

POST-COSTAR FOS APERTURE TRANSMISSIONS FOR POINT SOURCES

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SUMMARY

The FOS absolute sensitivities are routinely monitored by observations of standard stars in the 3.7" (4.3) acquisition aperture or the 0.86" (1.0) aperture. For estimates of absolute fluxes of point sources that are observed in smaller apertures, the measured relative transmissions of the smaller apertures are required. These relative transmissions should be constant over time and should require only infrequent monitoring. The proposals 4773, 4776, and 5539 established these baseline relative throughputs.

If accurate photometric measurements are needed, the use of pair apertures is NOT recommended. The lack of flat fields for these apertures increases the uncertainties on the aperture throughputs listed in this document.

1. INTRODUCTION

The same methodology is used as in CAL/FOS-106 (Bohlin 1993) and in CAL/FOS-120 (Bohlin 1994), which presented the cycle 1-3, pre-costar data. The new post-costar cycle 4 data are discussed here.

In order to compute the relative aperture throughput, the countrate spectrum after flat fielding (.c5 file) in the smaller single apertures is divided by the spectrum of the same star in the A1(4.3) aperture. No flat fields are available for the pair apertures. Aperture throughputs for the pairs are calculated in the same way as for the single apertures but use the countrate unflatfielded spectrum. Even though the transmissions vary with wavelength, the average transmissions in Table 1 for each aperture and filter grating wheel (FGW) mode are a measure of the repeatability and reveal bad observations. With the good focus achieved by the co-star fix of the spherical aberation, the aperture transmissions should not be a function of OTA focus.

2. DISCUSSION AND RECOMMENDATIONS

As described in CAL/FOS-106, quadratic fits as a function of wavelength adequately define the ratios of the response to the standard stars in each aperture relative to the A-1 (4.3) target acquisition aperture. The recommended average of the quadratic fits over wavelength are summarized in Table 2, while the average quadratic coefficients appear in Table 4. In contrast to the cycle 1-3 data, the new ratios vary systematically with wavelength, so that only values obtained with the same disperser and aperture can be averaged. For the apertures larger than 0.4": B-3(1.0), B-1(0.5), C-1(1.0-pair), and A-2(0.5-pair), the blue and red side transmissions can be averaged, although there is marginal evidence that these red side transmissions may be larger than the blue for L15 and the Prism by the typical 1-3% scatter in the ratios for the same mode. For the smaller apertures: B-2(0.3), C-2(0.25 slit), and A-3(0.25-pair), there is a systematically larger transmission measured for the red side. The upper and lower apertures of the pairs are averaged.

For the pair apertures no flat field correction has been done. As a consequence, the quadratic fit represents the wavelength dependence of the aperture throughput with a larger uncertainty. This uncertainty could be up to $\sim 3\%$ in different sections of any given spectrum. If the most accurate photometric measurements are required, the use of pair apertures is NOT recommended.

There are few apertures, A-2 and A-3 with grating H78 and prism, for which no aperture throughput measurements are available. These few unmeasured average throughputs have been guessed from the symmetries in Table 2. The aperture throughput ratio in these cases corresponds to the value listed in Table 2, and are independent of wavelength. The estimated uncertainty in these cases is $\leq 5\%$.

Figure 1a-f show the fits from Table 4 as function of wavelength for the various FOS modes. These fits are recommended for use in the PODPS pipeline for the routine FOS data processing. The symmetries and continuity of the curves between dispersers suggest an uncertainty of 0.02 for these aperture corrections, which agrees with the 1-3% scatter quoted above.

3.- COMPARISON WITH THEORETICAL APERTURE THROUGHPUTS USED FOR CYCLE 4 CALIBRATION

Table 3 compares the average measured throughputs relative to B-3(1.0) to those calculated from the predictions for the co-star optics by G. Hartig (private communication).

B-3 is chosen in preference to A-1, because the B-3 absolute sensitivity curves are available and because the uncertainties in the ratios are smaller for apertures that differ less in size. Before the measurement of the aperture throughputs by proposal 5539 in May-July of 1994, these theoretical values were used for the preliminary estimates of the absolute calibrations for the six apertures in Table 3. These preliminary FOS absolute calibrations for cycle 4 were implemented in PODPS on 1994 March 21 at 22:41 UT. The difference between the measured and theoretical transmissions in Table 3 along with the differential curvature of the quadratic fits shown in Figure 1 are indicative of the errors in the preliminary calibrations. In summary, these errors do not exceed 10% and are generally not of profound importance, because the A-1(4.3) or B-3(1.0) entrance apertures are normally used for the most precise FOS spectrophotometry of point sources.

4.- FUTURE CALIBRATION CHANGES

The new aperture corrections will be implemented in the PODPS pipeline later this year along with a revised absolute calibration (Lindler & Bohlin 1995, in prep.).

REFERENCES

- Bohlin, R. C. 1993, FOS Instrument Science Report CAL/FOS-106.
- Bohlin, R. C. 1994, FOS Instrument Science Report CAL/FOS-120.

TABLE 1

APERTURE THROUGHPUT RELATIVE TO A-1 (4.3)

GRAT	B-3			B-1			B-2			C-2			C-10			C-1L			A-3U			A-3L			A-2U			A-2L			
	BLUE	RED	BLUE	RED	BLUE	RED	BLUE	RED	BLUE	RED	BLUE	RED	BLUE	RED	BLUE	RED	BLUE	RED	BLUE	RED	BLUE	RED	BLUE	RED	BLUE	RED	BLUE	RED	BLUE	RED	
H13	0.87	--	0.73	--	0.64	--	0.69	--	0.91	--	0.91	--	0.91	--	0.62	--	0.62	--	0.61	--	0.61	--	0.76	--	0.76	--	0.75	--	0.75	--	
H13	0.88	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
H13	0.88	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
H19	0.90	0.90	0.81	0.81	0.72	0.72	0.76	0.80	0.92	0.92	0.92	0.92	0.91	0.90	0.71	0.71	0.71	0.72	0.72	0.72	0.72	0.83	0.83	0.83	0.83	0.82	0.82	0.82	0.82	0.82	
H19	--	0.90	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
H19	0.90	0.90	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
H27	0.93	0.90*	0.87	0.87	0.77	0.79	0.81	0.85	0.93	0.94	0.92	0.92	0.92	0.92	0.76	0.76	0.76	0.73	0.78	0.78	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87		
H27	0.92	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
H27	--	--	--	--	0.79	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
H27	0.92	0.92	--	--	0.79	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
H40	0.94	0.95	0.89	0.89	0.80	0.83	0.82	0.87	0.95	0.96	0.95	0.96	0.95	0.96	0.80	0.79	0.80	0.76	0.81	0.81	0.91	0.89	0.91	0.89	0.91	0.91	0.91	0.91	0.91	0.91	
H40	0.95	0.95	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
H57	--	0.96	--	0.89	--	0.84	--	0.88	--	0.96	--	0.97	--	0.97	--	0.80	--	0.82	--	0.82	--	0.92	--	0.92	--	0.92	--	0.92	--	0.92	
H57	--	0.96	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
H78	--	0.96	--	0.90	--	0.78	--	0.85	--	0.97	--	0.97	--	0.97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
H78	--	--	--	0.89	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
H78	--	--	--	--	--	--	--	0.85	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
H78	--	0.96	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
L15	0.89	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
L15	0.89	0.89	0.78	0.80	0.70	0.72	0.75	0.80	0.91	0.92	0.90	0.88	0.69	0.72	0.66	0.72	0.81	0.84	0.80	0.81	0.84	0.80	0.81	0.84	0.80	0.81	0.81	0.81	0.81	0.81	
L15	0.89	0.91	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
L65	--	0.96	--	0.90	--	0.84	--	0.87	--	0.97	--	0.97	--	0.97	--	0.79	--	0.80	--	0.80	--	0.92	--	0.92	--	0.92	--	0.92	--	0.92	
L65	--	0.95	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
PRI	0.92	0.89*	0.82	0.85	0.73	0.77	0.76	0.83	0.93	0.94	0.93	0.91	0.93	0.91	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
PRI	0.90	0.92	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

Lines with B3 or B2 entries only are from proposals 4773 and 4776, while the rest of the measurements are from 5539.
 * Bad measurement due to ybase problem.

TABLE 2

AVERAGE APERTURE THROUGHPUT RATIOS RELATIVE TO A-1

GRAT	B4R		B6R		B8R		B10R		B12R		B14R		B16R		B18R		B20R	
	B-3	C-1	B-1	A-2	B-2	C-2	B-2	C-2	B-2	C-2	B-2	C-2	B-2	C-2	B-2	C-2	B-2	C-2
H13	0.875	0.910	0.730	0.755	0.640	---	0.690	---	0.615	---	0.715	0.715	0.715	0.715	0.715	0.715	0.715	0.715
H19	0.900	0.915	0.810	0.825	0.720	0.720	0.760	0.800	0.745	0.770	0.745	0.770	0.745	0.770	0.745	0.770	0.745	0.770
H27	0.920	0.930	0.870	0.870	0.780	0.790	0.810	0.850	0.780	0.800	0.780	0.800	0.780	0.800	0.780	0.800	0.780	0.800
H40	0.950	0.955	0.890	0.905	0.800	0.830	0.820	0.870	0.800	0.820	0.800	0.820	0.800	0.820	0.800	0.820	0.800	0.820
H57	0.960	0.965	0.890	0.915	---	0.840	---	0.880	---	0.810	---	0.810	---	0.810	---	0.810	---	0.810
H78	0.960	0.970	0.895	0.910	---	0.780	---	0.850	---	0.820	---	0.820	---	0.820	---	0.820	---	0.820
L15	0.895	0.910	0.790	0.815	0.700	0.720	0.750	0.800	0.675	0.720	0.675	0.720	0.675	0.720	0.675	0.720	0.675	0.720
L65	0.955	0.970	0.900	0.920	---	0.840	---	0.870	---	0.795	---	0.795	---	0.795	---	0.795	---	0.795
PRI	0.910	0.930	0.835	0.865	0.730	0.770	0.760	0.830	0.720	0.760	0.720	0.760	0.720	0.760	0.720	0.760	0.720	0.760

Average ratios for A-2, gratings H78 and PRI, are estimated by the theoretical ratios. For aperture A-3, red detector and grating H78, the listed average is obtained subtracting to the theoretical value an offset. The offset equals the difference between the theoretical and measured aperture ratio for grating H57 and same aperture. The values for the A-3 and PRI combination are obtained with the same procedure, but using the theoretical and offset values for the prism plus B-2 combination.

TABLE 3

MEASURED AND THEORETICAL APERTURE THROUGHPUT RATIOS RELATIVE TO B-3

GRAT	B4R		B6R		B8R		B10R		B12R		B14R		B16R		B18R		B20R	
	B-1	C-1	B-1	A-2	B-2	C-2	B-2	C-2	B-2	C-2	B-2	C-2	B-2	C-2	B-2	C-2	B-2	C-2
H13	1.040	1.020	0.834	0.880	0.663	0.910	0.731	---	0.780	---	0.650	---	0.703	---	0.760	---	0.760	---
H19	1.017	1.010	0.900	0.920	0.917	0.940	0.800	0.800	0.835	0.885	0.885	0.885	0.794	0.794	0.815	0.815	0.815	0.815
H27	1.011	1.010	0.946	0.925	0.946	0.945	0.846	0.859	0.855	0.840	0.840	0.840	0.810	0.837	0.840	0.840	0.840	0.840
H40	1.005	1.010	0.937	0.930	0.953	0.950	0.842	0.874	0.875	0.865	0.865	0.865	0.821	0.842	0.865	0.865	0.865	0.865
H57	1.005	1.010	0.927	0.930	0.953	0.950	---	0.875	0.890	0.880	0.880	0.880	---	0.844	0.880	0.880	0.880	0.880
H78	1.010	1.010	0.932	0.930	0.948	0.950	---	0.813	0.900	0.890	0.890	0.890	---	0.854	0.890	0.890	0.890	0.890
L15	1.017	1.010	0.883	0.915	0.911	0.935	0.782	0.804	0.830	0.800	0.800	0.800	0.754	0.804	0.800	0.800	0.800	0.800
L65	1.016	1.010	0.942	0.930	0.963	0.950	---	0.880	0.890	0.880	0.880	0.880	---	0.832	0.880	0.880	0.880	0.880
PRI	1.022	1.010	0.918	0.930	0.951	0.950	0.802	0.846	0.875	0.865	0.865	0.865	0.791	0.835	0.865	0.865	0.865	0.865

TABLE 4

SUMMARY OF AVERAGE FOS APERTURE COEFFICIENTS

DETEC	FGWA	APER	APRPOS	CO	C1	C2	WMIN	WMAX	HAV
BLUE	H13	A-2	LOWER	2.04104e+00	-1.92757e-03	7.14832e-07	1138.00	1610.00	2
BLUE	H13	A-2	UPPER	2.04104e+00	-1.92757e-03	7.14832e-07	1138.00	1610.00	2
BLUE	H13	A-3	LOWER	1.06059e+00	-8.26783e-04	3.62285e-07	1138.00	1610.00	2
BLUE	H13	A-3	UPPER	1.06059e+00	-8.26783e-04	3.62285e-07	1138.00	1610.00	2
BLUE	H13	B-1	SINGLE	7.98286e-01	-2.14248e-04	1.18657e-07	1138.00	1610.00	1
BLUE	H13	B-2	SINGLE	4.31732e-01	1.18158e-04	2.41498e-08	1138.00	1610.00	1
BLUE	H13	B-3	SINGLE	1.13720e+00	-3.90763e-04	1.44133e-07	1138.00	1610.00	3
BLUE	H13	C-1	LOWER	2.01260e+00	-1.56648e-03	5.48119e-07	1138.00	1610.00	2
BLUE	H13	C-1	UPPER	2.01260e+00	-1.56648e-03	5.48119e-07	1138.00	1610.00	2
BLUE	H13	C-2	SINGLE	6.52842e-01	-6.51870e-05	6.65251e-08	1138.00	1610.00	1
BLUE	H19	A-2	LOWER	5.81301e-01	1.31688e-04	-3.47300e-09	1567.00	2336.00	2
BLUE	H19	A-2	UPPER	5.81301e-01	1.31688e-04	-3.47300e-09	1567.00	2336.00	2
BLUE	H19	A-3	LOWER	3.23931e-01	2.77328e-04	-3.89612e-08	1567.00	2336.00	2
BLUE	H19	A-3	UPPER	3.23931e-01	2.77328e-04	-3.89612e-08	1567.00	2336.00	2
BLUE	H19	B-1	SINGLE	4.51696e-01	2.49857e-04	-3.35546e-08	1567.00	2336.00	1
BLUE	H19	B-2	SINGLE	1.55983e-01	4.44808e-04	-7.88701e-08	1567.00	2336.00	1
BLUE	H19	B-3	SINGLE	7.05509e-01	1.54603e-04	-2.78135e-08	1567.00	2336.00	2
BLUE	H19	C-1	LOWER	1.19388e+00	-3.31388e-04	9.53739e-08	1567.00	2336.00	2
BLUE	H19	C-1	UPPER	1.19388e+00	-3.31388e-04	9.53739e-08	1567.00	2336.00	2
BLUE	H19	C-2	SINGLE	2.41902e-01	4.07798e-04	-7.20464e-08	1567.00	2336.00	1
BLUE	H27	A-2	LOWER	4.25484e-01	2.68451e-04	-3.84362e-08	2213.00	3308.00	2
BLUE	H27	A-2	UPPER	4.25484e-01	2.68451e-04	-3.84362e-08	2213.00	3308.00	2
BLUE	H27	A-3	LOWER	3.09503e-01	2.76119e-04	-4.23440e-08	2213.00	3308.00	2
BLUE	H27	A-3	UPPER	3.09503e-01	2.76119e-04	-4.23440e-08	2213.00	3308.00	2
BLUE	H27	B-1	SINGLE	4.22795e-01	2.83711e-04	-4.35428e-08	2213.00	3308.00	1
BLUE	H27	B-2	SINGLE	5.28567e-01	1.64309e-04	-2.61960e-08	2213.00	3308.00	3
BLUE	H27	B-3	SINGLE	7.99975e-01	5.99116e-05	-5.88374e-09	2213.00	3308.00	3
BLUE	H27	C-1	LOWER	5.24495e-01	2.68331e-04	-4.34416e-08	2213.00	3308.00	2
BLUE	H27	C-1	UPPER	5.24495e-01	2.68331e-04	-4.34416e-08	2213.00	3308.00	2
BLUE	H27	C-2	SINGLE	7.59830e-01	1.86587e-05	-1.77330e-10	2213.00	3308.00	1
BLUE	H40	A-2	LOWER	8.02632e-01	4.66494e-05	-4.90254e-09	3229.00	4831.00	2
BLUE	H40	A-2	UPPER	8.02632e-01	4.66494e-05	-4.90254e-09	3229.00	4831.00	2
BLUE	H40	A-3	LOWER	6.64327e-01	5.47824e-05	-6.38949e-09	3229.00	4831.00	2
BLUE	H40	A-3	UPPER	6.64327e-01	5.47824e-05	-6.38949e-09	3229.00	4831.00	2
BLUE	H40	B-1	SINGLE	7.27156e-01	8.90051e-05	-1.19042e-08	3229.00	4831.00	1
BLUE	H40	B-2	SINGLE	7.13605e-01	4.52521e-05	-5.83376e-09	3229.00	4831.00	1
BLUE	H40	B-3	SINGLE	8.62466e-01	3.58409e-05	-3.46050e-09	3229.00	4831.00	2
BLUE	H40	C-1	LOWER	8.60063e-01	3.90358e-05	-3.79330e-09	3229.00	4831.00	2
BLUE	H40	C-1	UPPER	8.60063e-01	3.90358e-05	-3.79330e-09	3229.00	4831.00	2
BLUE	H40	C-2	SINGLE	7.87090e-01	2.55131e-05	-4.24821e-09	3229.00	4831.00	1
BLUE	L15	A-2	LOWER	5.82634e-01	1.58073e-04	-1.60763e-08	1138.00	2526.00	2
BLUE	L15	A-2	UPPER	5.82634e-01	1.58073e-04	-1.60763e-08	1138.00	2526.00	2
BLUE	L15	A-3	LOWER	1.38999e-01	4.66545e-04	-9.04287e-08	1138.00	2526.00	2
BLUE	L15	A-3	UPPER	1.38999e-01	4.66545e-04	-9.04287e-08	1138.00	2526.00	2
BLUE	L15	B-1	SINGLE	3.31336e-01	3.94262e-04	-7.47814e-08	1138.00	2526.00	1
BLUE	L15	B-2	SINGLE	1.47323e-01	4.88380e-04	-9.70740e-08	1138.00	2526.00	1
BLUE	L15	B-3	SINGLE	8.51147e-01	8.15440e-06	8.31284e-09	1138.00	2526.00	3
BLUE	L15	C-1	LOWER	9.23451e-01	-4.16120e-05	1.79221e-08	1138.00	2526.00	2
BLUE	L15	C-1	UPPER	9.23451e-01	-4.16120e-05	1.79221e-08	1138.00	2526.00	2
BLUE	L15	C-2	SINGLE	2.73590e-01	4.08601e-04	-7.71957e-08	1138.00	2526.00	1
BLUE	PRI	A2	SINGLE	8.65000e-01	0.00000e+00	0.00000e+00	1498.00	5961.00	1
BLUE	PRI	A3	SINGLE	7.20000e-01	0.00000e+00	0.00000e+00	1498.00	5961.00	1
BLUE	PRI	B-1	SINGLE	5.54512e-01	1.90322e-04	-2.44619e-08	1498.00	5176.00	1
BLUE	PRI	B-1	SINGLE	1.89540e+00	-1.95412e-04	0.00000e+00	5174.00	5961.00	1
BLUE	PRI	B-2	SINGLE	4.65285e-01	1.81563e-04	-2.39072e-08	1498.00	5176.00	1
BLUE	PRI	B-2	SINGLE	1.49525e+00	-1.41204e-04	0.00000e+00	5174.00	5961.00	1
BLUE	PRI	B-3	SINGLE	8.02886e-01	7.06287e-05	-8.47449e-09	1498.00	5176.00	2
BLUE	PRI	B-3	SINGLE	2.15518e+00	-2.34599e-04	0.00000e+00	5174.00	5961.00	2
BLUE	PRI	C-1	LOWER	9.43072e-01	-2.31290e-05	7.16381e-09	1498.00	5176.00	2
BLUE	PRI	C-1	LOWER	2.91164e+00	-3.66565e-04	0.00000e+00	5174.00	5961.00	2
BLUE	PRI	C-1	UPPER	9.43072e-01	-2.31290e-05	7.16381e-09	1498.00	5176.00	2
BLUE	PRI	C-1	UPPER	2.91164e+00	-3.66565e-04	0.00000e+00	5174.00	5961.00	2
BLUE	PRI	C-2	SINGLE	5.34270e-01	1.47390e-04	-1.72459e-08	1498.00	5176.00	1
BLUE	PRI	C-2	SINGLE	2.63549e-01	1.10493e-04	0.00000e+00	5174.00	5961.00	1
AMBER	H19	A-2	LOWER	1.59145e-01	5.47854e-04	-1.04696e-07	1588.00	2318.00	2
AMBER	H19	A-2	UPPER	1.59145e-01	5.47854e-04	-1.04696e-07	1588.00	2318.00	2
AMBER	H19	A-3	LOWER	-1.82101e-01	7.53973e-04	-1.49090e-07	1588.00	2318.00	2
AMBER	H19	A-3	UPPER	-1.82101e-01	7.53973e-04	-1.49090e-07	1588.00	2318.00	2
AMBER	H19	B-1	SINGLE	4.58467e-01	2.42485e-04	-3.15854e-08	1588.00	2318.00	1
AMBER	H19	B-2	SINGLE	2.66595e-01	3.39839e-04	-5.44616e-08	1588.00	2318.00	1
AMBER	H19	B-3	SINGLE	5.34712e-01	3.34885e-04	-7.48317e-08	1588.00	2318.00	3
AMBER	H19	C-1	LOWER	5.43682e-01	3.08726e-04	-6.00115e-08	1588.00	2318.00	2
AMBER	H19	C-1	UPPER	5.43682e-01	3.08726e-04	-6.00115e-08	1588.00	2318.00	2

AMBER	H19	C-2	SINGLE	-3.39148e-01	1.07555e-03	-2.49178e-07	1588.00	2318.00	1
AMBER	H27	A-2	LOWER	9.85495e-01	-1.37730e-04	3.43875e-08	2215.00	3285.00	2
AMBER	H27	A-2	UPPER	9.85495e-01	-1.37730e-04	3.43875e-08	2215.00	3285.00	2
AMBER	H27	A-3	LOWER	8.75623e-01	-1.34268e-04	3.44338e-08	2215.00	3285.00	2
AMBER	H27	A-3	UPPER	8.75623e-01	-1.34268e-04	3.44338e-08	2215.00	3285.00	2
AMBER	H27	B-1	SINGLE	4.90387e-01	2.32213e-04	-3.38313e-08	2215.00	3285.00	1
AMBER	H27	B-2	SINGLE	6.09117e-02	4.93152e-04	-8.19169e-08	2215.00	3285.00	1
AMBER	H27	B-3	SINGLE	7.00275e-01	1.32313e-04	-1.88295e-08	2215.00	3285.00	2
AMBER	H27	C-1	LOWER	3.12658e-01	4.21480e-04	-7.07672e-08	2215.00	3285.00	2
AMBER	H27	C-1	UPPER	3.12658e-01	4.21480e-04	-7.07672e-08	2215.00	3285.00	2
AMBER	H27	C-2	SINGLE	-1.07777e-01	6.61211e-04	-1.12416e-07	2215.00	3285.00	1
AMBER	H40	A-2	LOWER	6.63861e-01	1.12210e-04	-1.31345e-08	3226.00	4791.00	2
AMBER	H40	A-2	UPPER	6.63861e-01	1.12210e-04	-1.31345e-08	3226.00	4791.00	2
AMBER	H40	A-3	LOWER	4.05685e-01	1.89541e-04	-2.24664e-08	3226.00	4791.00	2
AMBER	H40	A-3	UPPER	4.05685e-01	1.89541e-04	-2.24664e-08	3226.00	4791.00	2
AMBER	H40	B-1	SINGLE	7.44955e-01	6.42174e-05	-6.90827e-09	3226.00	4791.00	1
AMBER	H40	B-2	SINGLE	5.88455e-01	1.04787e-04	-1.09736e-08	3226.00	4791.00	1
AMBER	H40	B-3	SINGLE	8.50463e-01	3.59707e-05	-2.74561e-09	3226.00	4791.00	2
AMBER	H40	C-1	LOWER	6.45192e-01	1.47114e-04	-1.72067e-08	3226.00	4791.00	2
AMBER	H40	C-1	UPPER	6.45192e-01	1.47114e-04	-1.72067e-08	3226.00	4791.00	2
AMBER	H40	C-2	SINGLE	7.05579e-01	7.12705e-05	-7.45524e-09	3226.00	4791.00	1
AMBER	H57	A-2	LOWER	9.15671e-01	-1.89665e-06	3.08375e-10	4557.00	6831.00	2
AMBER	H57	A-2	UPPER	9.15671e-01	-1.89665e-06	3.08375e-10	4557.00	6831.00	2
AMBER	H57	A-3	LOWER	5.14520e-01	1.27148e-04	-1.30467e-08	4557.00	6831.00	2
AMBER	H57	A-3	UPPER	5.14520e-01	1.27148e-04	-1.30467e-08	4557.00	6831.00	2
AMBER	H57	B-1	SINGLE	1.09615e+00	-6.77702e-05	5.47249e-09	4557.00	6831.00	1
AMBER	H57	B-2	SINGLE	3.69648e-01	1.82772e-04	-1.73659e-08	4557.00	6831.00	1
AMBER	H57	B-3	SINGLE	8.48924e-01	3.73458e-05	-3.09269e-09	4557.00	6831.00	2
AMBER	H57	C-1	LOWER	1.08217e+00	-4.46652e-05	4.17622e-09	4557.00	6831.00	2
AMBER	H57	C-1	UPPER	1.08217e+00	-4.46652e-05	4.17622e-09	4557.00	6831.00	2
AMBER	H57	C-2	SINGLE	6.18257e-01	1.02066e-04	-9.72563e-09	4557.00	6831.00	1
AMBER	H78	A2	SINGLE	9.10000e-01	0.00000e+00	0.00000e+00	6254.00	8501.00	1
AMBER	H78	A3	SINGLE	8.20000e-01	0.00000e+00	0.00000e+00	6254.00	8501.00	1
AMBER	H78	B-1	SINGLE	8.10448e-01	2.52274e-05	-1.85161e-09	6254.00	8501.00	2
AMBER	H78	B-2	SINGLE	9.61357e-01	9.15007e-06	-4.52948e-09	6254.00	8501.00	1
AMBER	H78	B-3	SINGLE	1.19000e+00	-6.43961e-05	4.46860e-09	6254.00	8501.00	2
AMBER	H78	C-1	LOWER	8.48310e-01	3.38182e-05	-2.33029e-09	6254.00	8501.00	2
AMBER	H78	C-1	UPPER	8.48310e-01	3.38182e-05	-2.33029e-09	6254.00	8501.00	2
AMBER	H78	C-2	SINGLE	1.12594e+00	-5.02189e-05	1.72775e-09	6254.00	8501.00	2
AMBER	L15	A-2	LOWER	-2.72831e-01	9.88549e-04	-2.19970e-07	1619.00	2444.00	2
AMBER	L15	A-2	UPPER	-1.05167e+01	6.94901e-03	0.00000e+00	1568.00	1622.00	2
AMBER	L15	A-2	UPPER	-2.72831e-01	9.88549e-04	-2.19970e-07	1619.00	2444.00	2
AMBER	L15	A-3	LOWER	-5.14919e-01	6.94901e-03	0.00000e+00	1568.00	1622.00	2
AMBER	L15	A-3	UPPER	-1.05167e+01	6.94901e-03	0.00000e+00	1568.00	1622.00	2
AMBER	L15	A-3	UPPER	-5.14919e-01	1.11177e-03	-2.44620e-07	1619.00	2444.00	2
AMBER	L15	A-3	UPPER	-5.14919e-01	1.11177e-03	-2.44620e-07	1619.00	2444.00	2
AMBER	L15	B-1	SINGLE	1.80856e-01	7.05918e-03	0.00000e+00	1568.00	1622.00	1
AMBER	L15	B-1	SINGLE	-3.97664e+00	4.50982e-04	-7.31328e-08	1619.00	2444.00	2
AMBER	L15	B-2	SINGLE	-3.49995e-02	2.89622e-03	0.00000e+00	1568.00	1622.00	1
AMBER	L15	B-2	SINGLE	-7.16926e+00	6.10930e-04	-1.15996e-07	1619.00	2444.00	1
AMBER	L15	B-3	SINGLE	7.06594e-01	4.82236e-03	0.00000e+00	1568.00	1622.00	1
AMBER	L15	B-3	SINGLE	-9.92150e-02	1.33797e-04	-1.98436e-08	1619.00	2444.00	2
AMBER	L15	C-1	LOWER	-8.59355e-02	5.98546e-04	0.00000e+00	1568.00	1622.00	2
AMBER	L15	C-1	UPPER	-1.20766e+01	9.27265e-04	-2.12231e-07	1619.00	2444.00	2
AMBER	L15	C-1	UPPER	-8.59355e-02	9.27265e-04	-2.12231e-07	1619.00	2444.00	2
AMBER	L15	C-1	UPPER	-1.20766e+01	7.97748e-03	0.00000e+00	1568.00	1622.00	2
AMBER	L15	C-2	SINGLE	-2.26426e-01	9.61251e-04	-2.21461e-07	1619.00	2444.00	1
AMBER	L15	C-2	SINGLE	-1.24648e+01	8.14923e-03	0.00000e+00	1568.00	1622.00	1
AMBER	L65	A-2	LOWER	7.87596e-01	4.84997e-05	-4.30559e-09	3752.00	7077.00	2
AMBER	L65	A-2	UPPER	-5.39972e+00	1.68028e-03	0.00000e+00	3538.00	3755.00	2
AMBER	L65	A-2	UPPER	7.87596e-01	4.84997e-05	-4.30559e-09	3752.00	7077.00	2
AMBER	L65	A-3	LOWER	-5.39972e+00	1.68028e-03	0.00000e+00	3538.00	3755.00	2
AMBER	L65	A-3	UPPER	2.99418e-01	2.06096e-04	-2.05149e-08	3752.00	7077.00	2
AMBER	L65	A-3	UPPER	-5.15507e+00	1.58183e-03	0.00000e+00	3538.00	3755.00	2
AMBER	L65	A-3	UPPER	2.99418e-01	2.06096e-04	-2.05149e-08	3752.00	7077.00	2
AMBER	L65	B-1	SINGLE	-5.15507e+00	1.58183e-03	0.00000e+00	3538.00	3755.00	2
AMBER	L65	B-1	SINGLE	1.00747e+00	-3.10104e-05	1.99830e-09	3752.00	7077.00	1
AMBER	L65	B-1	SINGLE	1.85917e+00	-2.50352e-04	0.00000e+00	3538.00	3755.00	1
AMBER	L65	B-2	SINGLE	4.39353e-01	1.64819e-04	-1.62634e-08	3752.00	7077.00	1
AMBER	L65	B-2	SINGLE	7.92395e-01	9.72670e-06	0.00000e+00	3538.00	3755.00	1
AMBER	L65	B-3	SINGLE	8.58741e-01	4.02607e-05	-4.02586e-09	3752.00	7077.00	2
AMBER	L65	B-3	SINGLE	-1.43634e+00	6.36422e-04	0.00000e+00	3538.00	3755.00	2
AMBER	L65	C-1	LOWER	7.21477e-01	8.26463e-05	-6.57948e-09	3752.00	7077.00	2
AMBER	L65	C-1	UPPER	-5.12753e+00	1.61578e-03	0.00000e+00	3538.00	3755.00	2
AMBER	L65	C-1	UPPER	7.21477e-01	8.26463e-05	-6.57948e-09	3752.00	7077.00	2
AMBER	L65	C-1	UPPER	-5.12753e+00	1.61578e-03	0.00000e+00	3538.00	3755.00	2
AMBER	L65	C-2	SINGLE	5.94079e-01	1.19799e-04	-1.23269e-08	3752.00	7077.00	1

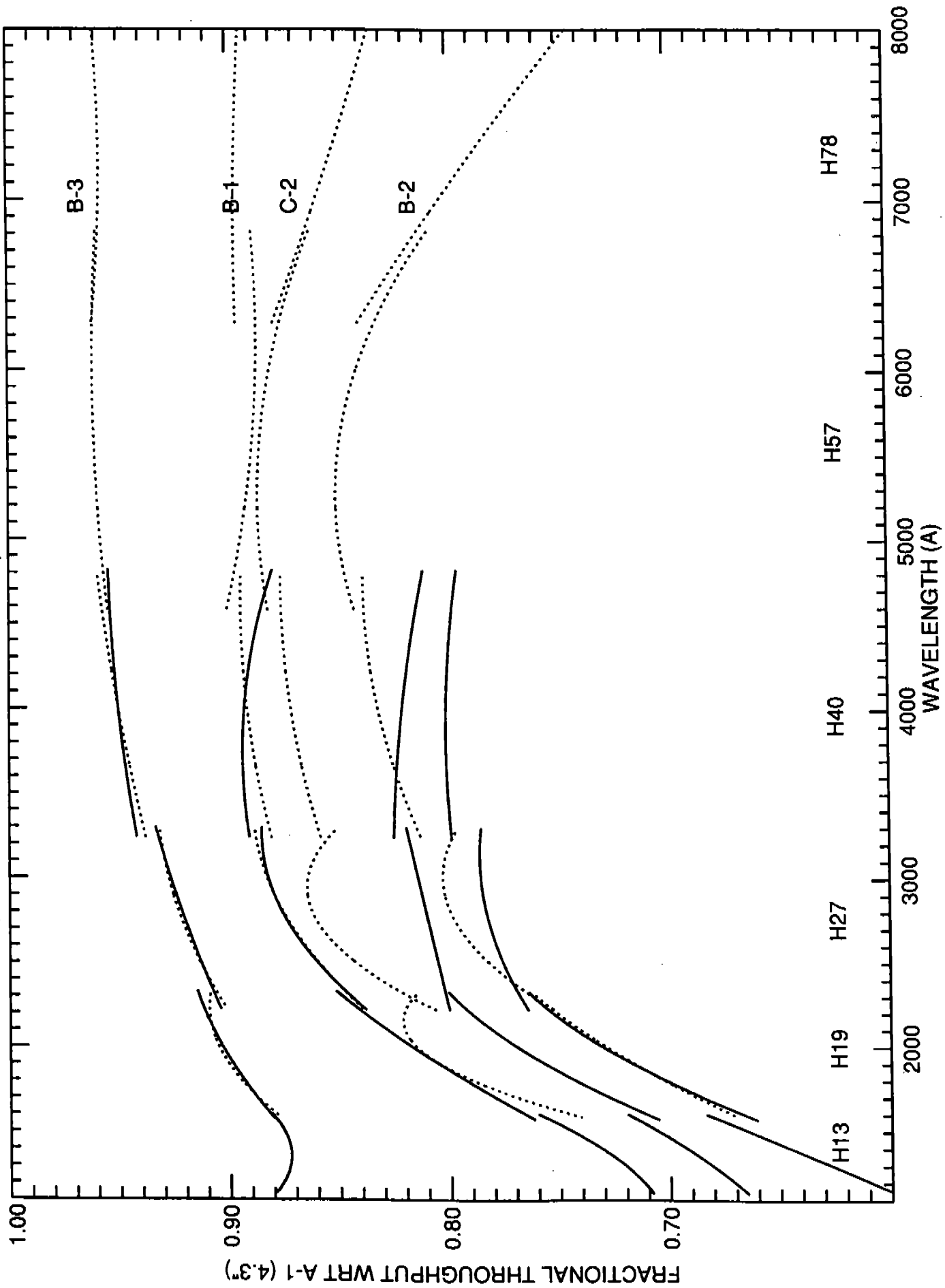
AMBER	L65	C-2	SINGLE	-3.56233e+00	1.18055e-03	0.00000e+00	3538.00	3755.00	1
AMBER	PRI	A2	SINGLE	8.65000e-01	0.00000e+00	0.00000e+00	1618.00	8890.00	1
AMBER	PRI	A3	SINGLE	7.60000e-01	0.00000e+00	0.00000e+00	1618.00	8890.00	1
AMBER	PRI	B-1	SINGLE	6.42012e-01	1.08186e-04	-9.90334e-09	1618.00	7776.00	1
AMBER	PRI	B-1	SINGLE	1.36240e+00	-6.14699e-05	0.00000e+00	7774.00	8890.00	1
AMBER	PRI	B-2	SINGLE	5.61278e-01	1.21630e-04	-1.22992e-08	1618.00	7776.00	1
AMBER	PRI	B-2	SINGLE	1.61758e+00	-1.09863e-04	0.00000e+00	7774.00	8890.00	1
AMBER	PRI	B-3	SINGLE	8.22847e-01	5.59738e-05	-6.91735e-09	1618.00	7776.00	2
AMBER	PRI	B-3	SINGLE	3.42654e+00	-3.32739e-04	0.00000e+00	7774.00	8890.00	2
AMBER	PRI	C-1	LOWER	8.39675e-01	5.81793e-05	-7.22701e-09	1618.00	7776.00	2
AMBER	PRI	C-1	LOWER	3.04600e+00	-2.81823e-04	0.00000e+00	7774.00	8890.00	2
AMBER	PRI	C-1	UPPER	8.39675e-01	5.81793e-05	-7.22701e-09	1618.00	7776.00	2
AMBER	PRI	C-1	UPPER	3.04600e+00	-2.81823e-04	0.00000e+00	7774.00	8890.00	2
AMBER	PRI	C-2	SINGLE	6.17004e-01	1.34396e-04	-1.60811e-08	1618.00	7776.00	1
AMBER	PRI	C-2	SINGLE	3.82505e+00	-4.03296e-04	0.00000e+00	7774.00	8890.00	1

$A(\lambda) = C_0 + C_1 \lambda + C_2 \lambda^2$, where λ is the wavelength in Angstroms.

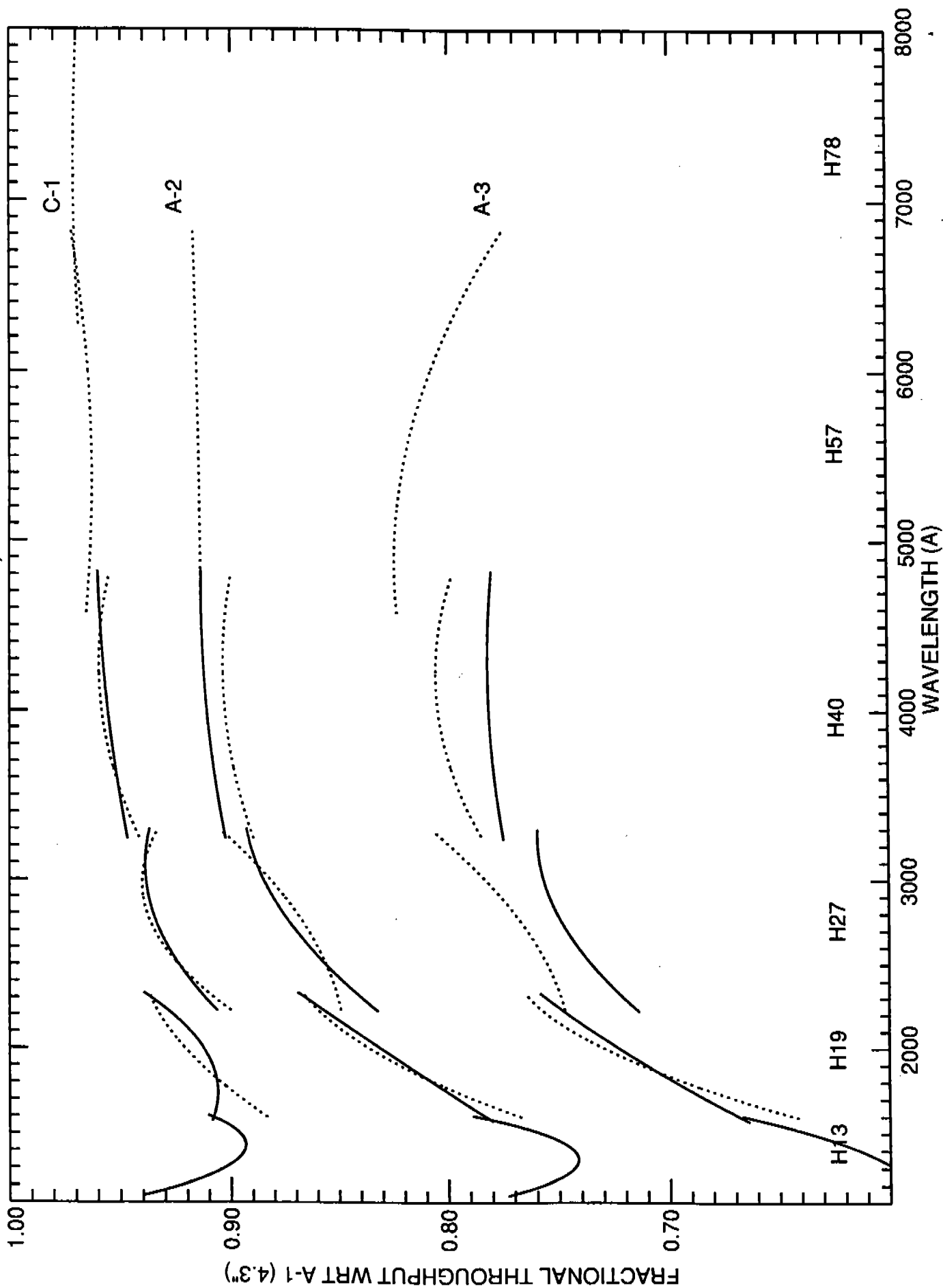
FIGURE CAPTION

FIG. 1a-f - The average quadratic fits for the aperture transmissions. Solid and dashed lines are for the blue and red side, respectively.

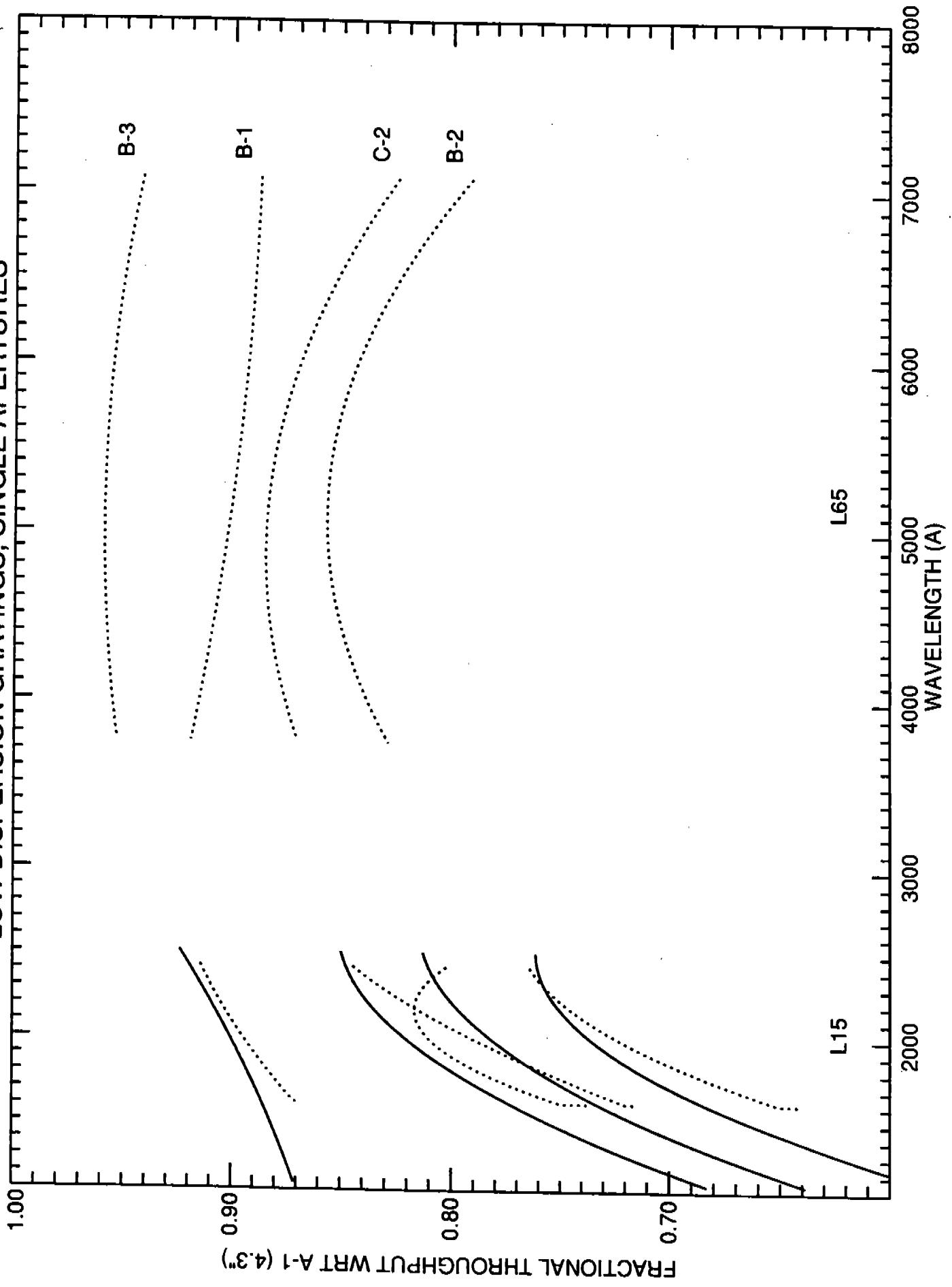
HIGH DISPERSION GRATINGS, SINGLE APERTURES



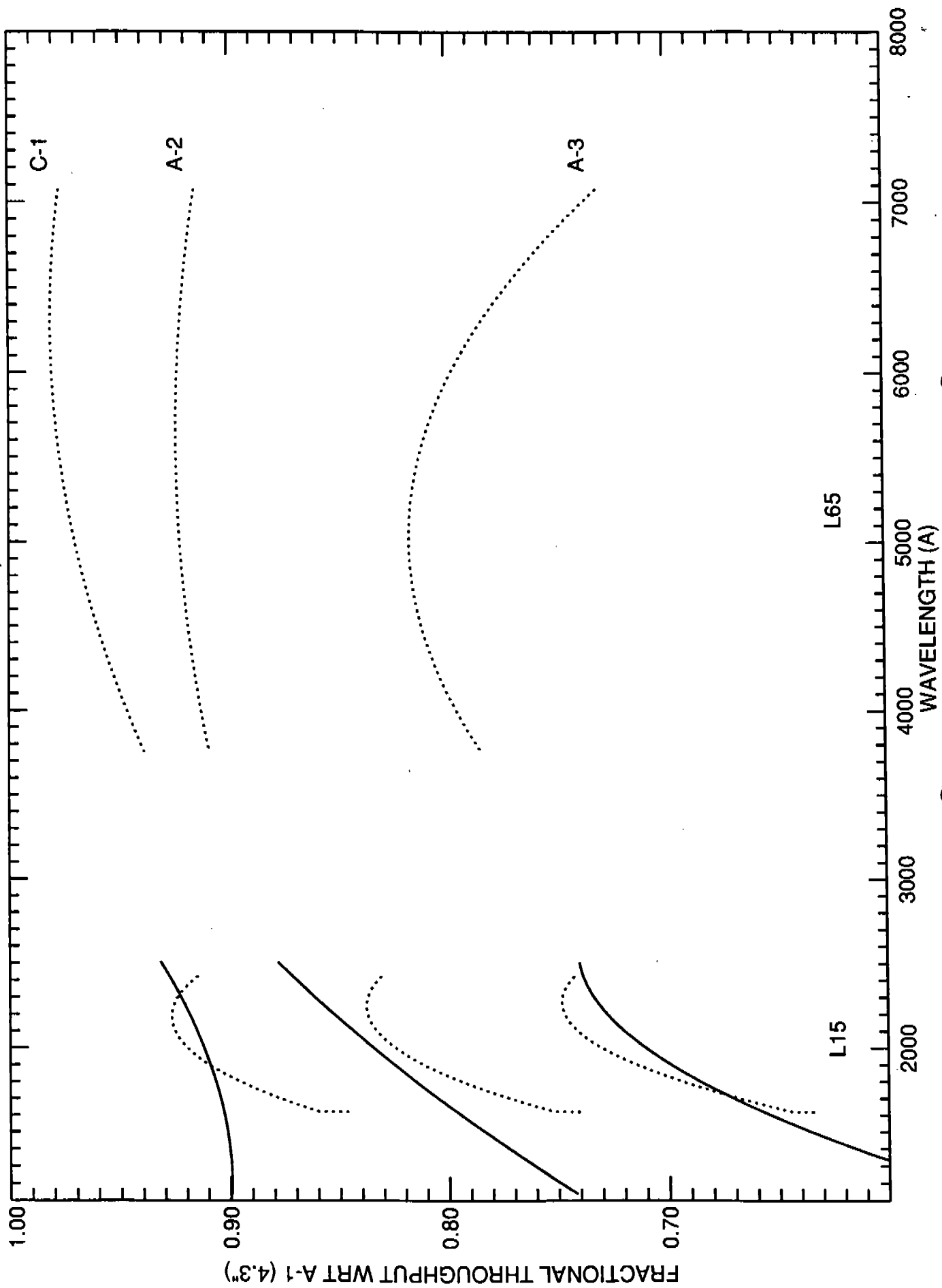
HIGH DISPERSION GRATINGS, PAIRED APERTURES



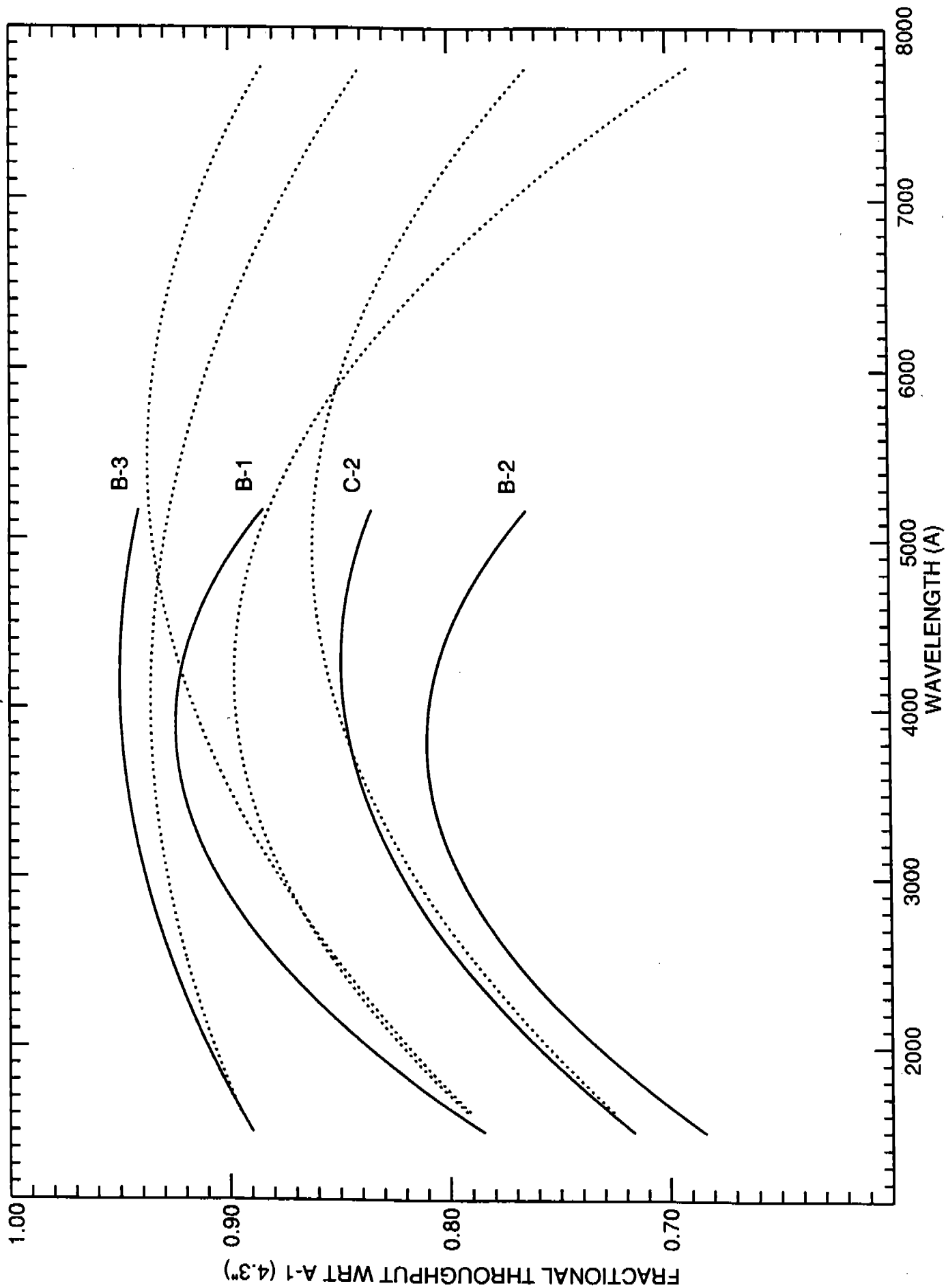
LOW DISPERSION GRATINGS, SINGLE APERTURES



LOW DISPERSION GRATINGS, PAIRED APERTURES



PRISMS, SINGLE APERTURES



PRISMS, PAIRED APERTURES

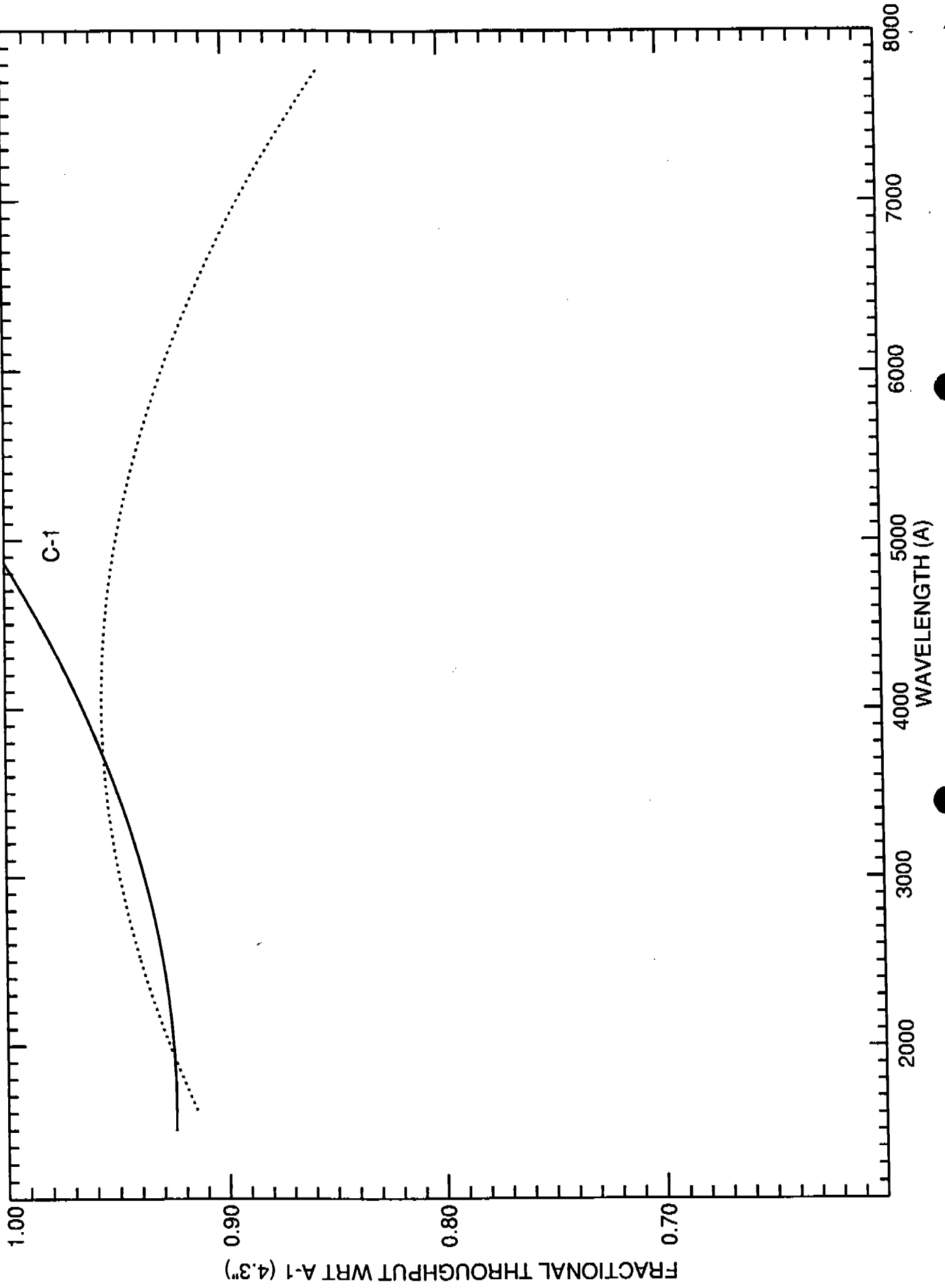


Fig. 1f

