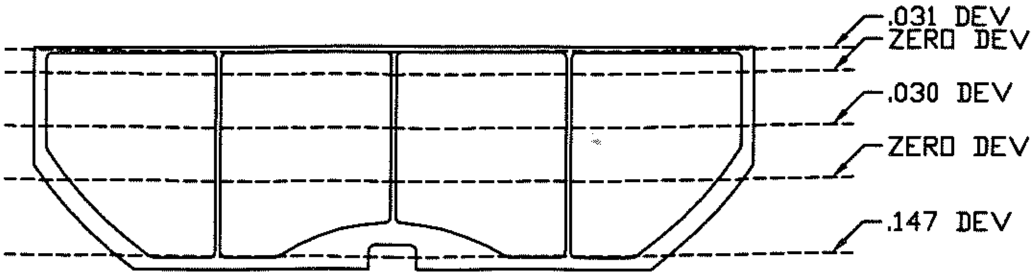

Figure 3.3

4.0 CONCLUSIONS

Of the two configurations it would appear that the cylinder shape produces the smallest deviations. The fit can be optimized by changing the point of tangency (and thus the angle) and by adjusting the offset. At this point in the design we do not have specific enough criteria for optimizing the fit. Reducing the deviation at one point will increase the deviation at others. Since we do not know at this time how the allowable deviation changes with the distance from the optical axis, we cannot determine what is the best fit. We do know that better fits might be attainable given the specific criteria.