LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

COMPONENT SPECIFICATION

E070080	-00-	D
Drawing No	Rev.	Group

SUBSTRATE, ALIGO MODE CLEANER MIRROR #3

AUTHOR:	CHECKED:	DATE	APPROVALS		
			DCN NO.	REV	DATE
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Applicable Documents

D070093-00-D	ALIGO Mode Cleaner Mirror #3 Substrate
D070085-00-D	ALIGO Mode Cleaner Mirror #3 Blank

Requirements

Physical Configuration

Fabricate from D070093-00-D ALIGO Mode Cleaner Mirror #3 Substrate

Arrow indicates Surface 1, the highly reflective surface.

Serial Number

The Serial number shall be of the format:

MC3-YY-Z Where

YY is incremental for each optic starting at 01.

Z is the current revision letter of this specification.

Registration Marks

Registration mark shall be etched, ground or sandblasted coincident with the registration mark drawn on the Blank within 5 mm. The arrow orientation used on the Blank will be preserved if possible or changes reported in detail. Reference D070085-00-D ALIGO Mode Cleaner Mirror #3 Blank.

Side and Bevel Polish

Sides and Bevels shall be polished from a 5 micrometer grit finish. These surfaces shall appear transparent with no grey, scuffs or scratches visible to the naked eye when viewed in normal room light against a black background.

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Scratches and Point Defects

Scratches, Surface 1

The total area of scratches within the central 40 mm diameter shall be as small as possible (not exceed 5 x 10^2 square micrometers, width times length).

The total area of scratches outside the central 40 mm diameter shall not exceed 10 x 10^3 square micrometers.

Point Defects, Surface 1

There shall be no more than 5 point defects within the central 40 mm diameter.

There shall be no more than 100 point defects on the entire surface.

Point defects of radius greater than 25 micrometers are treated like scratches for the purpose of this specification. Point defects of radius less than 2.5 micrometers are disregarded.

Scratches, Surface 2

The total area of scratches within the central 100 mm diameter shall be as small as possible (not exceed 30 x 10^2 square micrometers, width times length).

The total area of scratches outside the central 100 mm diameter shall not exceed 60 x 10^2 square micrometers.

Point Defects, Surface 2

There shall be no more than 30 point defects within the central 100 mm diameter.

There shall be no more than 80 point defects on the entire surface.

Point defects of radius greater than 25 micrometers are treated like scratches for the purpose of this specification. Point defects of radius less than 2.5 micrometers are disregarded.

Inspection Method

1. The surface is examined visually by two observers independently. The examination is done against a dark background using a three-bundle fiberoptic illumination system of 200 W total power. A 100% inspection of the surface is carried out. Pits and scratches down to 2 micrometers in width can be detected using this method of inspection. Any scratches that are detected will be measured using a calibrated eyepiece.
2. Further inspection will be done with a 6X eyeglass using the same illumination conditions, again, with two observers. Sleeks down to 0.5 micrometers wide can be detected using this method. The surface will be scanned along one or two chords from center to edge, then at ten positions around the edge, and ten to fifteen positions near the center.
3. An inspection is then carried out with a dark field microscope with a similar sampling frequency as described in section 2.

Wedge angle

Specified according to drawing D070093-00-D ALIGO Mode Cleaner Mirror #3 Substrate.

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Surface Figure

All specified quantities refer to the physical surface of the optics.

Surface 1: Flat, measured over the central 80 mm diameter

Radius of curvature: > 80 kilometers

Astigmatism: < 10 nanometers (surface peak to valley)

Surface 2: Flat, measured over the central 140 mm diameter

Radius of curvature: > 80 kilometers

Astigmatism: < 32 nanometers (surface peak to valley)

Surface Errors

All specified quantities refer to the physical surface of the optics.

The following root mean square (σ_{rms}) and peak-to-valley (σ_{pv}) standard deviation values are calculated from the phase maps which are to be provided with each optics. σ_{rms} is defined as the square root of the mean of the square of each pixel value. σ_{pv} is defined as the maximum peak-to-valley deviation. Known bad pixels are excluded from this calculation. The calculation assumes a wavelength of 632.8 nanometer wavelength source.

Aberrations, Surface 1:

With piston, tip, tilt, power (best fit spherical surface) and astigmatism removed over the central 80 mm diameter aperture:

RMS deviation from flatness < 1/200 wave

P-V deviation from flatness < 1/40 wave

Microroughness, Surface 1:

$\sigma_{rms} < 0.4$ nanometers

$\sigma_{p\text{-}v} < 2.4$ nanometers

Measured at the following locations:

1. The center of the mirror substrate
2. Four positions equally spaced along the circumference of centered 80 mm diameter circle

Aberrations, Surface 2:

With piston, tip, tilt, power (best fit spherical surface) and astigmatism removed over the central 140 mm diameter aperture:

RMS deviation from flatness < 1/200 wave

P-V deviation from flatness < 1/40 wave

Microroughness, Surface 2:

$\sigma_{rms} < 0.4$ nanometers

$\sigma_{p\text{-}v} < 2.4$ nanometers

Measured at the following locations:

1. The center of the mirror substrate
2. Four positions equally spaced along the circumference of a circle centered 140 mm diameter circle.

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Table 1

Specification	Test Method	Frequency of Inspection	Data Delivered
Physical Dimensions	Visual Inspection	100%	Diameter, Thickness, Bevel dimension, Wedge angle.
Side and Bevel Polish	Visual Inspection	100%	Certification
Scratches and Point Defects	Visual Inspection	100%	Certification
Registration Mark Location/Orientation	Visual Inspection	100%	Certification
Registration Mark Dimensions	Visual Inspection	100%	Certification
Identification Location	Visual Inspection	100%	Certification
Identification Serial Number	Visual Inspection	100%	Certification
Surface Figure	Interferometry	100%	Surface Map
Surface Errors – Low Spatial Frequency	Interferometry	100%	Surface Map
Surface Errors – High Spatial Frequency	High Resolution Surface Map	100%	Surface maps for 3 central locations. Numerical values included with Certification

Data: For the purpose of all data collection the Registration mark shall be at the top center of the optic.

Format: All Data shall be delivered according to Table 1. In addition to the hard copy the Surface Data shall be delivered on IBM PC compatible disk or via electronic file transfer in ASCII format. Phase difference data shall be in units of nanometers.