COMPONENT SPECIFICATION

TITLE

SUBSTRATE, END TEST MASS

APPROVALS:	DATE	REV	DCN NO	BY	CHK	DCC	DATE
DRAWN:				n/a	n/a	n/a	n/a
CHECKED:							
APPROVED:							
DCC RELEASE:							

Applicable Documents

LIGO-D960791-A-D	End Test Mass Substrate
LIGO-E960097-A-D	Mirror Blank Material, Folding Mirror, End Test Mass
LIGO-D960794-A-D	Core Optic Blank

Requirements

Physical Configuration

According to

LIGO-D960791	End Test Mass Substrate

Fabricate from

LIGO-E960097	Mirror Blank Material, Folding Mirror, End Test Mass

Serial Number

The Serial number shall be of the format:
ETMYY-Z Where
YY is incremental for each optic starting at 01.
Z is the current revision letter of this Specification

Registration Mark

Registration mark shall be etched, ground or sandblasted coincident with the registration mark drawn on the Blank within 1 mm. The arrow orientation used on the Blank will be preserved if possible or changes reported in detail. Reference LIGO-D960794, Core Optic Blank.

Side and Bevel Polish

Sides and Bevels shall be polished from a three 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

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.

Side 1

Scratches

The total area of scratches within the central 80 mm diameter shall not exceed 25 X 10^3 square micrometers (width times length.)

The total area of scratches outside the central 80 mm diameter shall not exceed 250 X 10^3 square micrometers.

Point Defects

There shall be no more than 10 point defects within the central 80 mm diameter

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

Inspection Method

These surfaces shall be inspected using a dark field microscope at 5X magnification over the central 80 mm diameter.

The area outside the central 80 mm diameter is inspected in a darkened room, against a black background with the optic illuminated at minimum by a 175 Watt high intensity light. The light shall be delivered perpendicular to, and 10 mm from, the surface using a 5mm ± 2mm fiberoptic bundle, the scratch area is determined by measurement using a dark field microscope.

Side 2

Scratches

The total area of scratches shall not exceed 1X 10^6 square micrometers over the central 235 mm.

Point Defects

There shall be no more than 100 point defects within the central 80 mm

There shall be no more than 300 point defects on the entire optic

Inspection Method

Side 2 is inspected in a darkened room, against a black background with the optic illuminated at minimum by a 175 Watt high intensity light. The light shall be delivered perpendicular to, and 10 mm from, the surface using a 5mm ± 2mm fiberoptic bundle, the scratch area is determined by measurement using a dark field microscope.

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Surface Figure, measured over the central 200 mm diameter

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

Surface 1: Spherical, concave.
Absolute Radius of curvature: 7400 meters $\pm$ 150 meters
Variation of Radius of curvature from Average: $\pm$ 111 meters
Astigmatism: < 10 nanometers (surface peak to valley)

Surface 2: Flat.
Radius of curvature > 80 kilometers
Astigmatism: < 64 nanometers (surface peak to valley)

Surface Errors, Surface 1

All specified quantities refer to the physical surface of the optic.
The following root mean square standard deviation (σ_{rms}) values are calculated from the phase maps which are to be provided with each optic. σ_{rms} is defined as the square root of the mean of the square of each pixel value. Known bad pixels are excluded from this calculation.

Low Spatial Frequency Band: $\leq$ 4.3 cm $^{-1}$
With piston, tip, tilt, power (best fit spherical surface) and astigmatism removed over the central 200 mm diameter aperture:
σ_{rms} <1.6 nanometers

With piston, tip, tilt, power (best fit spherical surface) and astigmatism removed over the central 80 mm diameter aperture:
σ_{rms} < 0.8 nanometers

High Spatial Frequency Band: 4.3 - 7,500 cm $^{-1}$
σ_{rms} < 0.2 nanometers
Measured at the following locations:
1. The center of the mirror substrate.
2. Four positions equally spaced along the circumference of a centered, 80 mm diameter circle.
3. Three positions equally spaced along the circumference of a centered, 200 mm diameter circle.

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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%	Inspection Report included with Certification
Scratches and Point defects	Visual Inspection	100%	Hand sketch including scratch/ pit dimensions
Registration Mark Location/Orientation	Visual Inspection	100%	Inspection Report included with Certification
Registration Mark Dimensions	Visual Inspection	100%	Inspection Report included with Certification
Identification Location	Visual Inspection	100%	Inspection Report included with Certification
Identification Serial number	Visual Inspection	100%	Inspection Report included with 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:
Orientation: For the purpose of all data collection the Registration mark shall be at the top center of the optic. Data shall be taken from side 1 where possible. If this is not possible there shall be a special note on the data indicating they were taken from side 2.

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 in ASCII format. Phase difference data shall be in units of nanometers.