

# CAMERA WINDOW REQUIREMENTS

## Spartan IR Camera for the SOAR Telescope

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| 4 December 2001  | Original                                   |
| 7 December 2001  | Revisions and clarifications               |
| 10 December 2001 | Flatness revision                          |
| 14 January 2002  | Added CaF <sub>2</sub> temperature concern |
| 18 January 2002  | Minor changes                              |

This document specifies the requirements for the vacuum window in the IR camera.

## 1 Optical Requirements

### 1.1 Thickness

A margin of safety against rupture of 4 was assumed when designing this window. To meet this margin of safety, the window should be 15 mm thick. The tolerance on this thickness is  $\pm 0.1$  mm so that our parts may be made to fit the window properly.

### 1.2 Flatness

This calculation assumes that the Strehl ratio may degrade by 0.0067 at  $1.65\mu$  due to surface irregularities in the window. Marechal's formula states that  $(1-0.0067) = \exp[-(2\pi SE (1-1/n)/\lambda)^2]$ . If peak-to-valley wave error is four times RMS error, this calculation gives a surface error of 196nm, or  $\lambda/3$  at 633 nm. Because the window is placed in front of an f/16 beam 150 mm from the focus, we only care that the lens is flat to  $\lambda/3$  within patches of radius 5 mm.

## 2 Physical Requirements

### 2.1 Clear aperture and diameter

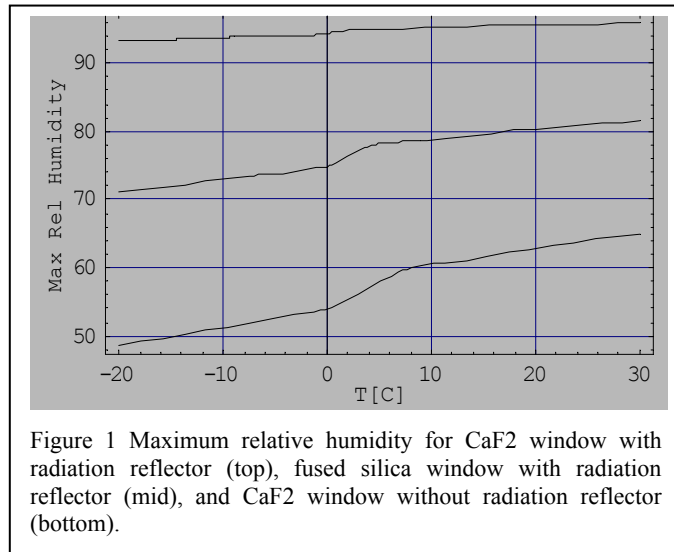
The window must have a 185 mm clear aperture to pass all incoming light. Beyond this aperture, there must be 5 mm space for a lip to support an o-ring. The Parker 2-170 O-ring has a 196-mm inner diameter and 2.6-mm width. The window should have a diameter of 210 mm, if it is oversized 10 mm.

### 2.2 Material

The window material is calcium fluoride.

The high conductivity of  $\text{CaF}_2$  means the window will not fog as long as the humidity is lower than 95%. (See Figure 1.) We will direct the vented nitrogen gas near the window to keep the humidity low.

Thermal shock is not a problem for calcium fluoride so long as there is not a fast (on the order of seconds) change in temperature. (Private communication, Janos Optical, January 2002.)



The window should have an anti-reflective coating to ensure maximum transmission (98% for  $\text{CaF}_2$ ) from 1-2.5  $\mu\text{m}$ .