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# NIRSPEC

UCLA Astrophysics Program

U.C. Berkeley

W.M. Keck Observatory

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Don Figer

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## NIRSPEC Optics Design Note 17.0a Efficiency and Wavefront Error of Gratings

### 1. Introduction

This document gives the efficiencies and interferograms of the gratings in the form of curves provided by Spectronics, Inc. MR182-2-1-1 refers to our cross-disperser grating. MR149-1-5-1 refers to the echelle.

### 2. Figures

#### A. Echelle

Echelle efficiency was measured in two orders under quasi-Littrow mode with  $\theta = 2.3^\circ$ , as compared with  $5^\circ$  under operation in our instrument. Efficiency scales as  $\cos(\theta)$ , so this difference should not have an impact on the eventual efficiency we will obtain. Notice that the efficiency is measured with respect to an aluminum mirror, so the true efficiency should be a few percent higher than that indicated on the graph. Notice that the efficiency in order = 118 is considerably higher than that in order = 141. This will result in even higher efficiency in operation, where the orders are roughly between 20 and 80.

The wavefront error is 0.78 PV at the HeNe wavelength. Note that this is total transmitted wavefront error, and not surface error. Also, the error has been measured for a 152 mm beam, compared to an approximately 270 X 120 mm beam in operation. Given that most of the error is cylindrical, covering additional area in the test should not increase the wavefront error.

#### B. Cross-disperser

The cross-disperser efficiency was measured in 3 orders. Spectronic did not have a detector sensitive at wavelengths long enough to measure efficiency past 2.5  $\mu$ m. As usual, efficiency is inversely proportional to order number.

The wavefront error has a cylindrical shape, as is the case for the echelle. The test beam covered about 75% (in linear dimension) of the blank.