

# Metal Mirror Design Review

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- Project Objective: Design a metal mirror for a Ritchey-Chrétien telescope for aerial surveillance
- Single Point Diamond Turning (SPDT)
  - Low cost of fabrication and assembly
  - Ease of assembly
  - Same material athermalization easy
  - High precision machining allows for assemblies to be bolted together without need for alignment
  - Optical surfaces machined directly onto surface, no need to polish
  - Aspheric surfaces no more difficult to produce than spherical surfaces

# Optical Requirements

- Clear Aperture: 190.50 mm
- EFL: 285.75 mm
- Surface Roughness: 100 Å
- Operating Range: 8-12  $\mu\text{m}$
- Reflectance: > 90%
- Surface:  $1/12\lambda$  RMS @ 8  $\mu\text{m}$
- Conic Constant:  $K < -1$

# Mechanical Requirements

- Elevation Travel: 0-90°
- Azimuthal Travel: 0-360°
- Mass: 15 kg
- Resonance Frequency: > 100 Hz

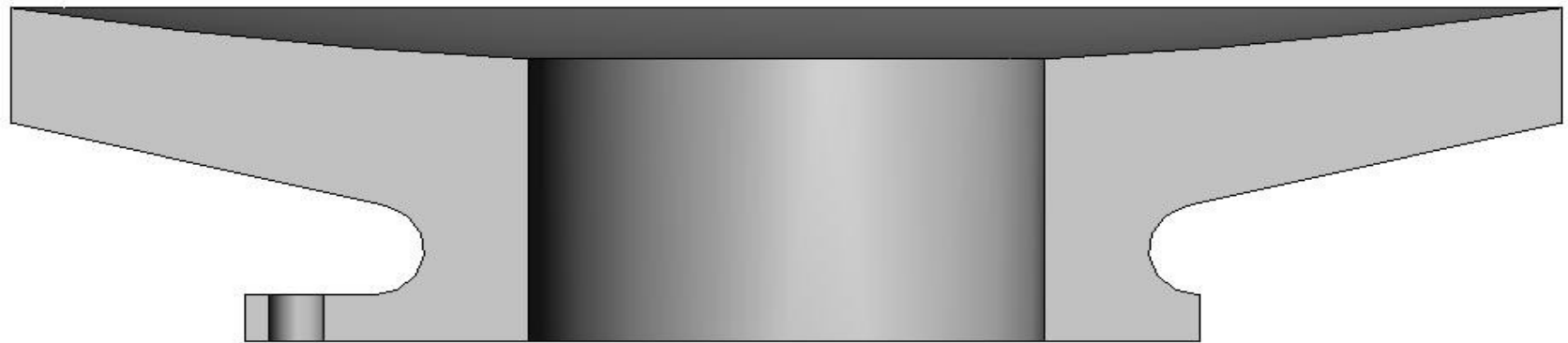
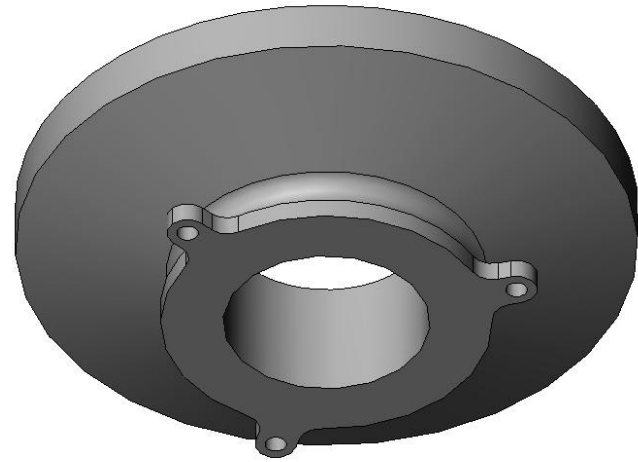
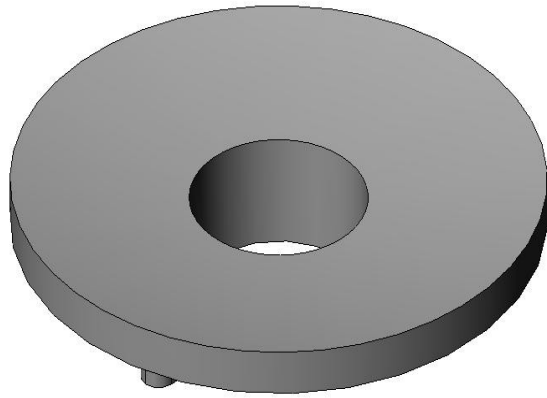
# Environmental Requirements

- Temperature Range: -20 - +35 °C
- Pressure Range: 270 – 760 mmHg
- Humidity Range: 0 – 100%
- Altitude Range: 0 – 25,000 feet

# The Design

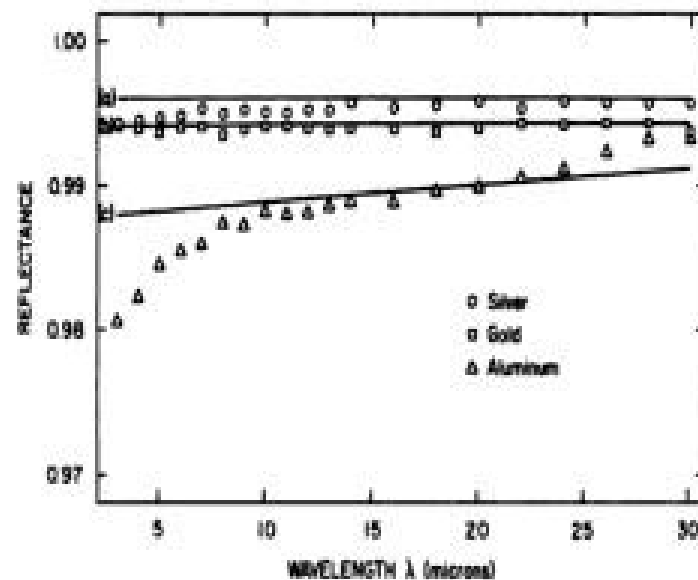
- AL-6061 – T6
  - Comes cast, low internal stress, easy to machine
  - Readily available
  - Cheap
  - Takes electroless nickel plating well
  - Lightweight
  - Stable

# The Design



# The Design

- AL – 6061 – T6 Base Part
- Electroless Nickel plated (150 nm thick) finished optical surface
- Gold plated 1<sup>st</sup> surface  
( $R > 95\%$  between 8-12 microns)



# Manufacturing Steps

- Rough Machine (all Dimensions +0.7mm)
- Stress relief with LN2 – Boiling Water
- Final Machining
- Re-Stress relieve
- Plate with Electroless Nickel. Coat all surfaces with 150 nm thick layer
- Re-Stress relieve
- Optical Finish
- Gold Plate 1<sup>st</sup> Surface



# Open Items

- Dielectric coat gold surface?
- Self-weight deflection FEA analysis.
- Flexure tab FEA analysis. Tabs must be much less stiff than mirror.
- Design camera-side mounting plate.
- Thermal stress analysis of electroless nickel surface on aluminum mirror.
- How to prevent icing at high altitude.

# Open Items

- Electroless Nickel coating or pure AL coating?
- Design circular standoff for mounting.
- Switch threaded insert in flexures to circular standoffs. Change mounting hardware to bolt with nut and washer.