

Mechanical Review of Three-Inch Holometer Windows

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Windows can be BK7 or fused silica glass with a diameter of 3.0 inches and a thickness of 0.5 inches. The window is supported on a 2.5 inch diameter O-ring. The loading on the window will be 14.7 psi, vacuum to atmospheric pressure.

From Roark's Formulas for Stress and Strain, 6th edition, the formula for flat plates, case 10a, simply supported:

Maximum line moment at center: $M_c = (qa^2/16) * (3+nu)$

q = the load, 14.7 psi

a = window support radius = 1.25 inches

nu = poisson's ratio, BK7 = 0.206 , fused silica = 0.170

Once M_c is known, then maximum stress at center, $\rho_c = 6 M_c / t^2$ = thickness

For BK7:

$$M_c = ((14.7 \text{ psi})(1.25 \text{ in})^2 / 16) * (3 + 0.206) = 4.6 \text{ in-lbs/in}$$

$$\rho_c = 6 * 4.6 / 0.5^2 = 110.4 \text{ psi}$$

For fused silica:

$$M_c = ((14.7 \text{ psi})(1.25 \text{ in})^2 / 16) * (3 + 0.170) = 4.55 \text{ in-lbs/in}$$

$$\rho_c = 6 * 4.55 / 0.5^2 = 109.2 \text{ psi}$$

Various web sources quote glass as having a tensile strength of about 800 to 10,000 psi. If we assume the lowest value found, we have a safety factor of nearly 8.

These windows are more than adequate for our application.