CHARA Technical Report

No. 57 23 October 1997

Beam Compressor Mirror Specifications

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1. INTRODUCTION AND GENERAL INFORMATION

The CHARA[1] Array will employ five 1-m size, alt-azimuth style telescopes at a site on Mount Wilson in southern California. The telescopes will be housed separately and operated remotely from a central laboratory. Light from each telescope will be directed by subsequent flat mirrors through vacuum pipes to additional optics and instrumentation at the central laboratory.

This document describes specifications for the manufacture of beam compressor mirrors for the telescopes of the CHARA Array. The beams from the telescopes will be reduced from 125 to 25 mm for beam combination (interference) in the Beam Combining Laboratory (BCL) building. Our general design for the beam compressor is basically two confocal paraboloids in a Cassegrain design. Rather than requesting two off-axis paraboloids, we require simpler, but larger on-axis optics in which the primary is 13.5 in diameter, slightly larger than that requested for the OPLE Cart (TM 38). These mirrors will be illuminated only on one side.

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 Sections 3 and 4, which describe:

- *Five (5) afocal Cassegrain beam compressors, each consisting of a concave parabolic primary mirror and a convex secondary mirror, both cut to size, with test documentation.*

The acceptance testing of the first mirror must be completed prior to GSU accepting delivery of the additional four mirrors. Quoted prices will be f.o.b. delivery point, including shipment

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TABLE 1. Mechanical Characteristics

Mirror	Primary	Secondary
Total quantity	5	5
Diameter	13.5 $\pm$0.02 in	2.10 $\pm$0.01 in
Hole	2.04 $\pm$0.01 in (see Fig 1)	
Focal length	50.4 $\pm$ 1%	7.56 $\pm$ 1%
Combined Focal Length:	∞ (i.e. flat)	
Thickness	2.0 +0.00/-0.05 in	0.40 in +0.05/-0.05
Coefficient of thermal expansion	$\leq 1.5 \times 10^{-7}\,^{\circ}\mathrm{C}^{-1}(-10^{\circ}$ to $25^{\circ}\mathrm{C})$	
Stress condition	$\leq$ 15 nm/cm	

costs to the CHARA Array site in California, and the mirrors must be packed in containers suitable for protecting them from damage during shipment. The first system is to be delivered no later than the first week in April of 1998, with the subsequent four systems to follow during the next six months.

3. MIRROR BLANK MECHANICAL CHARACTERISTICS AND MATERIAL PROPERTIES

General specifications are given here for blanks required for the CHARA Array beam compressor mirrors. Vendors are required to procure mirror blanks that meet the requirements of Table 1 and are therefore required to include information with this bid concerning the mirror blanks the vendor intends to provide.

The size and beam usage of the primary mirror is shown in Figure 1. The mirror is to have a diameter of 13.5 in and cut along the top and bottom to 8 in. The central hole is 2.04 in in diameter. The center of the hole is in the center of the mirror. The dotted lines in Figure 1 show the nominal beam usage of the mirror

Table 1 sets out the mechanical characteristics of the mirrors.

4. MIRROR SURFACE SPECIFICATIONS

The dimensions of the primary mirror are shown in Figure 1. The CHARA Array telescope primary and secondary mirrors are confocal parabolas. They serve as beam reducers, converting the collimated input light in a 1-m beam into a 5-in diameter collimated beam directed along the optical axis toward the primary. The required shape of the primary is shown in Figure 1.

The polished mirror surfaces will conform to the requirements set out in Table 2. The first RMS and P-V RMS optical specifications will be satisfied for a beam filling the 5-in input aperture of the primary mirror. We relax these tolerances by about a factor of two for the area outside the beam, which will be used for collimation only. Vendors should identify the

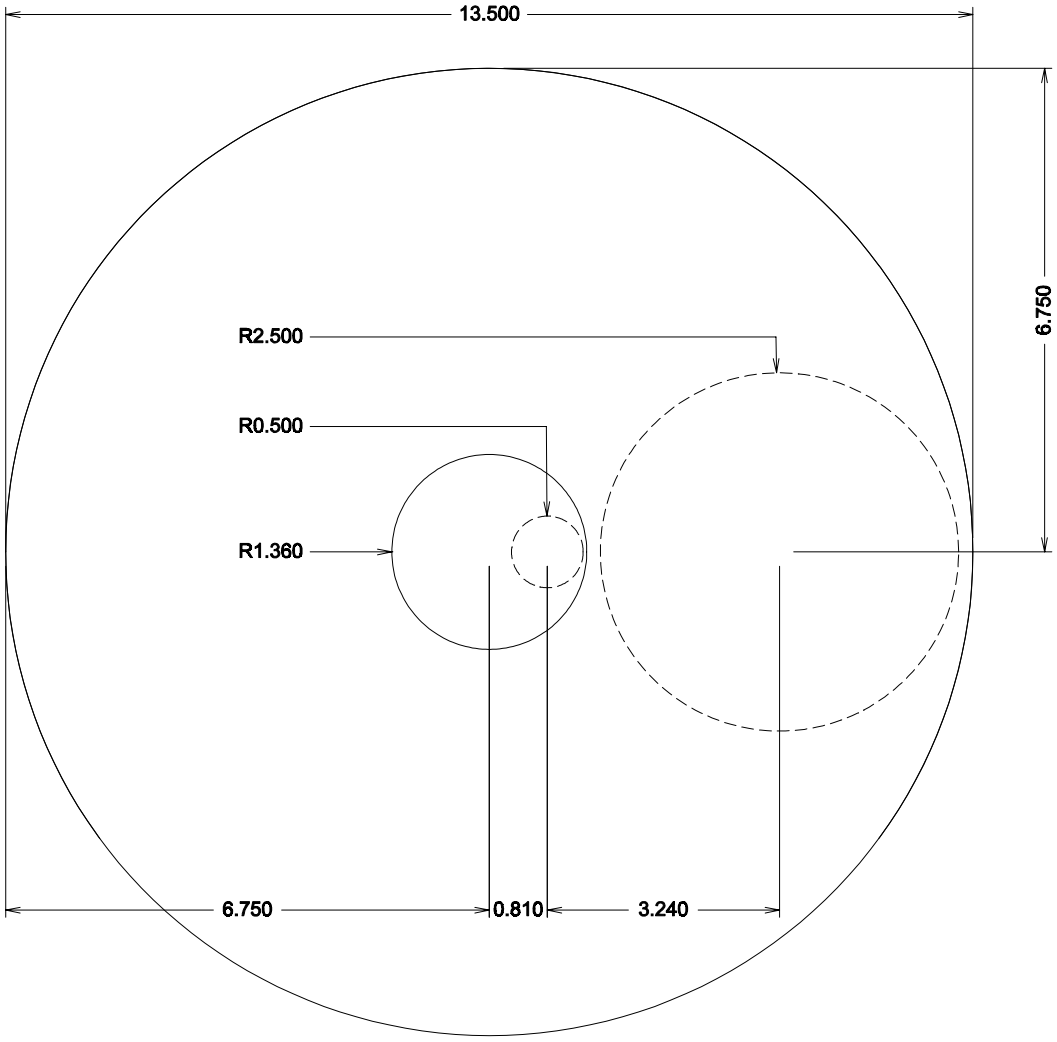

FIGURE 1. CHARA Primary BRT Dimensions. Dashed circles are input and reduced output beams. Outline of mirror and center hole shown in solid lines. **Dimensions are given in inches.**

TABLE 2. Combined Surface Specifications

Surface figure (beam) (RMS @ 633 nm)	0.030λ (wavefront)
Surface figure (beam) (P-V @ 633 nm)	0.120λ (wavefront)
Surface figure (non-beam) (RMS @ 633 nm)	0.060λ (wavefront)
Surface figure (non-beam) (P-V @ 633 nm)	0.240λ (wavefront)
Surface quality	60/40 (both mirrors)
Distance of optical vertex from blank axis of symmetry	<0.04 in
Coatings	None
Beam Sizes (dia.)	5.00 in (input), 0.75 in (output) (see Figure 1)

beam location on both mirrors by a scribe mark on its edge indicating the direction from the mirror's center, or by some other appropriate means.

4.1. 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 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.