

NEWFIRM

SYSTEM DESIGN NOTE

Title: NFM-AD-02-2203 NEWFIRM Broadband Filter Specifications					
Prepared by	Date	Approved by	Date	Rev.	Rev Date
R. Probst	10/2/03				
Related documents:					

Summary/Description: (attach additional sheets as required)
<p>This SDN tabulates the performance specifications for broadband infrared filters to be used in NEWFIRM.</p>



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NFM-AD-02-2203 NEWFIRM Broadband Filter Specifications

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 Ron Probst 10/02/03

1. Introduction

This SDN tabulates the performance specifications for broadband infrared filters to be used in NEWFIRM. These filters were procured via a consortium purchase involving many institutions and arranged by Alan Tokunaga (IRTF), Dan Clemens (Boston U.) and me. Where specifications varied, e.g. filter size, only the specification relevant for NEWFIRM is given.

The specifications are those circulated to potential vendors in the procurement process. The selected vendor was Barr Associates. Some specifications changed in negotiations with the vendor in order to improve the price/performance metric. These changes are noted, and constitute the final manufacturing specifications.

SDN 2303 tabulates some measured performance parameters of the NEWFIRM filters as received.

Useful background information on filter bandpass definition can be found in Simons and Tokunaga, PASP **114**, 169, 2002; and Tokunaga, Simons, and Vaca, PASP **114**, 180, 2002.

2. Performance specifications

2.1 Bandpass definition and performance

2.1.1 Filter bandpasses

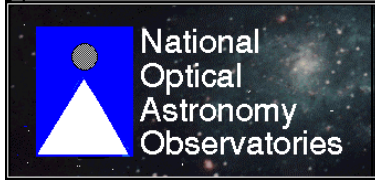
Band	Wavelength in microns		
	half peak trans	center	half peak trans
J	1.170	1.250	1.330
H	1.490	1.635	1.780
Ks	1.990	2.150	2.310

2.1.2 Absolute out of band transmission: $<10E-4$ to 5.6 microns (InSb detectors) or 3.0 microns (HgCdTe detectors). Separate blocker element is acceptable.

Final specification was $<10E-4$ to 3.0 microns for the J, H, Ks filters. A separate blocker could be procured separately at each customer's option.

2.1.3 Peak in band absolute transmission: $>80\%$ requirement, $>90\%$ goal

2.1.4 Peak transmission level to have a ripple of less than $\pm 5\%$ of average transmission between 80% peak transmission points.



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- 2.1.5 Cuton and cutoff wavelength accuracy: $\pm 0.5\%$ of stated half power points
- 2.1.6 Rolloff specification: % slope $< 2.5\%$ where

$$\% \text{ slope} = [(\lambda \text{ at } 90\% \text{ of peak} - \lambda \text{ at } 10\% \text{ of peak}) / (\lambda \text{ at } 10\% \text{ of peak})] \times 100$$
- 2.1.7 Operating temperature: all parameters for 65 K
- 2.1.8 Incidence angle: filters to be designed for a tilt of 5 degrees in a collimated beam.

2.2 Optical specifications

- 2.2.1 Substrate flatness: $< (0.0138 \lambda) / (n-1)$ where n is the substrate index of refraction.

This specification was set to allow use in Adaptive Optics systems. It was relaxed, for NEWFIRM and other non-AO users, to a final specification of $\lambda/4$ (peak to valley) at 633 nm. It was noted that the filters would bend into meniscus shape after coating, while still meeting 2.2.2 below.

- 2.2.2 Substrate parallelism: two faces parallel to 5 arcseconds or better prior to coating

Final specification was 10 arcseconds or better prior to coating.

- 2.2.3 Scratch and dig: 40 / 20

Relaxed to 60/40.

- 2.2.4 Pinholes: entire coated area to be free of pinhole defects, determined by visual inspection with the filter held in front of a bright lamp.

Final specification was for “best effort” with no guarantee of zero pinholes. This was cost driven, with amelioration expected as a result of the specific filter design and manufacturing process.

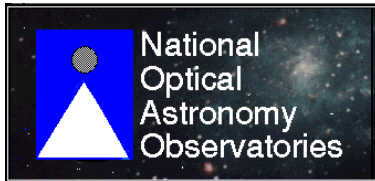
- 2.2.5 Coating clear aperture: maximum 1.5 mm uncoated radius at filter edge; edge to be chamfered (this specification at vendor’s suggestion)

2.3 Mechanical specifications

- 2.3.1 Size: 117 mm diameter round, ± 0.1 mm
- 2.3.2 Thickness: 5 mm ± 0.2 mm

2.4 Environmental specifications

- 2.4.1 Operation in vacuum at temperature ≤ 77 K
- 2.4.2 Laboratory handling and storage at 15-25 °C and 5-90% relative humidity. No degradation should occur with long term storage.



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- 2.4.3 Single piece filters only; no cemented composite units.
- 2.4.4 No radioactive materials may be used in the filter.
- 2.4.5 Coatings shall pass a Scotch tape test for adhesion and pencil eraser test for abrasion resistance.

The vendor did not offer manufacturing specifications for 2.4.2 and 2.4.5. We relied on his excellent reputation and previous experience with his products.