CHARA Technical Report

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Tertiary Mirror Specifications & Requirements

M.A. Shure (CHARA), S.T. Ridgway (NOAO/KPNO & CHARA) and T.A. ten Brummelaar (CHARA)

1. INTRODUCTION AND GENERAL INFORMATION

This document describes specifications for the manufacture of tertiary mirrors for the telescopes of the CHARA Array. These mirrors are referred to as "M3" in the telescope mechanical drawings. The information and specifications provided herein are intended to enable prospective suppliers (hereafter called "vendors") of polished mirrors to respond to an ITB ("Invitation To Bid"). It is expected that these specifications will become part of any contract for mirror blank purchase that may result from the ITB.

2. REQUIRED OPTICS

Optical components are required to meet the specifications given in Section 3, which describes:

- *Flat mirrors, cut to size, with test documentation.*

The acceptance testing of the first mirror must be completed prior to GSU accepting delivery of the additional mirrors. Quoted prices will be f.o.b. delivery point, including shipment costs to the CHARA Array site in California, and the mirrors must be packed in containers suitable for protecting them from damage during shipment.

CHARA will supply circular mirror quality ULE blanks, as described in Table 1. Supplied substrates will have been ground with #80 grit or finer, and beveled approximately 0.03 inch at 45°. Blank thickness will be satisfactory as supplied, and up to 0.5 mm additional surface thickness may optionally be removed.

3. MIRROR SPECIFICATIONS

The dimensions of the tertiary flat are shown in Figure 1. The CHARA Array telescope primary and secondary mirrors are confocal parabolas. They serve as beam reducers, con-

[1]Center for High Angular Resolution Astronomy, Georgia State University, Atlanta GA 30303-3083
TEL: (404) 651-2932, FAX: (404) 651-1389, FTP: ftp.chara.gsu.edu, WWW: http://www.chara.gsu.edu.
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TABLE 1. Mirror Substrate Dimensions (as supplied to Vendor by CHARA)

Shape	Diameter (mm)	Thickness (mm)
circular flat	$198 + 1/-0$	$30 + 0.25/-0.25$

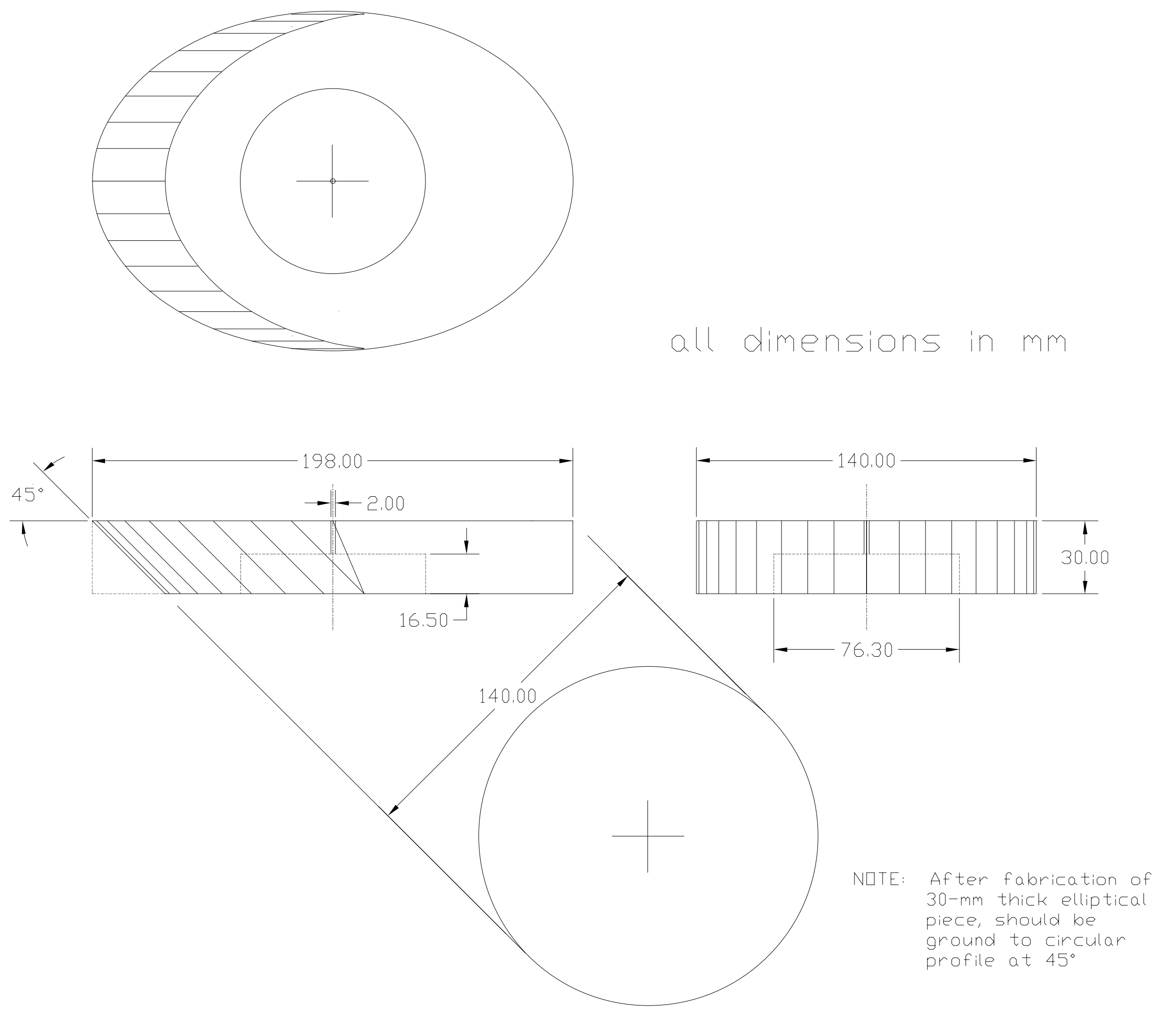

FIGURE 1. CHARA tertiary mirror dimensions. This mirror will be mounted at 45° to the telescope optical axis between the primary and secondary mirror. See text below for explanation of final grinding geometry. **Dimensions are given in millimeters.**

TABLE 2. Mirror Mechanical Specifications

Diameter (mm)	140 ± 0.25 (projected circle at 45°)
Center hole diameter (mm)	2 ± 0.25 (cut perpendicular to mirror face)
Focal length	∞ (i.e. flat)
Thickness (mm)	$30(+0.25, -0.75)$
Edge bevels (mm)	1 ± 0.5
ID marking	four-digit code number etched on back (number to be supplied by CHARA)

TABLE 3. Mirror Surface Specifications

Surface figure (RMS @ 633 nm)	$0.014 \times \lambda$ ($0.028 \times \lambda$ wavefront)
Surface figure (P-V @ 633 nm)	$0.10 \times \lambda$ ($0.20 \times \lambda$ wavefront)
Surface roughness	≤ 5 Å
Surface quality	60–20 scratch & dig
Coating	None
Clear aperture	128 mm outer diameter (projected circle at 45°)
NOTE: Surface tolerances are twice as large as above within 5 mm *radius* around 2 mm center hole.	

verting the collimated input light in a 1-meter beam into a 5-inch diameter collimated beam directed along the optical axis toward the primary. The flat tertiary mirror is mounted at 45° between the primary and secondary mirrors and will divert the collimated beam 90° to the side, along the elevation axis of the telescope mount. If the tertiary mirror were infinitely thin, it would be elliptically shaped when viewed along the normal to its surface. However, the tertiary is in fact quite thick (30 mm). In order to minimize obscuration of the light illuminating the primary, the tertiary must be ground so that it presents a circular profile along the telescope optical axis, 45° to the tertiary normal. The required shape is shown in Figure 1.

The polished mirror surface shall be optically flat and will conform to the requirements set out in Tables 2 and 3. The RMS optical specifications will be satisfied over the clear aperture of the mirrors (see Table 3).

Note the cylindrical counterbore (76.30 mm diameter) on the back side of the mirror and the small through-hole (2 mm diameter). Tolerances on all dimensions shown in Figure 1 are ± 0.25 mm.

3.1. Optical Testing

Optical surface testing for acceptance purposes shall be performed with interferometric testing equipment, or equipment with similar performance approved by CHARA, capable of resolving errors at least 50% smaller than the surface deviation specification given above, and capable of resolving the surface to spatial scales of 2 mm. The mirrors are to be tested with an interferometer having a minimum aperture of 6 inches.

Each mirror will be delivered with: 1) a digital wavefront map (as an ASCII file on a 3.5-inch HD floppy disk), including documented orientation with respect to the optic, and 2) documentation of surface roughness tests.

The tertiary will be mounted to a cylinder fitting into the counterbore in the back of the mirror (see Figure 1). At the fabricator's discretion, the mounting fixtures can be provided for installation prior to final figuring.