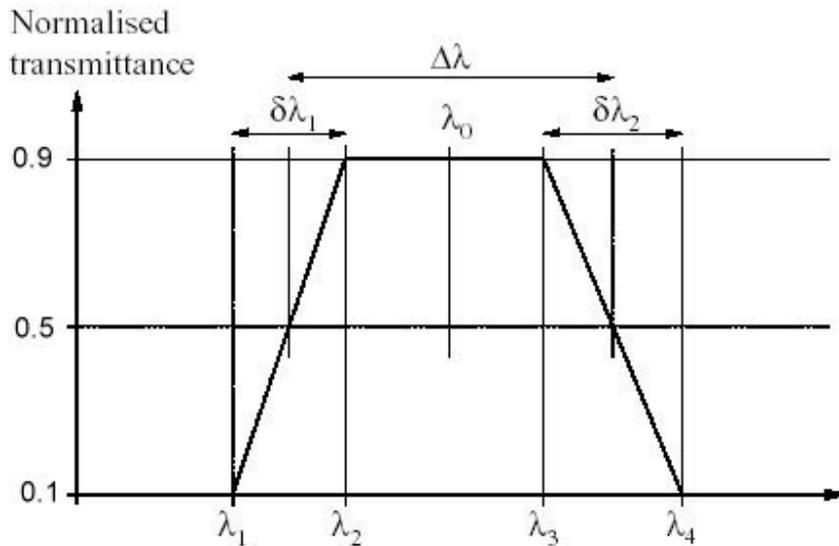The following diagram and listing describe performance features for the filters we would like to produce for us.

Application

Image quality filters (non-OA filters) for Imaging Infrared Astronomy in PANIC (http://www.iaa.es/PANIC/)

Manufacturing Specifications

This diagram defines the nominal passband shape in terms of the four parameters: the central wavelength λ_o, bandwidth $\Delta\lambda$ (FWHM[1]), and edge slopes $\delta\lambda_1$ and $\delta\lambda_2$.
The normalized transmittance should have approximate this general shape, although somewhat rounded 'corners' are actually desirable.

Filter	λC (μm)	$\Delta\lambda$ FWHM (μm)	Cut-on 50% (μm)	Cut-off 50% (μm)
Z	0.877	0.095	0.830	0.925
Y	1.020	0.100	0.970	1.070
J	1.250	0.160	1.170	1.330
H	1.635	0.290	1.490	1.780
K_s	2.150	0.301	1.990	2.310

Table 1: *Broad Band filter definition*

Filter	λC (μm)	$\Delta\lambda$ FWHM (μm)	Cut-on 50% (μm)	Cut-off 50% (μm)
H2	2.122	0.032	2.106	2.138

Table 2: *Narrow Band filter definition*

Broad band filters	
0. Number of units:	1 of each
1. Operating temperature of optimum performance:	100 K All parameters for 100 K
2. Center Wavelength, λ_o:	Specified in table 1
3. FWHM, $\Delta\lambda$:	Specified in table 1
4. Cut-on (short $\lambda_{50\%trans.}$) and Cut-off (long $\lambda_{50\%trans.}$): Tolerance:	Specified in table 1 $\pm 0.5\%$
5. In band transmission:	Z: >80% average (goal >90%) (OPTION 1A in your last quotation ref. 1009-5024BE, 22/09/2010) Y: >70% average (goal >75%) (OPTION 2B in your last quotation ref. 1009-5024BE, 22/09/2010) J: >80% average (goal >85%) H: >80% average (goal >90%) Ks: >80% average (goal >90%)
6. In band transmission variation (ripple):	$\leq \pm 5\%$ of average transmission between 80% points (where the 80% is relative to the peak of the filter)
7. Edge slopes, $\delta\lambda_1$ and $\delta\lambda_2$:	%slope^2 $\leq 2.5\%$
8. Out of band transmission:	<0.0001 (blocking OD 4) required in the range from 0.3μm to 3.0μm
9. AOI[3]: The filter is placed without tilt towards the incoming beam. Nevertheless the AOI on the filter varies with the FOV[4].	Non- 0 degrees Average AOI on the filter surface: 6.8º. Thus nominal CWL and FWHM apply to this AOI. Maximum AOI: 14.2º Minimum AOI: 0º
10. Cone angle of incident beam:	Collimated
11. Size (mm):	Diameter: 122.00, +0, -0.1
12. Minimum CA[5] (mm):	Diameter: 113.5, +1, -0.2
13. Maximum Physical thickness (mm):	8.5 mm, The Physical thickness depends on the Optical thickness (see next spec.), please specify it for

Broad band filters	
	each filter.
14. Optical thickness[6] (mm) at 100K and vacuum:	12.00 ±0.10
15. Edge:	Mounted in ring
16. Marking:	Customer, filter part number, and manufacturing trace code
17. Substrate construction:	Single substrate construction, Not cemented filters
18. Substrate flatness, TWF[7]:	<1/5 wave P-V @ 633 nm over any Ø20mm <1/2 wave P-V @ 633 nm per CA
19. Substrate Parallelism prior to coating:	≤ 1 arcmin
20. Substrate surfaces Roughness:	≤2.5nm RMS[8]
21. Coating durability:	Coatings shall pass a Scotch tape test for adhesion and pencil eraser test for abrasion resistance.
22. Substrate and coating materials:	No radioactive
23. Pin hole restriction:	. Entire coated area shall be free of pinhole defects (best effort)
24. Surface quality:	S/D ≤ 60/40 (per MIL-C-48497A)
25. Environmental conditions:	·Operation in vacuum at 100K. ·Laboratory handling and storage at room temperature, pressure and humidity. ·Require long-term storage with no degradation.
26. Theoretical transmission reports to be provided before manufacturing:	* Transmission at: T= 293 K, ambient temperature; AOI of 0º; f/8 beam. * Transmission at: T= 100 K, operating temperature; AOI of 0º; f/8 beam. * Transmission at: T= 100 K; AOI of 0º; collimated beam. * Transmission at: T= 100 K; AOI of 6.8º; collimated beam. * Transmission at: T= 100 K; AOI of 14.2º; collimated beam. * Transmission at: T= 100 K; AOI of 2.8º; half cone angle of 9.2º.
27. To be provided in Filter Shipment:	2 witness samples per filter. ·* Transmission scans of one witness sample at: T= 293 K and T=100 K; AOI of 0º; f/8 beam. ·* Transmission scans of the filter at: T= 293 K; AOI of 0º; f/8 beam, in center and three equall positioned points near the edge of the CA.

Broad band filters	
	·An Optical Density blocking scan at 293K. (all the scans graph and electronic data) ·Cleaning and handling procedure. · Inspection report for spec. of the filter. · Witness adhesion and abrasion tests results.
Delivery:	?
Price each:	?

Narrow band filters (Bandwidth[9] $\leq$1.5%)	
0. Number of units:	1 of each
2. Center Wavelength, λ_o:	Specified in table 2
3. FWHM, $\Delta\lambda$:	Specified in table 2
4. Cut-on (short $\lambda_{50\%trans.}$) and Cut-off (long $\lambda_{50\%trans.}$): Tolerance:	Specified in table 2 $\pm$0.2%
5. Peak transmission:	>65% peak transmission (goal >70%)
7. Edge slopes, $\delta\lambda_1$ and $\delta\lambda_2$:	%slope[10] $\leq$0.5%
Also applied specs. number: 1, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26 and 27.	
Delivery:	?
Price each:	?

Conchi Cárdenas Vázquez (conchi@iaa.es)
Ingeniera Óptica
Instituto de Astrofísica de Andalucía-CSIC
Glorieta de la Astronomía s/n
PO Box 3004
Granada E-18080
España

Tel (+34)958121311 Switchboard
Fax. (+34)958814530

[1] FWHM: Full band Width at Half Maximum transmission

[2] $\%slope = \dfrac{\lambda(90\% \text{ trans.}) - \lambda(10\%\text{trans.})}{\lambda(10\%\text{trans.})} \cdot 100$, where the 90%trans and 10%trans are relative to the peak of the filter.

[3] AOI: Angle of Incidence

[4] FOV: Field of View

[5] CA: Clear Aperture

[6] Optical Thickness = refraction index (at 100 K) * Physical thickness.

[7] TWF: Transmission Wavefront

[8] RMS: Root Mean Square

[9] The Bandwidth is calculated as FWHM/CW*100.

[10] $\%slope = \dfrac{\lambda(80\% \text{ trans.}) - \lambda(5\%\text{trans.})}{\lambda(5\%\text{trans.})} \cdot 100$, where the 90%trans and 10%trans are relative to the peak of the filter.